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COMMERCIAL WAXES

NATURAL AND SYNTHETIC

Including Properties, Uses, Methods of Handling and Formulas for Making Commercial Wax Compositions

A SYMPOSIUM AND COMPILATION

Edited by

H. BENNETT

Editor-in-chief, The Chemical Formulary
Technical Director, Glyco Products Co., Inc.



1944
CHEMICAL PUBLISHING CO., INC.
BROOKLYN, N. Y. U. S. A.

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PREFACE

Natural waxes and wax-like materials have been used, from time immemorial, for candles, waterproofing, sealing, decorative, preservative, and other purposes. Synthetic waxes and wax-like materials, developed in the last decade, are finding increasing use and are supplanting natural waxes for many purposes. Since different waxes have different properties, each one is used to obtain certain end results. Whereas certain waxes are used alone, as paraffin wax in waxed papers, other uses require combinations of different waxes, resins, etc., to obtain a desired result.

Because there is no one source of information available on the waxes used in industry, the writer was asked to prepare a book on commercial waxes for the chemist, engineer, superintendent, purchasing agent, and student. It is hoped that this book will be helpful to these and others who are interested in commercial waxes and wax compositions.

Much of the data given herein is from the writer's own laboratory and has never been disclosed. Grateful acknowledgment is made to Allan B. Olsen, both for data supplied by him and his constructive criticism of the manuscript. The following, among others, were good enough to furnish useful data: H. M. Abbott, H. W. Kraaz, H. C. Eaton, Hercules Powder Co., Monsanto Chemical Co., Givaudan-Delawanna, Inc., General Electric Co., Century Stearic Acid & Candle Works, E. I. du Pont de Nemours & Co., Inc., Carbide and Carbon Chemical Corp., Armour & Co., Socony-Vacuum Oil Co., The Texas Co., Glyco Products Co., Inc.

H. BENNETT

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INTRODUCTION

The chemist may roughly define a wax as being composed of carbon, hydrogen and oxygen and consisting chiefly of fatty acid esters of monohydric alcohols of high molecular weight, with or without minor quantities of free fatty acids, alcohols, sterols or hydrocarbons. Beeswax, Chinese wax, carnauba wax and sperm oil (a liquid) conform to this definition of a wax. The engineer, other technical workers, and the layman think of a wax as a solid, easily fusible, unctuous or slippery substance, regardless of its chemical composition. Thus paraffin wax and ozokerite do not conform to the chemist's definition of a wax, because they contain no oxygen or esters, but in ordinary and commercial parlance they are termed waxes. Since the great majority of those, who use the word wax, use it in the non-chemical sense, it seems more desirable to cater to the majority in using the term wax in its more common meaning. So, in this book, a material will be termed a wax if its physical properties are those of a wax, regardless of its chemical composition.

Waxes may be classified, in accordance with their origin, as follows:

1. Mineral
2. Vegetable
3. Animal
4. Insect
5. Miscellaneous
6. Synthetic
7. Compounded

Natural materials all show certain variations in properties such as melting point, specific gravity, etc. This may be due to different sources of origin, age, exposure to the elements, impurities and sophistication, or other factors. That is why

constants, given in this and other books, vary with different samples tested. For some uses, larger variations may be permissible. In other cases, too large a variation from a standard will necessitate rejection of a particular lot of wax.

Most of the applications of wax, in industry, are based on one or more of the following properties:

Melting point (Congealing point)
Form and fracture
Purity (Inorganic matter, moisture, oil, etc.)
Hardness
Flexibility
Moldability (Plasticity)
Adhesiveness or stickiness
Tenacity or coherence
Color
Opacity or clarity
Polishing properties
Resistance to moisture
Solubility
Emulsifiability
Dielectric properties
Saponifiability
Combustibility or inflammability (Flash point)
Volume change with temperature
Chemical inertness
Compatibility with other ingredients
Toxicity
Odor
Density or specific gravity
Viscosity
Slipperiness
Corrosiveness
Edibility
Stability to heat, light, etc.

Since it is not always possible to find all the needed properties in one wax, recourse is had to mixtures of waxes or mixtures of waxes with resins, rubbers, fillers (inert mineral matter), or other materials.

In addition to the above properties, which govern a choice of wax, consideration must be given to

Availability

Price

Legal restrictions (health, safety, or patent).

ABBREVIATIONS

AMP ..... American melting point
Amp. ..... Ampère
A.P.I. ..... American Petroleum Institute
A.S.T.M. ..... American Society for Testing Materials
Av. ..... Average

Bé. ..... Baumé
B.P. ..... Boiling point

C ..... Centigrade
c. ..... Cold
cal. ..... Calorie
cc ..... Cubic centimeter
cm ..... Centimeter
cm^3 ..... Cubic centimeter

D. ..... Dispersible
d. ..... Density
D.H. ..... Dispersible hot
Dist. ..... Distillation
dr. ..... Dram

E. ..... Engler

F. ..... Fahrenheit
F.F.A. ..... Free fatty acid
f.p. ..... Freezing point

g ..... Gram
G. ..... Gels
gr. ..... Grain

H. ..... Hot
hr. ..... Hour

I. .....Insoluble
in. .....Inch
Inf. .....Infinite

kg .....Kilogram

l .....Liter
lb .....Pound

m .....Meter
Max. .....Maximum
Min. .....Minimum
ml .....Milliliter
mm .....Millimeter
Mol. wt. .....Molecular weight
M.P. .....Melting Point

n .....Refractive Index
No. .....Number

oz .....Ounce

P. .....Partially
P.S.H. .....Partly soluble hot
Pt. .....Point
pt .....Pint

q.s. .....A quantity sufficient to make

rd .....Specific optical rotation
Ref. .....Refined

S. .....Soluble cold
S.A.E. .....Society of Automotive Engineers
Sap. .....Saponification
sec .....Second
S.H. .....Soluble Hot
Soln. .....Solution
Sp. Gr. .....Specific gravity
S.U.V. .....Saybolt Universal Viscosity
S.X. .....Clearly miscible in certain proportions

Temp. .....Temperature

Unsap. .....Unsaponifiable matter

Visc. .....Viscosity

Wt. .....Weight

Symbols

~.....Approximately

>.....More than

<.....Less than

± .....Plus or minus

CHAPTER I

NATURAL WAXES

MINERAL WAXES

Under mineral waxes, there will be included those commercial waxes which are derived from the earth as such or obtained from a material of earthy origin by refining. They occur in petroleum, bituminous coal and slate, and consist of unsaponifiable hydrocarbons, nearly all saturated. The melting point of these waxes increases in the order of their molecular weights, disregarding any contaminants which they may contain.

PARAFFIN WAX (PARAFFINE WAX)

Paraffin wax is the most commonly used commercial wax. It is mainly derived from the high-boiling fractions of petroleum. It is commonly sold in slabs or blocks which exhibit crystallinity and various degrees of translucency. A difference in melting point between the outside and inside of a slab often occurs because of non-homogeneity of this product. The crude paraffin waxes, containing varying amounts of volatile constituents, are odorous and greasy. The refined grades are tasteless, odorless, harder and less greasy.

Each year, in the United States, there are produced between 500,000,000 and 600,000,000 pounds of a group of materials known as paraffin wax. Considering the magnitude of the yearly production, there is suprisingly little published literature dealing with the composition, manufacture, or use of this commodity. It is an accepted fact that paraffin wax is not a pure chemical compound, but a variable mixture of organic compounds. This probably explains the reluctance of investigators in the field of pure science to examine paraffin wax thoroughly. The investigation of the more practical, or commercial aspects

of production and utilization of paraffin wax has been conducted in the laboratories of either suppliers or consumers. The more specific results of these studies are generally regarded as trade secrets, and as such are not published in technical journals.

There are perhaps two dozen authoritative published technical papers dealing with paraffin wax which have appeared in the past ten or fifteen years. Certain worth-while data were obtained by the authors of these papers which have, to a large degree, established the composition of paraffin wax. In addition, the laboratories of Socony-Vacuum Oil Co. have been engaged in studying paraffin wax for the past five or ten years. The results of these investigations have as yet not been collected and presented in the form of a report.

Refined paraffin wax is the most commonly used grade of paraffin wax and has the following properties:

Melting Point (A.S.T.M.)	122–124° F.
Color, Saybolt	25–30
Flash Point	395° F.
Penetration at 32° F.	16
" " 77° F.	22
" " 115° F.	221
Saponification Value	0
Acid Value	0
Viscosity at 212° F.	39
Structure	Crystalline
Specific Gravity	0.880–0.915

Soluble in: Benzol, ether, chloroform, carbon disulfide, car bon tetrachloride, turpentine, petroleum, fixed oils.

Insoluble in: Water, cold alcohol.

Uses: Candles; waterproofing; sealing; lubricating; food, plant, fruit and vegetable protection; paper (waxed); polishes; cosmetics; crayons; pharmaceutical ointments and salves; electrical insulation, etc.

General Characteristics

Paraffin wax is defined as a white, translucent, waxy, tasteless, odorless solid, consisting of a mixture of solid hydrocar-

bons chiefly of the methane (paraffin) series obtained from petroleum. It ranges in specific gravity from about 0.880 to 0.915 at ordinary temperatures, and melts in the range from 110° F. (43.3° C) to about 150° F. (65.6° C).

Paraffin wax is sold in various grades, which differ from one another chiefly in melting point. Generally, each grade covers a range of melting points of 2° F., for example 125 to 127° F. Melting points are given by either of two accepted standards. These are: American melting point (AMP) and ASTM melting point, which is often called English melting point (EMP). At present the American melting point is a purely calculated value based upon the ASTM melting point, the former being arbitrarily taken as 3° F. higher than the latter. The method for determining this value has the ASTM designation: D87–37, and involves cooling molten wax in a cooling bath with a constant rate of temperature drop. The melting point of the wax is taken at the temperature at which the wax first shows a minimum rate of temperature change. This method is based on the fact that, upon solidification, the wax gives up its latent heat of fusion and the rate of temperature drop is appreciably reduced.

The melting point of a wax, in itself, is no measure of quality or chemical composition, since it is derived from the melting points of the constituents which influence one another in various ways. Other characteristics of the wax must also be considered in determining quality. These include oil content, light stability, tensile strength, etc. Their relationship to the applicability of the wax will be discussed later in greater detail.

For the time being, it should suffice to say that so-called "refined waxes" have oil contents of about 0.5% or less. In general, they are reasonably stable to darkening, when exposed to light, and possess tensile strengths ranging from 160 to 400 lb per sq in. when measured on the Perkins Tensile Tester. These methods for evaluating and testing the uniformity of waxes are conventional. Unfortunately, many users of waxes consider these characteristics as the sole measure of their quality for all applications. The existing relationship between quality and applicability is, by no means, as clear cut as is frequently assumed,

so that erroneous conclusions, regarding applicability, are drawn far too often.

The largest percentage of the paraffin wax, which is produced and sold, is of the "refined" type. As previously mentioned, this type of wax contains a small percentage of oil, is hard, and has been refined to a point where it is tasteless, odorless and stable to light. The bulk of the remainder consists of crude scale wax. This type of wax is sold either as white crude scale wax or as yellow crude scale wax. Both are similar except for one step in the refining procedure which produces the light color in the wax. The bulk of crude scale wax sold in the market consists of the white type.

Crude scale wax differs from refined wax in several important details. First, it contains appreciably more oil (on the average 3%). For this, and other reasons, its quality is poorer than that of refined waxes of comparable melting points. The high oil content of crude scale wax is reflected in a low tensile strength (40 to 100 lb per sq in.) and also in a softer and more crumbly structure. Due to the lesser degree of refining given these waxes, they are not entirely tasteless and odorless, and their color stability is questionable. Wide variations in the over-all quality of crude scale waxes exist today, largely because no standards or specifications (except melting point) are established for them. This condition is also due to the large number of petroleum refiners who produce crude scale waxes and to the variations in the crudes from which they are derived.

Between refined waxes and crude scale waxes, there is a third type which is sold as "semi-refined" wax. This designation has even less meaning, insofar as quality is concerned, than the term "white crude scale wax." Just as crude scale waxes may vary in quality, so may semi-refined waxes. Despite a relatively uniform price, these grades will differ appreciably depending upon the supplier and the source from which they are derived. Frequently, semi-refined waxes will approach fully refined waxes in quality, but just as frequently, they may be little, if any better than crude scale waxes. Consequently, a purchaser of these grades, unless dealing directly with a producer, will have no real guarantee of uniformity.

Semi-refined waxes are produced by a group of small refiners whose main business is the refining of wax. These concerns purchase crude scale wax on the open market and sweat it to a more highly refined grade. Depending entirely upon the base crude scale wax, and upon their ability to conduct this operation, they will offer waxes varying widely in quality. As a group, semi-refined waxes will have melting points in the range 120 to 135° F., oil contents varying between about 0.6 and 3%, and tensile strengths between 40 and 200 lb per sq. in.

Match wax is a low-melting (104 to 116° F.) refined paraffin wax. Reclaimed paraffin wax is often available at a lower price. This refers to wax that has been scraped off or melted out of paper, textiles, etc. It is usually darker in color and may have different kinds of foreign impurities and decomposition products.

Occurrence in Nature

Petroleum is a natural resource found in various parts of the world. It is now generally conceded that petroleum was formed during a vast period of geologic time by the decomposition of organic refuse, largely of marine origin, aided by conditions of low temperatures and enormous pressures. An analysis of petroleum, freed from extraneous matter, shows that it is composed mainly of hydrogen and carbon in amounts ranging from 11 to 14 per cent and 83 to 87 per cent, respectively. Small quantities of sulfur, oxygen and nitrogen are frequently present. The elements contained in petroleum are in chemical combination, as are most of the elements in nature. It is a peculiarity of carbon that it has the ability to enter into a vast number of chemical combinations with itself and other elements and to be a part of all living organisms. Because of the latter fact, early chemists distinguished between carbon compounds and all others, classifying the former as "organic" and the latter as "inorganic."

Most of the compounds contained in petroleum are known as "hydrocarbons," indicating that they are composed of hydrogen and carbon. They range from gases to solids with a predominance of liquid members. Relatively few pure chemical compounds have been isolated from petroleum, but thousands actu-

ally exist. This is due to the multiplicity of combinations which are possible between hydrogen and carbon atoms.

Petroleum is composed essentially of four distinct types of hydrocarbons that differ from one another in respect of their chemical structure. The four generic classes of hydrocarbons, contained in petroleum, are known as paraffins, olefins, naphthenes, and aromatics.

Paraffins or saturated, open-chain hydrocarbons are those in which the carbon atoms are linked together with single bonds, the remaining valences of the carbon atoms being satisfied with hydrogen atoms. Methane (CH_4) is the simplest paraffin hydrocarbon, followed by ethane ($CH_3.CH_3$), propane ($CH_3.CH_2.CH_3$), etc.

The above mentioned compounds are known as straight-chain hydrocarbons, indicating that the carbons are linked together in a chain with no branches or side chains. A branched-chain paraffin hydrocarbon is represented by isobutane, which is the simplest member of the series, having the formula

$$\begin{array}{l} CH_3—CH—CH_3. \\ \quad\quad\;\; | \\ \quad\quad\;\; CH_3 \end{array}$$

Obviously, normal butane ($CH_3.CH_2.CH_2.CH_3$) has the same composition as isobutane, but is an entirely different compound, due to a distinct difference in arrangement of the carbon atoms. It can be seen that as the number of carbon atoms increases, the number of possible arrangements also increases, but at an even more rapid rate. This accounts for the complexity of petroleum products and the difficulty in isolating pure compounds from them.

Olefinic hydrocarbons are closely related to the paraffins in that they possess an open-chain. However, they differ in that, at some point in the chain, two carbon atoms are joined together by means of a double (or more rarely a triple) bond. Such products are said to be "unsaturated," meaning that under certain conditions they will take up hydrogen or other elements. Olefines can be converted into paraffins by a reaction which is known as "hydrogenation." It consists of the introduction of

two hydrogen atoms into the molecule at the double bond, and its conversion to a single bond.

Naphthenic and aromatic hydrocarbons are described as being cyclic in nature, i.e., their carbon atoms form ring structures. Simple members of these series are cyclohexane (C_6H_{12}) and benzene (C_6H_6).

Naphthenes are saturated hydrocarbons (no double bonds) containing one or more ring nuclei. In some naphthenes paraffinic side chains are attached to the carbon rings.

Aromatic hydrocarbons are characterized by the presence of a benzene ring in the molecule. These too may have paraffinic side chains attached to the benzene ring. The relationship between naphthenes and aromatics is about the same as between paraffins and olefins.

Petroleum crudes, occurring in various parts of the world, differ from one another in the percentage of the four classes of hydrocarbons which they contain. In so-called Pennsylvania crudes, paraffinic hydrocarbons predominate, whereas in California crudes naphthenes and aromatics constitute the greater portion. Crudes from mid-continent sources, in general, are mixed-base in nature and contain substantial quantities of all four types.

Manufacture

As previously noted, petroleum fractions are complex mixtures of many constituents. Their properties depend, in general, upon two factors: the average molecular weight, and the average configuration. The differences in properties are used for the separation of one fraction from another.

Crude petroleum is first subjected to distillation to break it up into fractions varying in boiling point and viscosity. Gaseous light ends, gasoline, naphtha, kerosene, and gas-oil fractions are removed in this order. In paraffinic crudes, there is then obtained a fraction known as wax distillate, or paraffin distillate, which consists of a mixture of light-bodied oils ranging from 40 to 300 seconds Saybolt Universal Viscosity at 100° F., and various waxy fractions of about the same boiling range.

Generally, fractions, having boiling points slightly higher than that of the wax distillate cut, are not distilled, but remain as a residuum and are further processed to prepare heavier bodied lubricating oils.

Separation of the wax and oil in the wax distillate must be obtained in order to render both usable. The wax distillate will have a pour point of about 80° F., which indicates that below that temperature it is, at best, a semi-fluid mixture of wax and oil possessing poor lubricating properties. Most oils are dewaxed to a pour point of 25° F. or lower for use as lubricants. Similarly, satisfactory waxes for most uses must be deoiled to relatively low oil contents. This separation is accomplished as a result of either the differences in melting points of the wax and oil or differences in the solubilities in a solvent. It should be emphasized, at this point, that there is a very close relationship between paraffin wax and a paraffin oil having, for example, a viscosity of 100 seconds S.U.V. at 100° F. Both materials have approximately the same boiling range and volatility, and, when heated to above the melting point of the wax, have comparable viscosities. Care, in handling of molten paraffin wax, is therefore essential for at elevated temperatures, its tendency to be oxidized and its loss due to evaporation are little less than those of paraffin oil. Paraffin wax differs from the oil primarily in that its chemical structure is nearly straight chain in character, whereas that of the oil is more branched chain.

In order to separate wax and oil, the wax distillate is processed by either of two methods. The older procedure involves the so-called "sweating" operation, whereas the latter utilizes crystallization from a solvent mixture, and is known as solvent pressing. Wax distillates will vary appreciably in wax content over a range of 6 to 25%. On the average, 15% wax may be expected in the distillate.

Sweating Process

The first step in the separation of the wax distillate is termed pressing, and consists, essentially, of filtering solid wax from liquid oil at low temperatures. Dewaxed oil and slack wax are produced in this operation. Often the paraffin distillate is diluted

with dewaxed oil to facilitate handling. This is particularly necessary if the wax content is high, since otherwise, the chilled mass will have a thick consistency and will be difficult to pump from the chillers to the filter presses.

Frequently, the prepared distillate is given a mild acid treatment to lighten its color and remove highly polymerized impurities. After the acid treatment, the distillate is washed with water, neutralized with soda, and washed again. Finally, it is chilled to between 13 and 15° F., to precipitate the higher-melting, waxy hydrocarbons. The temperature to which the distillate is chilled is dependent upon the pour point which is desired in the dewaxed oil. For a 20° F. pour point, the above temperature is necessary. For lower pour points, the pressing temperature must be lowered accordingly. The chilled distillate is pumped to a bank of filter presses in which the crystalline wax is filtered from the dewaxed oil. This produces slack wax containing about 35% oil. The dewaxed oil is finally resolved into various paraffin oils and other light lubricating stocks by distillation and conventional refining procedures.

The slack wax, which melts at about 107° F, must be subjected to further processing, the first stage of which may be a second mild acid treatment. The slack wax then is charged, in molten condition, to sweaters which are generally of pan design. A conventional sweater consists of a room or oven in which is housed a stack of ten to fifteen or more horizontal trays each equipped with a gravity drain. The slack wax is allowed to solidify over water, the surface of which has been adjusted to be on a level with a wire mesh in each tray. When the wax is completely solid (wax temperature of about 80° F.), the water is withdrawn and the slack cake, 5 to 10 inches thick, remains suspended on the screen. The sweater is then warmed at a rate of about 2° F. per hour by circulating warm water through banks of tubes embedded in the wax and along the walls of the oven. Heat causes beads of oil to form on the surface of the wax, thus giving the appearance of sweating, hence this term. The oil and lower melting wax are allowed to drain away as the temperature increases. Finally, a cake of high-melting waxes remains, and is melted and segregated. This is known as yellow crude scale

wax and it averages 5% oil and 122 to 124° F., in melting point. The oil and low-melting waxes comprise foots oil which is used as cracking feed stock for the manufacture of gasoline.

The crude scale wax is given a further mild acid treatment, washed, neutralized, and again washed, and is then in condition to be resweated to refined wax. These subsequent resweatings are frequently highly complicated and generally involve the recycling of the lower-melting fractions (intermediates) to produce a series of three or four grades of refined wax. For example, waxes melting at 130 to 132° F., 126 to 128° F. and 122 to 124° F. may be produced. Some refiners will produce a higher-melting grade, and others one melting as low as 118 to 120° F. These waxes contain only 0.4% or less of oil and are used for blending to intermediate-melting waxes. Finished waxes are finally prepared by blending to melting point and filtering through bone char, bauxite, or some other suitable medium to produce water-white products.

Many of the white crude scale waxes, sold today, are treated in a similar manner, but, due to their nature, the refining has been unable to make them meet refined wax specifications. In other words, despite resweating from yellow crude scale wax, they still contain 2% oil, have low tensile strengths, are not entirely color-stable and must be sold as white crude scale wax. On the other hand, other refiners merely treat yellow crude scale wax to a lighter color to produce the same materials. Such white crude scale waxes are inferior to those which have been resweated.

Solvent-Pressing Process

In this method of producing paraffin wax, the raw material is the same wax distillate as used in the sweating process. In general, it is pressed to slack wax by conventional procedures, although a solvent-pressed slack may be used, in some instances, the oil content of which will be appreciably lower than usual. The slack wax is dissolved in a suitable solvent, which may be petroleum naphtha or a mixture of other solvents such as benzol and methyl ethyl ketone. In one process, three parts of slack wax and two parts of solvent are chilled to 45° F., and filtered

in a wax press, as before, to yield a crude scale wax containing only 3% oil. This crude scale wax is further processed by repeated solvent pressing or recrystallization to yield suitable base waxes. The quantity of solvent and the temperature employed are by no means fixed, but are dependent upon the yield and melting point of the desired wax. Recycling of intermediate fractions is practiced also in this process, but is not so complicated as in sweating because of the greater degree of fractionation which is obtained. For the same reason, only two or three blending waxes are produced, these being drier, less ductile and in general more oil-free than sweated waxes.

Composition

Paraffin wax, as already stated, consists of a mixture of a great number of hydrocarbons. Small amounts of liquid "impurities" are present in the form of oil. The solid constituents are saturated paraffinic hydrocarbons.

Frequently, it is stated that these hydrocarbons are all of the straight-chain type, and that no branched-chain products are present. Considering that the oils, from which they are separated, are highly complex in composition and contain a wide variety of branched-chain hydrocarbons, this would be indeed surprising, if true. A large amount of work of an exploratory nature was completed by numerous investigators but it was not until 1931 that the exact composition of paraffin wax was established. The final solution may be credited to Ferris, Cowles and Henderson.[1] The bulk of the contents of this section is derived from their publication, although reference will be made to the work of other investigators as well.

As mentioned previously, paraffin wax is derived from the wax distillate fraction of crude petroleum, and is separated from other lower melting waxes lost in foots oil and sweater oil. In addition, higher melting waxes, which are sold as microcrystalline, amorphous, or petrolatum waxes, are derived from heavier lubricating oil fractions. A definite relationship exists between all of these waxes, as shown by Buchler and Graves.[2] These

[1] *Ind. Eng. Chem.* **23**, 681 (1931).
[2] *Ibid.* **19**, 718 (1927).

investigators found that by isolating pure, oil-free fractions from waxes of these types and plotting a melting point-refractive index curve, there resulted a substantially straight line. Certain deviations from the straight line occurred at higher melting points, but by recrystallization from a solvent, small amounts of an impurity were lost, with the result that the melting point-refractive index curve, for the purified waxes, then became a straight line.

It has also been observed that paraffin wax crystallizes in both plates and needle type crystals, depending upon the conditions of crystallization. One theory explained this as being due to differences in viscosity of the medium, and also to the rate of cooling. This explanation discounted the fact that differences in composition had any bearing upon the type of crystal formation. Buchler and Graves attributed the differences in the crystal system entirely to the presence of the impurity described above, which they termed "soft wax."

In the work of Ferris, Cowles and Henderson, a slack wax, from a mid-continent crude, was selected for study. It was completely deoiled by successive recrystallization at about 5° F. and fractionally distilled into narrow cuts. These were purified into 26 separate waxes by repeated recrystallization and recombination of fractions having the same melting points. At the completion of the purification, waxes were obtained which, on further crystallization, were practically unchanged in character. It was therefore assumed that practically pure components had been produced.

Careful observation was then made of the types of crystals which were formed when these pure waxes were crystallized from a solvent. Three different types were found. Most of these waxes formed plate-type crystals; another group crystallized as needles, and the remainder assumed forms that could not be identified. The authors called the latter "malcrystalline," for lack of a better name. Further studies of these fractions showed that, no matter what solvent was used, each individual fraction invariably yielded the same type of crystals. These observations effectively disproved the theory that differences in crystal system are due to the crystallization medium.

In order to study the significance of these three types of

crystals, the physical characteristics of all of the pure waxes were determined. By plotting these characteristics the relationships between melting point and refractive index, melting point and boiling point, melting point and density, and melting point and molecular weight were found. In each case, three curves were obtained which corresponded exactly to the three types of crystals. All of these observations are conclusive of the fact that paraffin wax contains three series of compounds, each of which possesses a characteristic crystal form, irrespective of the medium from which it is precipitated. It is now generally recognized that the rate of cooling merely affects the size of the crystals formed and not their type. Storage of wax, containing small crystals, may result in the development of larger crystals, but can never cause a change in their type. This can be accomplished only by removing from the wax, or adding to it an impurity which is capable of impressing its form upon the basic type.

It can be concluded that the plate-type crystals represent straight-chain hydrocarbons and comprise the basic fraction of paraffin waxes. The needle and malcrystalline type crystals are probably Buchler and Graves' "soft wax," and are assumed to be branch-chain hydrocarbons. Microcrystalline waxes are examples of products composed largely of these types although high melting paraffin waxes, in some instances, will be found to contain small amounts of the needle type. The above conclusions have been substantiated to a large degree by further work in the laboratory on certain selected fractions believed to be rich in "soft wax."

The authors also determined the relative percentages of these three types which might be expected in fractions of different boiling points. These are approximately as given below.

Boiling Point, ° F. @ 10 mm	Type of Crystals		
	Plates	Malcrystalline	Needle
180	100	0	0
200	99	1	0
220	98	2	0
240	91	7	2
260	78	12	10
280	54	17	29
300	37	27	36

It can be seen that in the highest-boiling fraction, the malcrystalline and needle types are present in a greater total amount than the plate type. These waxes yield a much lower melting point for a given boiling point. For this reason, they are usually almost completely lost in paraffin refining. These types probably represent Buchler and Graves' "soft wax" and also comprise the bulk of microcrystalline or amorphous waxes obtained from higher-boiling distillates and residues.

Since pure components are never isolated in practice, the authors conducted additional work to determine the effect of mixtures of the three components on crystallization behavior. One phase of this investigation involved the determination of relative solubility of the three types in various solvents. They found that

1) Needle-type waxes are much more soluble in any solvent than plate-type waxes of the same molecular weight, and that the malcrystalline type was intermediate between the two;
2) For all solvents investigated, waxes of the same melting point, regardless of type, have about the same degree of solubility.

Mixtures of the three types, each having the same melting point, were prepared and their crystallization behavior was noted. It was found that the needle type was strong enough to impress its form upon the plates if both types were allowed to crystallize simultaneously, from the same solution. However, if crystallization was such that the needle type was kept in solution (either by high temperature, or excessive solvent), the plate type formed its characteristic crystals.

Similar work showed that the malcrystalline type of wax is even more powerful than the needle type in impressing its form upon plates and upon mixtures of plates and needles. Thus, any blends with the malcrystalline type will yield malcrystalline formations, unless this impurity is kept from the sphere of activity by reason of higher solubility.

One practical utilization of these differences in crystallization behavior is found in the manufacture of paraffin wax by

the sweating process. It is well known that a wax distillate, with good pressing characteristics, contains plate-type crystals, and that a slack wax, with good sweating characteristics, must crystallize as large, interlacing needles. In the two cases it is apparently the same wax which is being crystallized, but the conditions of crystallization are far different. In paraffin distillates, the percentage of oil is relatively high, thus holding the needles entirely in solution and allowing plates to be formed. However, in chilling slack wax, which contains the needles dissolved in the oil, to a solid cake, both types are precipitated simultaneously, and the needles impress their form on the plates.

It has also been recognized by refiners that, if the wax distillate contains too great a quantity of high-boiling constituents, it will not press satisfactorily. This is evident from a table which shows that, as the boiling point increases, the percentage of the malcrystalline-type wax also increases very rapidly. A long-cut paraffin distillate will contain excessive quantities of malcrystalline waxes which precipitate simultaneously with the plates and impresses their forms upon them, rendering the distillate non-pressable.

It follows from the above discussion that paraffin wax contains only paraffinic hydrocarbons having the generic formula C_nH_{2n+2} and that cyclic hydrocarbons are absent. It is also desirable to know what ranges of molecular weights, or lengths of carbon chains, are present. Buchler and Graves isolated numerous fractions believed to be relatively pure chemical compounds. In paraffin wax these ranged from $C_{18}H_{38}$ to $C_{32}H_{66}$. work with petrolatum waxes (microcrystalline waxes) disclosed the presence of hydrocarbons from $C_{34}H_{70}$ to $C_{43}H_{88}$. Clark and Smith [1] report hydrocarbons ranging from $C_{21}H_{44}$ to $C_{57}H_{116}$, but it appears that they are including high-melting paraffin waxes (up to 150° F., and higher) in their discussion. These investigators also claim, as a result of X-ray studies, that the number of different straight-chain hydrocarbons in the wax is small and seldom exceeds ten. The number of branched-chain

[1] *Ind. Eng. Chem.* 23, 697 (1931).

hydrocarbons could not be determined, but is probably somewhat higher.

Practical Evaluation

It has often been stated that the distribution of paraffin wax, by uses, is roughly 80% for the coating and impregnating of paper and paper products, 10% for candles, and 10% for other applications. For the lack of any definite figures to prove otherwise, these proportions must be accepted as at least a good approximation. The 80% used in paper includes both refined wax and white crude scale wax. However, since the requirements of the latter are not nearly so exacting, and, in general, represent lower-quality merchandise, only refined waxes will be considered in this discussion of quality and applicability.

The suppliers of refined paraffin waxes have adopted certain tests for controlling the production of these materials. Because of the more or less continuous nature of manufacture, and the rapidity with which these tests can be conducted, they have served as a means of maintaining fairly satisfactory uniformity of quality. Such tests include determination of the following characteristics:

Melting Point
Tensile Strength
Color
Oil Content
Reaction with Sulfuric Acid

In addition to these, there is a test which measures the degree of fluorescence exhibited by a wax when exposed to ultra-violet light.

Unfortunately, many consumers of refined wax have adopted these determinations as specifications for their purchases. They demand high tensile strength, low oil content and water-white waxes, and assume that all these are an absolute necessity for satisfactory performance. When waxes fail to meet these arbitrary specifications, they are either rejected or viewed with suspicion and are held responsible for any failure which may occur in the finished product. In many ways, this is deplorable, although

the exacting requirements, of the consuming trade, have probably been responsible for the advances in quality of refined waxes which have been made during the past decade.

Because of the complex nature of paraffin wax, a study of the correlation of physical characteristics and chemical composition with performance, has been extremely difficult. There are practically no published data of this nature. In many instances it has been impossible to arrive at definite conclusions regarding the performance characteristics, but in most cases certain trends are indicated. Thus, it can be shown that several of the accepted tests predicate good performance, but others are not definitely related to it.

Of all paper-coating and impregnating applications, the manufacture of bread-wrapping paper, or other high-gloss wax-coated stocks, is probably the most exacting. Other uses for wax may have the same requirements to a lesser degree, but few demand such all-round excellence. These requirements include, no tendency to block at ordinary temperatures, stability to discoloration, satisfactory sealing strength, ability to retain gloss, good ductility and not to change appreciably on aging. Each of these items will be discussed separately with relation to possible means of controlling production and maintaining uniformity.

Blocking

Blocking is a term used throughout the paper-converting trade, and refers to the tendency of two sheets of waxed paper to adhere to each other. It is encountered where sheets of waxed paper are stored in stacks or piles, and where a tightly wound roll is exposed to elevated temperatures. Various degrees of blocking are possible, all of which are primarily the result of either fusion of the wax from both sheets or localized adhesion of wax particles. The extreme case from which the term is derived, is one where a practically solid cake, or block, is formed. Milder forms of blocking result in the formation of pock marks in the surface caused by localized blocking, or a general marring of the waxy surface due to a mild over-all tendency to form a wax bond between two layers of paper. As such a difference in

severity exists, and since a solid block practically precludes rerunning the paper, all forms of blocking are objectionable, and should be avoided.

Blocking is due to complete or incipient fusion of wax from the surfaces of both layers of paper, and is influenced by temperature, time and pressure. As any of these three increases, so does the tendency to block. Since time and pressure are somewhat beyond control (except in the case of the user) the effect of temperature must be overcome. This is accomplished, most simply, by the use of higher-melting waxes when elevated temperatures of storage are anticipated. Carefully controlled laboratory data have shown that, with waxes from the same source, blocking is almost entirely due to low melting point. No safe temperature limits can be established for general use because of the effect of pressure and time, but approximately five degrees increase in melting point is equivalent to ten degrees increase in permissible storage temperature. This approximation holds only over the range of 125–135° F., in which most domestic, refined waxes fall. Practically all converters purchase higher-melting grades during summer months, and those catering to the southern trade ought to make certain that the lower-melting waxes are not used on stocks destined to be shipped to such points.

In addition to melting point, there are two other factors which influence blocking in a lesser degree. The first of these is oil content, which, if too high, will tend to increase blocking. However, the quantity of oil required for so adverse an effect is excessive, and would be objectionable for other reasons which alone would preclude its presence.

The second factor is the ductility of the wax. As previously shown, two waxes of identical melting points can have entirely different melting point distribution. Thus, in one of them there may be low-melting fractions which are softer than usual. The presence of these constituents will result in a wax of greater ductility, and one which is more easily deformed by constant pressure. Such waxes tend to block at slightly lower temperatures than harder more brittle waxes of equal melting points.

Discoloration (Light Stability)

Many grades of paraffin wax will darken in color, appreciably, if allowed to stand in direct, or even indirect sunlight for any length of time. This property of a wax was often attributed to its crude source and was supposed to be characteristic of all waxes derived from the same crude. However, careful investigation has shown that this is not the case. The pure, solid constituents of paraffin wax are remarkably stable to the action of ultra-violet light, and will discolor only if subjected to it for prolonged periods or at elevated temperatures. However, the oil, or liquid constituent in poorly stable waxes is far from stable. It will be found that, despite the presence of only a small (0.5) percentage of oil in a wax, this oil may be so unstable that its oxidation is sufficient to cause the entire mass of wax to become noticeably darker.

Light stability is an obvious requirement in waxes. Waxed paper must not become yellowed, lest it lose its sales appeal. Other articles, including candles, are even more degraded by discoloration, and often deteriorate and become unsightly.

Two methods are available for improving light stability: removal of the oil, or refining it, until it is color-stable. The first method is impracticable, so that wax producers resort to additional refining, resting assured that even if 0.5% oil is left in the wax, it will not be harmful if the treatment has been adequate. Thus, the relation between color-stable and color-unstable waxes is identical with that between two theoretically oil-free waxes, to one of which has been added a small percentage of white oil, and to the other similar quantities of an unrefined paraffin distillate.

It will be observed from the above that the quantity of oil present in a wax, in itself, is not a measure of color stability. The type of the oil must also be considered, for, if the oil is color-stable, excessive quantities will not be detrimental to color stability.

In view of the relationship between light stability and oil content, it would perhaps be well to explain the term "oil

content" at this point. Previously, a determination of the so-called "expressible oil and moisture" was given tentative recognition by the ASTM. This method measured the quantity of liquid (chiefly oil and low-melting wax) squeezed from a sample of wax under standard conditions at 1000 lb per sq in. pressure. Due to poor reproducibility, this test has been abandoned, and an improved method has been suggested instead. The new test actually measures the quantity of oil which is present in the wax, by recrystallizing the wax from a solvent under prescribed conditions, and weighing the oil held in solution. The oil is defined in terms of pour point to make certain that excessive quantities of wax are not removed at the same time. Highly reproducible results may be obtained by this method, which shows that refined waxes consistently contain less than 0.5% oil. As determined by the old "expressible oil and moisture" method, values ranging from 0 to 1.0% were often reported for the same wax.

Ductility

In general, refined waxes are described as being brittle and non-ductile, especially when compared with microcrystalline or amorphous waxes. However, when this property is considered over a narrow range, it soon becomes evident that wide differences exist among various waxes. It is well known that, to a mild degree, refined waxes are thermoplastic below their melting points, and that changes in temperature have a pronounced effect on ductility. Conversely, at any given temperature, lower-melting commercial waxes are, in general, more ductile than those of higher melting point, probably because they are closer to the liquid state. Besides these variations, there is also the fact to consider that a measurable difference in ductility exists between waxes of the same melting point when subjected to the same conditions of temperature and pressure.

The importance of this difference can be illustrated by the performance of two waxes used for coating paper milk bottles with the Excello machine. This machine immerses the paper container in a bath of molten wax, coating it inside and out, and

delivers the coated article to a conveyor which carries it through a chilling tunnel. During the cooling, drainage from the side walls to the bottom occurs, building up a thick cake of wax which is not completely congealed. Immediately, after leaving the conveyor, the container is filled with milk at 38° F., the filling time being only a few seconds. When the less ductile of the two waxes is used, the impact of the cold stream on the plastic mass of wax sets up strains, which result in open cracks, and allow leakage of the milk to the paper board. In one test, four per cent of all bottles filled were classed as "leakers." With a more ductile wax, the strains are counteracted by cold flow of the wax and cracks are practically non-existent. In a similar controlled test, the more ductile wax produced a fraction of one per cent of "leakers."

Other practical applications might be cited, for example, the use of waxes for coating frozen food containers which are subjected to temperatures below 0° F. Even papers creased, at ordinary temperatures, will show that more ductile waxes will cause less flaking than others.

A suitable test has been developed to evaluate ductility. This is somewhat similar to a tensile strength determination in that carefully prepared briquettes are broken, but has the important difference that constant loads are applied at controlled temperatures, and are chosen so that a measurable elongation of the briquette is obtained. Instead of obtaining a break in 10–15 seconds, as in tensile strength measurements, times as long as several hours are required.

Attempts have been made to ascertain a correlation between ductility and other characteristics of refined waxes, such as tensile strength, oil content, sealing strength, etc., but, apparently, none exists. Instead, it appears that the most important factor involved is the distribution of the component parts with respect to melting point. Waxes, with wide ranges of melting points of the constituents, are appreciably more ductile than those with narrower ranges. Also, it appears that the evenness of distribution has an important effect upon ductility. Waxes having a very even distribution, as contrasted with those composed of a blend of narrow cuts, will be noticeably more ductile. It is

possible, therefore, for a consumer to prepare a highly ductile synthetic wax by blending together equal, or nearly equal, portions of several grades of wax.

The ductility of paraffin wax is also dependent upon temperature, but different waxes are not always affected in the same manner. In general, ductility will increase, as temperature is increased, reaching a maximum at some point below the melting point, and above that it will decrease as the temperature is further raised. The maximum ductility is apparently associated with the transition point of the wax, which occurs 40–50° F. below its melting point and is the result of a change in crystal structure.

Investigators of paraffin wax have noticed that, at temperatures below the apparent solidification point of the wax, changes in crystal structure frequently take place. The temperature at which this occurs is known as the transition point. Not all waxes exhibit transition points and, furthermore, most waxes, if quickly chilled to below the transition point, will show no change unless stored at slightly elevated temperatures where crystal reformation can occur. Waxes, having uniform melting point distribution, particularly over a wide temperature range, will show no transition point, or at best an indistinct one. Waxes of uneven distribution invariably have the most pronounced transition points and show the greatest changes in ductility at these temperatures.

With further reference to these crystal changes, the following phenomena, which occur when waxes having transition points are cooled slowly, may be of interest. When a large wax mass is cooled and reaches the so-called melting point, latent heat of fusion is released, and the temperature of the wax remains constant or increases slightly until solidification is complete. Below this temperature cooling begins again at a regular rate. However, an appreciable quantity of wax remains as an isotropic viscous fluid for some degrees below the solidification point. When this fluid congeals, contraction commences and air begins to enter the wax. This point probably represents the final solidification of all constitutents. At a still lower temperature, tran-

sition takes place, which is accompanied by a definite change in volume caused by contraction of certain solid portions of the wax, an evolution of heat and a release of the air which was dissolved in the prior cooling. The release of heat causes a change in the rate of cooling and is used for determining the transition point. In some instances the change in rate is pronounced, whereas, in other instances, it is indefinite. Following transition, the wax again continues to cool at a regular rate. Frequently, a microscopic study of these cooling phenomena will show that a portion of the wax actually becomes liquefied and recrystallizes long after it appears to have become permanently solid. The quantity involved is quite small but is spread uniformly throughout the mass of wax.

The practical aspects of the transition point in waxes are not definitely established as yet. However, it appears that waxes showing indistinct transitions, or no transition points, are more translucent than those in which the transition is marked. It might also be reasoned that the absence of a transition point would be indicative of a more satisfactory wax for moisture proofing, since there would be no fractures between crystal boundaries due to contraction. This is another way of saying that the more ductile waxes, which are those having no transition points, but having a uniform distribution of components, are more satisfactory for this purpose, due to their ability to be deformed without fracture.

An additional observation of interest is that molded articles, such as candles, can be made most readily from waxes with sharp transition points. It is found that these waxes show a greater contraction on cooling and thus have less tendency to adhere to the mold than those with indistinct transition points.

Oxidation Stability

In nearly all practical applications of paraffin waxes, they must be melted at one time or another. This is particularly true in the paper industry, which consumes the bulk of the production. For melting waxes, many types of equipment are

employed, but, in general, they consist of iron or steel assemblies heated with steam, direct flame or electricity. As steam constitutes the commonest source of heat, and since even exhaust steam has a temperature of at least 212° F., the temperature of the molten wax is frequently above 200 or 210° F. At such elevated temperatures the oxidation of the wax will proceed with great rapidity, unless extreme care is exercised.

Oxidation of paraffin wax is dependent upon a number of variables encountered in usual practice. These are temperature, time, surface of exposure, and contact with metals and impurities. It is surprising, how little concern is paid to these factors in both the design and operation of commercial equipment. As previously stated, paraffin wax is closely related, in chemical composition, to low-viscosity paraffin oils. Few operators would expose light oils, such as these, particularly if used as lubricants, to conditions often encountered by paraffin wax. Yet they expect the wax to be unharmed by careless treatment. This is probably due to the erroneous assumption that a solid is much more stable than a liquid.

Paraffin waxes will show a gradual increase in stability as the melting point increases. This is a reasonable observation, since products of higher molecular weight, or higher viscosity, are present in these grades. However, the difference in stability is not sufficient to permit a high-melting wax (such as one of 135° F. A.M.P.) to be treated with less care than one melting at a lower temperature (122° F.). Crude scale waxes are less stable than refined waxes of equal melting point, and, in general, will deteriorate at about twice the rate of these more refined products. Most measurements of oxidation are relative, but it usually results in darkening of color, lowering of melting point, loss of tensile strength, and the formation of products, such as aldehydes, ketones, organic acids and esters, most of which have a pronounced odor. Initially, oxidation probably causes a breakdown of the small oily fraction of the wax, but eventually it results in degradation of the solid constituents as well.

The effect of temperature and, for that matter, of all other variables is dependent upon other conditions of exposure as

well. Under normal conditions, little oxidation occurs at 150° F. but when a temperature of 200° F. is reached, serious oxidation begins, and above this temperature, it proceeds at a rapid rate. From a practical viewpoint, arrangements should be made to hold temperatures below 200° F., if this is consistent with the job being accomplished. Best results are obtained with thermostatic control, whatever the source of heat may be. Low-pressure steam should always be used for heating purposes, otherwise local overheating and consequent oxidation will result.

Similarly, the time of exposure to conditions of oxidation must be held at a minimum. Naturally, the longer a wax is held at elevated temperatures in the molten condition, the greater will be the oxidation. Equipment, which is not used 24 hours a day, should be shut down during idle periods. This should be usual practice in all plants and should be followed for all week-end shut-downs. Losses of time, in reheating solid wax, will be more than compensated for by savings in wax and a maintenance of uniform high quality. In this connection, it should also be mentioned that waxing equipment should be cleaned periodically to remove accumulations of oxidized wax. The presence of highly oxidized material in fresh wax, aside from contaminating the good wax, will catalyse further oxidation and accelerate further degradation. Where the quantity of wax used is large, cleaning may be less frequent. The simplest means of control is to resort to cleaning when the odor of the wax bath has become distinctly rancid.

The third variable, affecting rate of oxidation, is the surface of exposure of the molten wax. Since it is the quantity of oxygen reacted with the wax that is involved, reduction of area of contact between air and wax is desirable. Samples stored in containers of about the same surface area showed that oxidation in the open is four times as rapid as that in a closed container. Equipment used for handling molten wax should always be designed to provide for the least possible exposed surface area. Other precautions, which should be observed, are to reduce to a minimum any wax spray or foam. Drippings from coating rolls usually cannot be controlled, but often lines deliver wax to

heating pans above the surface and cause spattering. Extending the lines below the surface will rectify this fault. Spraying paraffin wax is always conducive to excessive oxidation, since the surface area is tremendously increased. If other means of application are available for a given job, they should be chosen in preference to spraying.

In many chemical reactions, the presence of certain metals markedly affects the speed and extent of the reaction. Oxidation of wax is no exception, and the type of metal, used in the equipment, is, therefore, of considerable importance in preventing oxidation. Generally speaking, ferrous metals are satisfactory, and copper-bearing metals are not. There is apparently a difference among the various ferrous metals since cast and wrought iron are less deleterious than stainless steel. Similarly, copper is much less desirable than brass and bronze. In order of desirability, the metals usually encountered may be listed as follows: cast and wrought iron, carbon steel, stainless steel, aluminum, nickel, brass, bronze, and copper. From this it is apparent that fittings made from copper and copper-bearing metals should be eliminated from waxing equipment wherever possible. Replacements made of iron or steel should always be installed if at all possible.

Samples of refined paraffin, white crude scale, and microcrystalline waxes have been subjected to storage at several temperatures and in contact with metals. In addition, several of these waxes have been stored with no surface of exposure. From the data obtained, the following conclusions can be drawn.

1. Upon oxidation of petroleum waxes, deterioration occurs. This is evidenced by darkening, development of acid and saponifiable bodies, loss of tensile strength, lowering of melting point and loss of hardness.

2. High-melting-point waxes are more stable than those of lower melting point. This is particularly true of the microcrystalline waxes which are only slightly affected even at 250° F. for 7 days.

3. Refined paraffin waxes are more stable than crude scale waxes of similar melting points since the more oxidizable fractions have been removed during refining.

4. Refined paraffin and crude scale waxes, stored at 150° F., exhibit little deterioration even after 21 days exposure. Serious oxidation does not occur until a storage temperature of 200° F. is encountered. Above this temperature, oxidation is very rapid.

5. Surface of exposure has a pronounced effect upon oxidation. In actual practice, it should be reduced to a minimum. This refers to agitation, aeration, spraying, and construction of equipment.

6. There is a period in the oxidation of waxes in which little change, other than darkening, occurs. Eventually, drastic oxidation commences with resultant increases in acid number, loss in tensile strength, and lowering of melting point. This is found when storing paraffin waxes at 250° F., at which temperature, it requires from 3 to 5 days for serious oxidation to begin.

7. Drastic oxidation of microcrystalline waxes does not commence at 250° F., for a considerably longer period than for paraffin wax. Less care is, therefore, needed in the handling of these waxes.

Anti-Oxidants for Paraffin Wax [1]

Baths of paraffin wax such as those used commercially for water-proofing, sizing or impregnating paper, tend to foul and to cause discoloration or undesirable odors due to oxidation of the paraffin, particularly after long continued use at elevated temperatures. Certain other substances, even when present in minute quantities in a bath of paraffin waxes or paraffin oils, have the property of preventing such oxidation and permit the bath to be used commercially for long periods of time without fouling.

Natural and artificial asphalts and pitches, and their derivatives and asphalt-like substances, such as gilsonite, manjak and other asphaltites and petroleum residue asphalts, in extremely small percentages, are suited to prevent oxidation of a paraffin wax bath when the bath is operated at 235–240° F. It is understood that the percentage of anti-oxidant required increases in

[1] Vore, U. S. Patents 2,325,085 and 2,325,167 (1943).

accordance with the temperature of the bath and at the higher temperatures the increase is much more rapid.

The following table gives certain examples of such anti-oxidants:

Anti-Oxidant Material	Approximate per cent required to prevent oxidation in an industrial paraffin bath at 230–240° F.	Approximate per cent required to prevent oxidation in an industrial paraffin bath at 160–210° F.
Egyptian Asphalt	0.02	0.01
Cuban Gilsonite	0.04	0.02
Petroleum Residue Asphalt	0.006	0.003
Isthmian Asphalt	0.02	0.01
Manjak	0.02	0.01
Utah Gilsonite	0.02	0.01
Fatty Acid Pitch	0.50	0.25
Cottonseed Pitch	0.10	0.05
Stearine Pitch	0.50	0.25
Crude Montan Wax	0.04	0.02
Ozokerite (Crude)	0.1	0.05
California Asphalt	0.2	0.1
Carnauba Wax	0.6	0.3
Candelilla Wax	0.6	0.2
Esparto Wax	0.8	0.4

In addition to the above-named anti-oxidants, it has been found that about 0.6% ceresin breaks down the crystalline structure of the paraffin and tends to make the wax harder and more water-resistant. A bath of paraffin wax of the type melting between 133° F. and 138° F., containing about 0.6 per cent ceresin and about 0.04 per cent of petroleum residue asphalt is particularly suitable.

Data on Different Paraffin Waxes[1]

Paraffin waxes, from different sources, have very similar compositions. Differences in the melting points of commercial paraffin waxes are due to differences in their oil content. Paraffin wax apparently retains oil as a solid solution of oil in wax. The melting points of the solid solutions lie between the melting

[1] L. D. Myers and G. Stegeman, *Ind. Eng. Chem.* **20,** 640 (1928).

PARAFFIN WAX: VARIATIONS OF PHYSICAL CONSTANTS IN DIFFERENT SHIPMENTS

M.P. ° F.	ASTM Ball & Ring Softening Point ° F. Regular Min.	Regular Max.	Sloping Ring Min.	Sloping Ring Max.	Hardness Standard ASTM Needle Penetration 82° F. Min.	82° F. Max.	90° F. Min.	90° F. Max.	100° F. Min.	100° F. Max.	Tensile Strength lb per ¼ sq in. Area 90° F. Min.	Tensile Strength 90° F. Max.	Elongation or Stretch (millimeters) 90° F. Min.	Elongation or Stretch 90° F. Max.
Domestic 124–126	113.9	127.2	120.0	128.8	137	44	½ sec.	98	..	..	0	11.1	0	750
Domestic 125–127	121.1	129.1	127.6	136.2	90	21	2 sec.	236	½ sec.	2 sec.	20.2	45.0	½	2
Domestic 128–130	121.5	131.5	129.1	135.0	35	14	117	42	1 sec.	2 sec.	15.7	40.4	¼	45
Domestic 133–135	126.6	138.2	127.8	140.4	..	..	39	16	1 sec.	50	19.6	52.2	¼	¾
Domestic 135–137	127.1	136.2	136.2	139.5	..	..	42	18	3 sec.	140	29.8	63.3	¼	¾
Domestic 138–140	129.2	136.9	137.2	141.8	..	..	24	12	166	41	17.9	49.0	⅛	½
Imported 125–130	127.9	132.0	132.7	134.0	18	14	47	27	2 sec.	294	30.6	38.2	¼	¾
Imported 130–135	131.3	133.5	137.0	139.4	..	..	23	19	189	105	43.0	54.1	½	¼
Imported 133–135	130.8	137.2	136.4	141.0	..	..	26	15	207	32	35.9	59.7	¼	½
Imported 135–137	136.5	140.2	141.8	142.8	..	..	18	13	41	28	38.2	46.9	¼	½
Imported 138–140	136.6	142.1	142.2	147.4	..	..	15	10	29	19	37.8	61.8	¼	½
Imported 140–145	142.8	142.8	....	....	..	..	12	12	20	20	35.8	35.8	¼	¼

The above table shows the lowest and highest tests for each grade of paraffin wax. The maximum and minimum tests were taken from a total of 426 tests made on different samples of paraffin waxes during the past five years. It has been found that changes brought about by the war have resulted in lower tests, for a specific grade.

points of the components. Owing to the existence of solid solutions, paraffin wax does not possess a sharp melting point.

The solubility of paraffin wax in oil increases very markedly at temperatures approximately 10° C. below the melting point of the wax. The low-melting waxes are more soluble in oil than the high-melting waxes. Mixtures of high- and low-melting waxes have solubilities intermediate between the solubilities of the components. The increase in solubility of the mixtures, in oil, at temperatures approximately 10° C. below their melting points, is as marked as in the case of pure waxes.

VARIATION OF MELTING POINT OF PARAFFIN WAX WITH OIL CONTENT [1]

Material	% of Pressed Oil	Refractive Index at 25° C.	Melting Point ° C.
"Parowax"	0.16	1.4481	51.7
Refined Wax	0.28	1.4487	50.0
Refined Wax	0.25	1.4485	50.0
Refined Wax	0.17	1.4481	51.7
Refined Wax	0.16	1.4479	51.7
Refined Wax	0.09	1.4476	54.4
Refined Wax	0.08	1.4475	54.4
Scale Wax	2.58	1.4570	48.3
Scale Wax	2.56	1.4568	48.3

The melting point under pressure, between 1 and 200 atmospheres, can be calculated from the following formula:

$$t_p = t_o + 0.029776\,(P\text{-}1) - 0.0000523\,(P\text{-}1)$$

Solubilities of Petroleum Waxes in Various Solvents

Frequently, it is desired to apply petroleum waxes in solution, and data, concerning their solubilities at definite temperatures, are essential. In addition, petroleum waxes are used extensively as coating materials. These waxes are waterproof, but often they are called upon to resist other solvents as well. In such instances, waxes of minimum solubility are required. Solubility data are also of value in separating waxes from other materials, since, frequently, a solvent is available which will preferentially dissolve one component.

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[1] Wilson and Wilkins, *Ind. Eng. Chem.* **16**, 9 (1924).

SOLUBILITIES OF PETROLEUM WAXES IN VARIOUS SOLVENTS

Solvent:	Per Cent Wax in Solution						lb Wax per 100 lb Solvent					
	60° F.	70° F.	80° F.	90° F.	100° F.	110° F.	60° F.	70° F.	80° F.	90° F.	100° F.	110° F.
133/135° F. AMP Refined Paraffin Wax												
Sovasol #6	4.4	8.5	16.0	27.5	43	61	4.6	9.2	19	38	75	156
Turpentine	4.6	9.5	19.2	31.8	46	63	4.8	10.6	24.7	47	85	170
Pine Oil	0.6	1.4	2.9	6.2	13.4	29	0.6	1.5	3.0	6.6	16	41
125/127° F. AMP Refined Paraffin Wax												
Sovasol #3	16	26	41	61	81	90	19	35	70	156	425	...
Sovasol #4	13	23	37	56	76	88	15	30	59	127	316	...
Sovasol #5	10	19	32	49	69	83	11	25	47	96	222	...
Sovasol #6	7.9	14.5	26.5	42	61	81	8.6	16.5	36	72	156	...
Sovasol #5-A	12	21	33	50	70	84	14	27	50	100	233	...
Benzene	10	18	35	56	77	90	11	21	54	127	335	...
Carbon Tetrachloride	10	15	31	48	68	83	11	18	45	92	210	...
Ethylene Dichloride	0.2	0.8	1.6	7	30	81	0.2	0.8	1.6	7.5	43	...
Perchlorethylene	10	15	26	42	63	82	11	18	35	72	170	...
Trichlorethylene	12	20	32	50	68	83	14	25	47	100	210	...
Halowax 1000	2	4	8	13	31	62	2.1	4.2	8.7	15	45	...
Turpentine	9.2	17.5	29.2	43.5	60	78	10	21.2	41	77	150	...
Pine Oil	1.1	2.5	5.4	11.6	25.2	55	1.1	2.6	5.7	14	34	...
S/V 907	2.7	5.1	9.5	17.5	33	55	2.8	5.4	10.5	20	50	...
Petrolatum Melting Point 120° F.												
Sovasol #6	10.5	19.3	33	51	72	..	11.7	25	50	104	260	...
Turpentine	12	22	36	54	74	..	14	28	56	117	284	...
Pine Oil	1.8	4.0	8.5	19	40	85	1.8	4.2	9.2	25	67	...
S/V 907	4.5	8.2	16.0	30	55	89	4.8	8.9	19	43	122	...

SOLUBILITY OF PARAFFIN WAX (M.P. 53° C.)

1 cc of	Dissolves at 20° C.
Ethyl Acetate	1.1 mg
Acetone	1.2 "
Alcohol (96%)	1.9 "
Ether	83.4 "
Petroleum Ether	200.0 "
Ligroin	244.0 "
Chloroform	246.0 "
Benzene	285.0 "
Carbon Tetrachloride	317.0 "

The solubility of paraffin wax in Pliolite increases with increase in temperature to the melting point of the wax, whereupon they become miscible in all proportions. These mixtures (Pliowax) are tougher and in films are more flexible and lustrous than the wax alone.

SOLUBILITY OF PARAFFIN WAX (M.P. 124.5° F.) IN ORGANIC SOLVENTS

Solvent	Temperature ° F.	Grams Wax per 100 cc Solvent
Cyclohexanol	87	0.880
	68	0.294
	58	0.142
	47	0.0823
Isopropyl Alcohol	85	0.240
	66	0.0600
	52	0.0240
	39	0.00944
n-Propyl Alcohol	80	0.214
	60	0.0535
	46	0.0214
	32	0.00859
Tertiary Butyl Alcohol	80	0.292
	58	0.0730
n-Butyl Alcohol	77	0.36
	59	0.090
	45	0.036
Fusel Oil	80	0.462
	58	0.115
	42	0.046

SOLUBILITY OF PARAFFIN WAX (M.P. 124.5° F.) IN ORGANIC SOLVENTS—Continued

Solvent	Temperature ° F.	Grams Wax per 100 cc Solvent
Tertiary Amyl Alcohol	72	0.552
	53	0.138
	42	0.0552
Diacetone Alcohol	97	0.256
	78	0.0640
	65	0.0256
Ethyl Alcohol	98	0.358
	83	0.0895
	72	0.0358
Pentasol	83	0.828
	61	0.207
	50	0.0828
n-Propyl Formate	79	1.048
	65	0.316
	47	0.0790
Isopropyl Formate	75	0.412
	57	0.103
	45	0.0412
n-Butyl Formate	75	0.898
	57	0.225
	46	0.0898
	37	0.0475
Methyl Acetate	85	0.278
	66	0.0695
	57	0.0278
	35	0.00858
Phenyl Acetate	96	0.350
	75	0.0875
	62	0.0438
Ethyl Oxalate	112	0.660
	93	0.165
	80	0.066
Chloroethyl Carbonate	70	0.524
	50	0.131
	39	0.0524

SOLUBILITY OF PARAFFIN WAX (M.P. 124.5° F.) IN ORGANIC SOLVENTS—Continued

Solvent	Temperature ° F.	Grams Wax per 100 cc Solvent
β,β-Dichloroethyl Ether	90	0.28
	70	0.070
	57	0.028
Trichloroethylene	59	2.86
	36	0.916
	7	0.229
Methyl n-Hexyl Ketone	65	1.064
	48	0.266
	38	0.1064
	30	0.0546
Isobutyl Methyl Ketone Hexone	83	2.07
	72	0.828
	46	0.202
Cyclopentanone	74	0.516
	57	0.229
	45	0.0516
Methyl Cyclohexanone	83	3.08
	54	0.352
	35	0.0880
	22	0.0352
Dipropyl Ketone	61	0.882
	43	0.221
	33	0.0882
	23	0.0414
Cyclohexane	62	7.76
	50	2.448
Benzol (90%)	32	0.744
	18	0.186
Cresol	96	0.608
	75	0.152
	62	0.0608
Tetralin	56	2.51
	43	1.184
	26	0.394

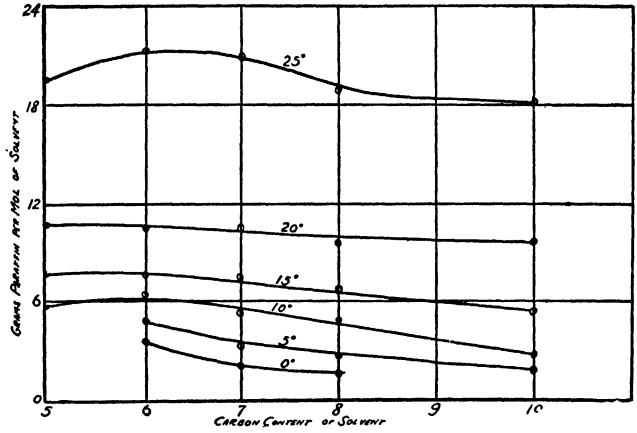
SOLUBILITY OF REFINED PARAFFIN WAX (M.P. 130–132° F.) IN ORGANIC SOLVENTS

Solvent	Temperature ° F.	Grams Wax per 100 cc Solvent
Butane	68	3.67
	43	0.548
	45	0.596
	42	0.488
	14	0.066
	–4	0.015
Propane	39–40	0.238
	45	0.260
	23	0.0548
	31	0.0824
	6	0.0189
	9	0.0189
	8.5	0.0189
	17.5	0.033
	–2 to 2	0.0105
	–10	0.0056
Cylinder Stock Naphtha (128–348° F. B.P.)	39	0.500
	44	0.750
	27	0.250
	17	0.125
	60	2.490
	50	1.25
	40	0.62
	6	0.061
	–10	0.020
35% Acetone + 65% Benzol	62	0.507
	41.0	0.0995
	21.0	0.0205
	12.0	0.0100

SOLUBILITY—GRAMS PARAFFIN WAX PER 100 cc SOLVENT

Temperature ° C.	Pentane	Hexane	Heptane	Octane	Isodecane
0	....	2.77	1.37	0.99	....
5	....	3.69	2.18	1.69	0.94
10	5.11	4.81	3.55	2.90	1.44
15	6.94	6.07	5.06	4.24	2.74
20	9.53	8.31	7.18	5.93	4.98
25	17.16	16.23	14.36	11.66	9.17

SOLUBILITY OF PURE PARAFFIN WAX IN HYDROCARBONS[1]



SOLUBILITY—GRAMS PARAFFIN WAX PER MOL SOLVENT

Temperature ° C.	Pentane	Hexane	Heptane	Octane	Isodecane
0	....	3.61	2.01	1.60	....
5	....	4.81	3.22	2.73	1.84
10	5.83	6.28	5.23	4.67	2.84
15	7.92	7.91	7.48	6.84	5.40
20	10.87	10.83	10.57	9.58	9.80
25	19.48	21.33	21.06	18.81	18.03

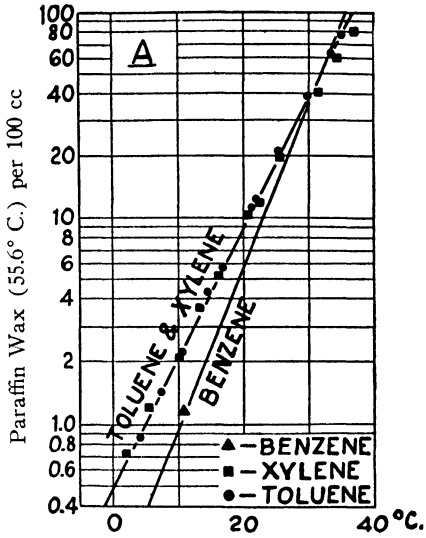
The solubility of a solid paraffin in hydrocarbons of low molecular weight increases rapidly with rise of temperature. The solubility increases from that of isodecane to that of pentane. The increase in solubility with rise of temperature is more rapid with the higher-molecular-weight solvent. This can be seen by dividing the solubilities at 10° C. into the solubility at 25° C., the ratio being 2.3, 3.8, 4.0, 3.9, and 6.6, respectively, for pentane, hexane, heptane, octane, and isodecane.

Paraffin wax (M.P. 56° C.) is dissolved in solvents at 19° C. as follows: benzene 9.34%; toluene 9.74%; xylene 9.90%; benzene (at 20° C.) 11.82%. The amount of paraffin wax required to cause gel formation decreases with the viscosity of

[1] P. Weber and H. L. Dunlap, *Ind. Eng. Chem.* **20**, 384 (1928).

the solvent as is shown by the addition of paraffin to benzene, xylene, chloroform, turpentine and carbon disulfide. Solubility varies with the isomeric form. Tests with various mineral solvents show that minimum viscosity is associated with maximum adsorption.[1]

SOLUBILITY OF PARAFFIN WAX IN TOLUENE-XYLENE AND BENZENE

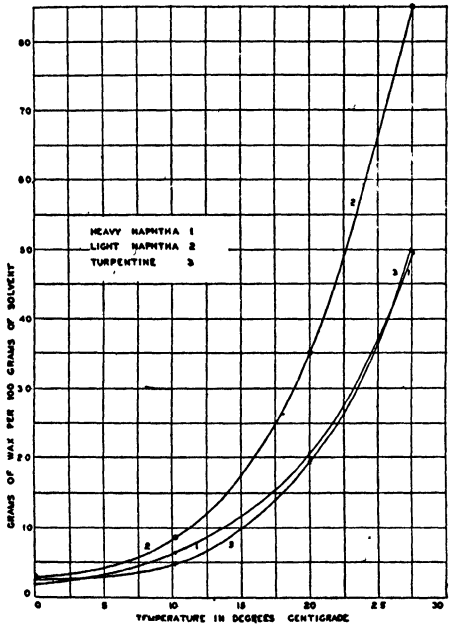


For any particular solvent, the solubility is the greater the lower the melting point of the paraffin wax, and for any particular paraffin wax, the solubility decreases with increasing density of the solvent. Benzine, density 0.677, dissolves about ten times as much paraffin wax as machine oil, density 0.908. In the liquid state, the paraffin waxes are miscible, in all proportions, with all petroleum fractions, benzene, and isoamyl alcohol. As the solubility of the paraffins increases more rapidly at higher temperatures, a given lowering of temperature will cause the deposition of more paraffin wax at a high temperature than at a low temperature. The difference between the temperature at

[1] M. A. Rakuzin, *Petroleum Z.* **21**, 1489 (1925).

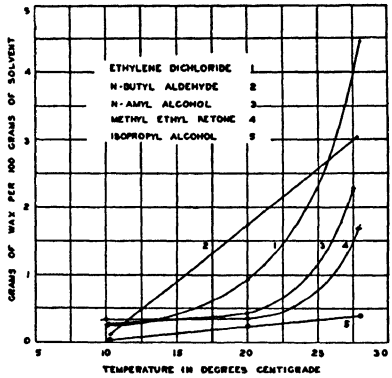
which paraffins first separate, on cooling a solution, and the solidifying point of the paraffins is the greater the lower the temperature of deposition, that is, the lower the concentration of the solution. The difference is 1–3°, 3–7°, and 7–20° for solutions containing more than 15 g, 15–5 g, and less than 5 g per 100 g of solvent, respectively. The higher the freezing point of the solution, the greater is the proportion of material which separates out on cooling to the freezing point. During solidification, the whole of the solvent is absorbed by the solid paraffins, which reduces the rise of temperature, and thus, at low temperatures, a small separation of paraffins is sufficient to cause solidification. The quantity of absorbed solvent is dependent upon the size of the crystals, which again is dependent upon the previous treatment of the solution.

SOLUBILITY OF PARAFFIN WAX IN VARIOUS SOLVENTS[1]

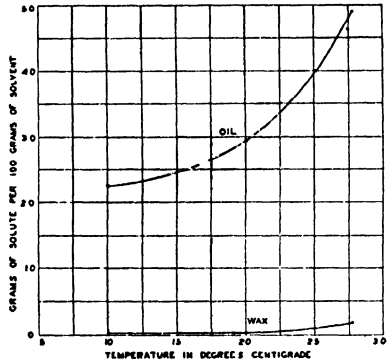


Temperature-Solubility Curves for Paraffin Wax in Naphthas and Turpentine.

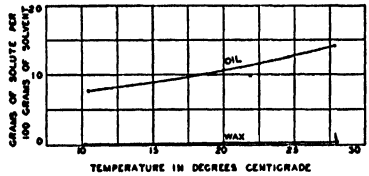
[1] J. W. Poole, *Ind. Eng. Chem.* 23, 171 (1931).



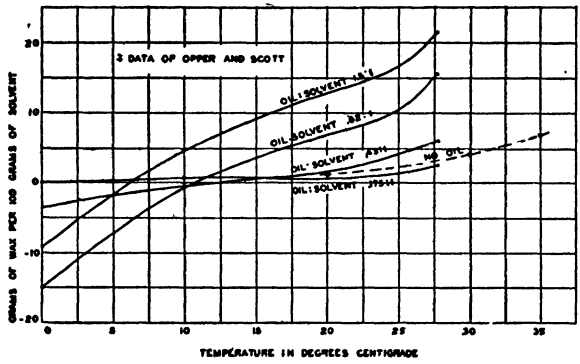
Temperature-Solubility Curves for Paraffin Wax in Ethylene Dichloride *n*-Butyl-Aldehyde, *n*-Amyl Alcohol, Methyl Ethyl Ketone, and Isopropyl Alcohol.



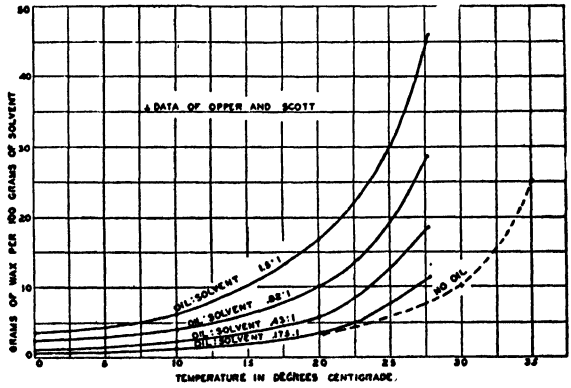
Temperature-Solubility Curves for Paraffin Wax and Mineral Oil in Methyl Ethyl Ketone.



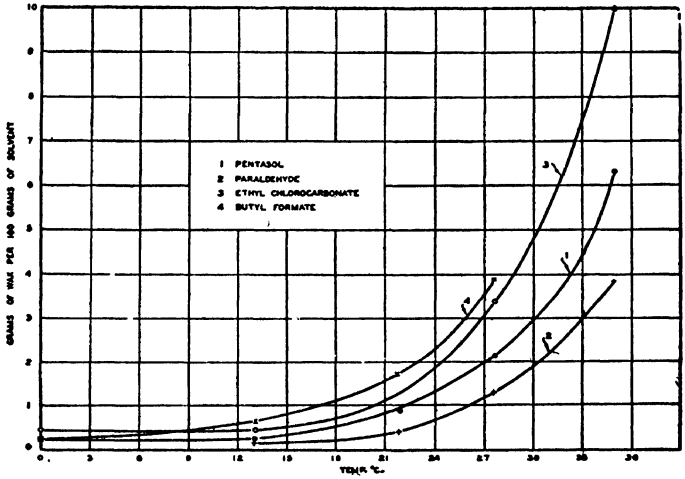
Temperature-Solubility Curves for Paraffin Wax and Mineral Oil in Isopropyl Alcohol.



Temperature-Solubility Curves for Paraffin Wax in Various Solutions of Mineral Oil and Butanol.



Temperature-Solubility Curves for Paraffin Wax in Various Solutions of Mineral Oil and Butyl Acetate.

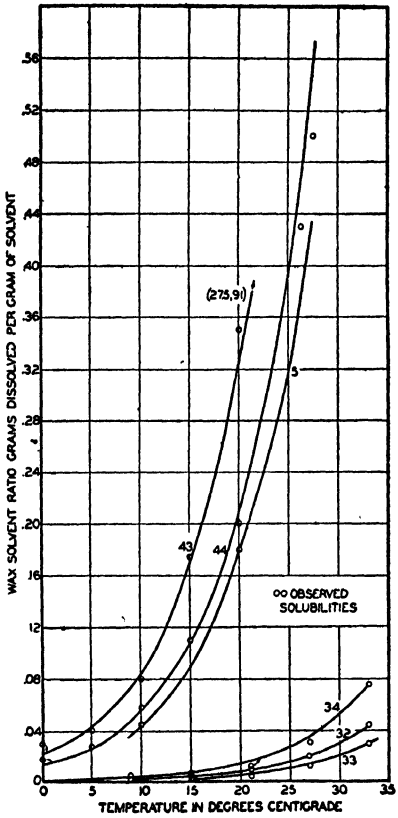


Temperature-Solubility Curves for Paraffin Wax in Pentasol, Paraldehyde, Ethyl Chlorocarbonate, and Butyl Formate.

(1) The solubility of paraffin wax in mineral oil increases as the melting point of the wax decreases.

(2) The solubility of paraffin wax in mineral oil decreases with increasing viscosity of the solvent.

(3) Difference of solubility due to difference in melting point of wax decreases with decreasing temperature.

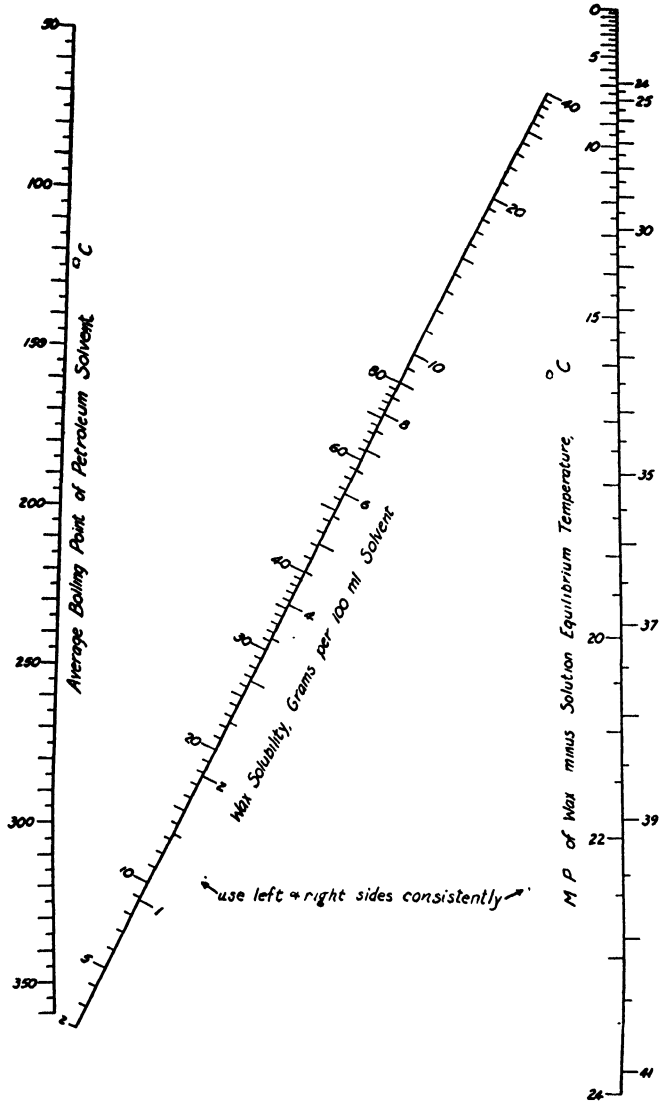


Temperature-Solubility Curves for Wax in Various Solvents Showing Agreement between Observed and Calculated Values.[1]

(Curves represent calculated values) 5, chlorobenzene; 32, pentasol; 33, ethyl-chlorocarbonate; 34, butyl formate; 43, light naphtha (27.5 and 0.91 are calculated co-ordinates; 27.5 and 0.85 are observed); 44. heavy naphtha.

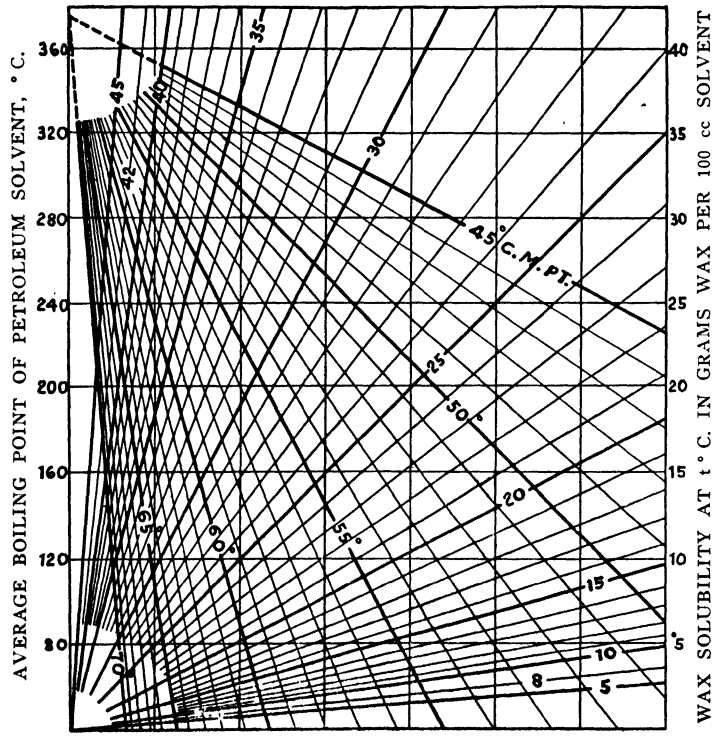
[1] J. W. Poole and T. A. Mangelsdorf, *Ind. Eng. Chem.* **24**, 1217 (1932).

SOLUBILITY OF PARAFFIN WAX IN PETROLEUM FRACTIONS [1, 2]



[1] D. S. Davis, *Ind. Eng. Chem.* **32**, 1293 (1940).
[2] A. Berne-Allen and L. T. Work, *Ibid.* **30**, 811 (1938).

The use of this chart may be illustrated as follows: What is the solubility of paraffin wax in petroleum when the melting point of the wax is 45° C., the temperature of the solution is 26° C., and the average boiling point of the pure distillate is 260° C.? The difference between the melting point and the solution temperature is 45 — 26, i.e. 19° C. Connect 19 on the right-hand scale with 260 on the left-hand scale and read the solubility on the inclined axis as 31.0 g of wax per 100 ml of solvent. Similarly, the chart reveals that 100 ml of a distillate, boiling at 190° C., will dissolve 5 g of paraffin wax when the melting point of the wax is 60° C. and the temperature of the solution is 23° C. Note that one reads solubilities on the right-hand side of the inclined scale when temperature differences are read on the right-hand side of the temperature difference scale, and conversely.



DATA ON PURIFIED (OIL-FREE) PETROLEUM WAXES[1]

Melting Point °F.	Melting Point °C.	n^{84}_D	d^{84}	Observed: Mol. wt.	Observed: Mol. refractivity	Observed: %C	Observed: % H	Formula	Calculated: Mol. wt.	Calculated: % C	Calculated: % H	Calculated: Mol. refractivity
					PARAFFIN WAX							
80.5	27.0	1.4133	0.7347	255	86.5	84.55	15.04	$C_{18}H_{38}$	254	85.04	14.96	86.9
88.5	31.4	1.4155	0.7397	271	92.0			$C_{19}H_{40}$	268			89.6
97.5	36.4	1.4173	0.7417	287	97.6			$C_{20}H_{42}$	282			94.1
101.0	38.3	1.4183	0.7440	292	99.1			$C_{21}H_{44}$	296			98.8
105.5	40.8	1.4191	0.7458	294	99.6	84.86	14.98	$C_{21}H_{44}$	296	85.10	14.90	98.8
107.0	41.7	1.4191	0.7466	298	100.8			$C_{21}H_{44}$	296			98.8
114.2	45.7	1.4210										
116.7	47.1	1.4217	0.7513	330	111.2	84.75	14.91	$C_{23}H_{48}$	324	85.18	14.82	107.9
118.7	48.2	1.4221										
121.0	49.4	1.4226	0.7526	337	113.5			$C_{24}H_{50}$	338			112.6
126.5	52.5	1.4240										
127.5	53.0	1.4242										
128.0	53.3	1.4244	0.7558	357	121.2	85.31	14.75	$C_{25}H_{52}$	352	85.21	14.79	117.2
131.5	55.3	1.4252										
133.5	56.4	1.4257	0.7580	367	123.9			$C_{26}H_{54}$	366			121.8
137.2	58.4	1.4266	0.7607									
138.5	59.1	1.4269	0.7609	385	129.9			$C_{27}H_{56}$	380			126.3
144.2	62.3	1.4285	0.7642	410	137.7			$C_{29}H_{60}$	408			135.5
149.5	65.3	1.4297	0.7660	430	144.7	85.22	14.74	$C_{31}H_{64}$	436	85.32	14.68	144.7
156.0	68.9	1.4315	0.7687	456	153.7			$C_{32}H_{66}$	450			149.3
					PETROLATUM WAX							
159.7	71.0	1.4323	0.7706	474	159.6			$C_{34}H_{70}$	478			159.6
164.5	73.6	1.4333	0.7727	492	164.4	85.45	14.78	$C_{35}H_{72}$	492	85.36	14.64	163.2
166.7	74.8	1.4339	0.7739	502	168.9			$C_{36}H_{74}$	506			169.9
169.2	76.2	1.4347	0.7753	520	174.9			$C_{37}H_{76}$	520			172.4
170.7	77.1	1.4351	0.7759	539	181.3			$C_{38}H_{78}$	534			177.0
173.7	78.8	1.4359	0.7771	555	186.7	85.13	14.62	$C_{39}H_{80}$	548	85.40	14.60	181.6
177.2	80.7	1.4366	0.7784	572	192.3			$C_{41}H_{84}$	576			190.8
181.2	82.9	1.4375	0.7803	586	194.9			$C_{42}H_{86}$	590			195.4
182.7	83.8	1.4378		603		85.54	14.47	$C_{43}H_{88}$	604	85.43	14.57	200.0

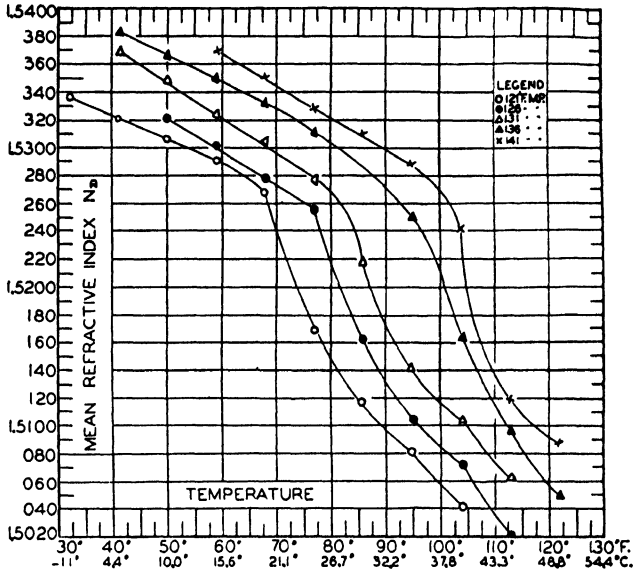
[1] Buchler & Graves, *Ind. Eng. Chem.* **19**, 725 (1927).

DATA ON PURIFIED (OIL-FREE) PETROLEUM WAXES (Continued)

Melting Point °F.	Melting Point °C.	n^{84}_{D}	d^{84}	Observed: Mol. wt.	Observed: Mol. refractivity	Observed: %C	Observed: % H	Formula	Calculated: Mol. wt.	Calculated: % C	Calculated: % H	Calculated: Mol. refractivity
						SLOP WAX						
132.2	55.7	1.4255		360		84.87	14.83	$C_{26}H_{54}$	366	85.23	14.77	
136.2	57.9	1.4263	0.7600	385	129.7			$C_{27}H_{56}$	380			126.3
138.5	59.2	1.4270										
139.0	59.4	1.4270	0.7614	394	133.0			$C_{28}H_{58}$	394			130.9
140.5	60.3	1.4275										
142.5	61.4	1.4280										
144.5	62.5	1.4284										
145.5	63.1	1.4287	0.7644	405	136.5	85.18	14.81	$C_{29}H_{60}$	408	85.29	14.71	135.5
148.5	64.7	1.4294										
150.5	65.9	1.4300	0.7677	431	145.1	85.19	14.74	$C_{31}H_{64}$	436	85.32	14.68	144.7
152.0	66.7	1.4303										
153.5	67.5	1.4306	0.7677	437	147.5			$C_{31}H_{64}$	436			144.7
156.0	68.5	1.4312	0.7684	451	152.1			$C_{32}H_{66}$	450			149.3
157.0	69.4	1.4316	0.7695	460	155.0			$C_{33}H_{68}$	464			153.9
160.0	71.1	1.4323	0.7706	470	158.1			$C_{33}H_{68}$	464			153.9
161.5	72.0	1.4327										
162.2	72.3	1.4329	0.7715	483	162.7	85.22	14.65	$C_{34}H_{70}$	478	85.35	14.65	163.1
168.0	75.6	1.4342	0.7741	508	171.6			$C_{36}H_{74}$	506			167.7
176.5	80.3	1.4365	0.7785	563	189.2			$C_{40}H_{82}$	562			186.1
182.0	83.3	1.4379	0.7810	600	201.8	85.21	14.65	$C_{43}H_{88}$	604	85.43	14.57	199.9
						ROD WAX						
165.0	73.9	1.4334	0.7728	493	165.9			$C_{35}H_{72}$	492			163.2
167.5	75.3	1.4340	0.7739	516	173.6	85.40	14.55	$C_{37}H_{76}$	520	85.38	14.62	172.4
169.5	76.4	1.4345	0.7743	524	176.4			$C_{37}H_{76}$	520			172.4
171.0	77.2	1.4349	0.7757	527	177.2			$C_{38}H_{78}$	534			177.0
172.7	78.2	1.4353	0.7761	545	183.3	85.38	14.68	$C_{39}H_{80}$	548	85.40	14.60	181.6
174.2	79.0	1.4358	0.7771	550	185.0			$C_{39}H_{80}$	548			181.6
176.7	80.5	1.4363	0.7780	569	191.3			$C_{40}H_{82}$	562			186.2
180.5	82.5	1.4372		575		85.39	14.60	$C_{41}H_{84}$	576	85.41	14.59	190.8

It has been found that the melting point of the wax has a profound effect upon its solubility in any given solvent. The higher-melting-point waxes are less soluble than those of lower melting point. The data given in the following table were determined with representative samples of the waxes in question.

MEAN REFRACTIVE INDEX OF COMMERCIAL PARAFFIN WAXES IN THE SOLID STATE[1]



SPECIFIC REFRACTION OF COMMERCIAL PARAFFIN WAXES IN THE LIQUID STATE

M.P. of Wax		n	d	Temp.	Mol. Wt.	Approx. Formula	r_D		
° F.	° C.			t° C.			At t°	At 20° C.	Calcd.
121	49.4	1.4349	0.7780	60	332	$C_{23.55}H_{49.1}$	0.3353	0.3343	0.3341
126	52.2	1.4352	0.7788	60	340	$C_{24.1}H_{50.2}$	0.3352	0.3342	0.3338
131	55.0	1.4355	0.7800	60	355	$C_{25.2}H_{52.4}$	0.3349	0.3339	0.3340
136	57.8	1.4370	0.7815	60	372	$C_{26.4}H_{54.8}$	0.3351	0.3341	0.3337
141	60.6	1.4294	0.7690	85	376	$C_{26.7}H_{55.4}$	0.3353	0.3337	0.3337

[1] J. M. Page, *Ind. Eng. Chem.* **28**, 856 (1936).

SPECIFIC REFRACTION OF COMMERCIAL PARAFFIN WAXES IN THE SOLID STATE[a]

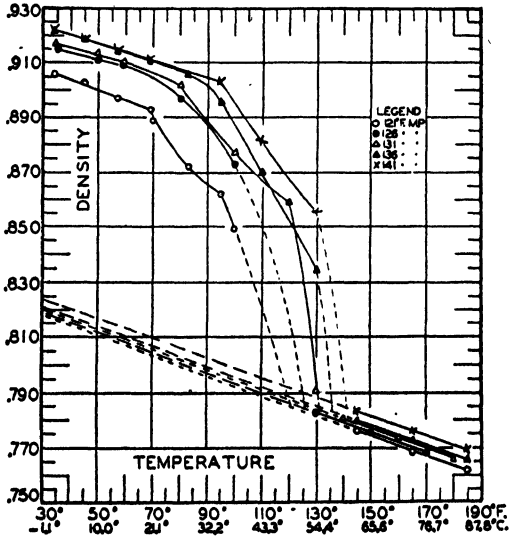
Temperature		n_D of Wax Melting at:				
° F.	° C.	121° F. (49.4° C.)	126° F. (52.2° C.)	131° F. (55.0° C.)	136° F. (57.8° C.)	141° F. (60.6° C.)
30	−1.1	0.3434	0.3405	0.3413	0.3400	.....
40	4.4	0.3429	0.3403	0.3410	0.3401	.....
50	10.0	0.3430	0.3401	0.3412	0.3403	0.3415
60	15.6	0.3437	.....	0.3410	0.3405	0.3414
70	21.1	.....	.....	0.3411	0.3405	0.3413
80	26.7	.....	.....	.....	.....	0.3414
100	37.8	.....	.....	.....	.....	0.3414

[a] Calculated from curves.

Light Sensitivity of Paraffin Wax

Paraffin wax, containing more than 0.1% oil, is unstable toward ultra-violet rays. Paraffin wax, treated with Fuller's earth and exposed to ultra-violet light, becomes light-stable.[1]

DENSITY OF COMMERCIAL PARAFFIN WAXES



[1] V. I. Shile, *Neftyanoe Khozyaistvo* **25**, 59 (1933).

TRUE DENSITY OF, AND VOLUME PER CENT AIR IN, SOLID COMMERCIAL PARAFFIN WAXES

M.P. of Wax		r_D at 20° C.	Temp.		n	d_1	d_2		Vol.
° F.	° C.		° F.	° C.	(Obsvd.)	(Obsvd.)	(Calcd.)	$d_2 - d_1$	% Air
121	49.4	0.3343	50	10.0	1.5306	0.900	0.925	0.025	2.7
			60	15.6	1.5289	0.897	0.922	0.025	2.8
126	52.2	0.3342	50	10.0	1.5321	0.911	0.927	0.016	1.8
			60	15.6	1.5297	0.909	0.924	0.015	1.7
131	55.0	0.3339	50	10.0	1.5348	0.912	0.932	0.020	2.2
			60	15.6	1.5323	0.909	0.928	0.019	2.1
136	57.8	0.3341	50	10.0	1.5366	0.917	0.934	0.017	1.9
			60	15.6	1.5347	0.914	0.931	0.017	1.9
141	60.6	0.3337	60	15.6	1.5366	0.914	0.935	0.011	2.3
			70	21.1	1.5344	0.911	0.932	0.011	2.3

Tensile Strength and Density of Paraffin Wax [1]

The tensile strength of paraffin wax increases rapidly from 30 to about 50° F., when it begins to fall off; a maximum is reached at about 0°. Cooling the wax from 15 to –6° over a period of 10 hours does not reduce the strain or flaws any more than rapid cooling. This decrease of tensile strength is due to tiny cracks. Above 30° the wax behaves like a plastic solid, because of liquefaction of some of the hydrocarbons. Below 25°, the density of paraffin wax is a linear function of temperature. If density is plotted against tensile strength, the curve is not linear. It is evident that the tensile strength and the density are affected by the nature of the crystal matrix formed, since paraffin wax is known to contain three types of crystals: plates, needles and macrocrystals. Occluded air in the way may also be a contributing factor.

SPECIFIC GRAVITY OF THREE PARAFFIN WAXES
(M.P. 60–130° F.)

Temperature		118.5° F. (48° C.)	123.2° F. (50.7° C.)	127.2° F. (52.9° C.)
° F.	° C.			
60	15.56	0.906	0.907	0.920
70	21.1	0.899	0.903	0.913
80	26.7	0.885	0.890	0.905
90	32.2	0.882	0.887	0.893
100	37.8	0.874	8.868	0.878
110	43.3	0.858	0.856	0.876
115	46.1	0.841	0.830	0.870
120	48.9	0.801	0.802	0.848
125	51.7	0.802	0.801	0.818
130	54.4	0.780	0.785	0.803

[1] W. F. Seyer and K. Inouye, *Ind. Eng. Chem.* **27**, 567 (1935).

Crystal Forms of Paraffin Wax

Certain paraffin waxes crystallize in two forms which differ in crystal symmetry, the less symmetrical form being nearly triclinic and the more symmetrical form monoclinic. The former exhibits, under the microscope, individual or twin crystals, whereas the latter shows needle-like crystals in a fibrous structure.[1]

Crystal Growth

Small amounts of Paraflow inhibit excessive growth of crystals and change the shape from the needle type to small equiaxial grains of uniform size.[2]

Transition Effects in Paraffin Wax[3]

When different temperatures are plotted against time, a minimum marks the melting point, a maximum the final solidification point, probably, and a second minimum in some waxes, a transition point at which internal forces modify the crystalline structure, with release of energy. This second minimum marks the maximum rate of change, that is, from the α- to the β-condition. Isoparaffins show no transition points. Some waxes exhibit no transition point unless cooling is rapid, others, none at all. Waxes, blended for a particular melting point, tend to be more homogeneous in structure and more stable in temperature change if they have no transition point. Translucency and a transition point accompany each other. The transition change leads to contraction in crystalline boundaries and this is unfavorable where wax is used to prevent the passage of water vapor, as in electric condensers, or waxed papers; it is an advantage, however, when the wax is to be molded.

The transition from needle-shaped prisms to rhomboid plates or leafy masses occurs at 10 to 15° below the melting point. The crystal form depends upon the solvent used, the rate of cooling and the wax used. Wax dissolves 7 to 15% of its own volume of air, at ordinary temperature.[4]

[1] Yannaquis, *Ann. combustibles liquidas* **9**, 295 (1934).
[2] G. H. B. Davis, *Nat. Petroleum News* **24**, 32 (1932).
[3] C. R. Scott-Harley, *J. Inst. Petroleum* **25**, 238 (1939).
[4] J. A. Carpenter, *J. Inst. Petroleum Tech.* **12**, 288 (1926).

Fibrous Paraffin Wax

Paraffin wax, after drawing by hand or extrusion through a die, is shown by its X-ray diffraction effects to have a distinct

HEAT CONTENT AND HEAT OF SOLUTION OF PARAFFIN WAXES (M.P. 110, 125, and 140° F., in Btu/lb) [1]

Temp. °F	Heat content of wax			Effective heat content of wax in solution			Heat of solution			Temp. °F.
	Melting point			Melting point			Melting point			
	110°	125°	140°	110°	125°	140°	110°	125°	140°	
0	−15	−13	−11	62	65	68	77	78	79	**0**
5	−13	−11	−9	65	68	71	78	79	80	5
10	−11	−9	−8	67	70	73	78	79	81	10
15	−8	−7	−6	70	73	76	78	80	82	15
20	−6	−5	−4	72	75	78	78	80	82	20
25	−3	−2	−2	75	78	81	78	80	83	**25**
32	0	0	0	78	81	84	78	81	84	32
35	+1	+1	+1	79	82	85	78	81	84	35
40	4	3	+3	82	85	88	78	82	85	40
45	7	6	5	85	88	91	78	82	86	45
50	10	8	7	87	90	93	77	82	86	**50**
55	13	11	9	90	93	96	77	82	87	55
60	16	13	11	92	95	98	76	82	87	60
65	19	16	13	95	98	101	76	82	88	65
70	23	19	16	98	101	104	75	82	88	70
75	27	22	19	100	103	107	73	81	88	**75**
80	32	27	22	103	106	109	71	79	87	80
85	38	31	25	105	108	111	67	77	86	85
90	44	36	29	108	111	114	64	75	85	90
95	51	42	33	111	114	117	60	72	84	95
100	60	49	38	113	116	119	53	67	81	**100**
105	73	57	43	116	119	122	43	62	79	105
110	119	65	49	119	122	125	0	57	76	110
115	121	76	55	121	124	127	0	48	72	115
120	124	90	62	124	127	130	0	37	68	120
125	127	130	71	127	130	133	0	0	62	**125**
130	130	133	81	130	133	136	0	0	55	130
135	132	135	94	132	135	138	0	0	44	135
140	135	138	141	135	138	141	0	0	0	140
145	138	141	144	138	141	144	0	0	0	145
150	141	144	147	141	144	147	0	0	0	**150**
160	146	149	152	146	149	152	0	0	0	160
170	152	155	158	152	155	158	0	0	0	170
180	157	160	163	157	160	163	0	0	0	180
190	163	166	169	163	166	169	0	0	0	190
200	169	172	175	169	172	175	0	0	0	**200**
220	181	184	187	181	184	187	0	0	0	220
240	193	196	199	193	196	199	0	0	0	240
260	205	208	211	205	208	211	0	0	0	260
280	217	220	223	217	220	223	0	0	0	280
300	230	233	236	230	233	236	0	0	0	**300**
320	243	246	249	243	246	249	0	0	0	320
340	256	259	262	256	259	262	0	0	0	340
360	269	272	275	269	272	275	0	0	0	360
380	282	285	288	282	285	288	0	0	0	380
400	295	298	301	295	298	301	0	0	0	**400**

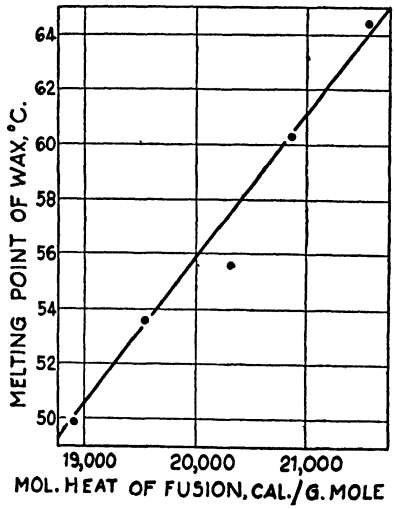
[1] *Thermal Properties of Petroleum Products*, U. S. Bureau of Standards, Pbl. 97, 45 (1929).

fiber structure. The fiber axis may have either of two crystallographic directions, depending on the conditions of formation, but, in both cases, the long axes of the paraffin molecules are perpendicular to the fiber axis.[1a]

Heat of Fusion

Paraffin wax of an average molecular weight of 400 has a molecular heat of fusion of about 21,000 calories.[1] Its latent heat of fusion ranges from 38.9 to 43.9 gram calories, increasing with rise of specific gravity, solidfying point and molecular weight.[2]

HEAT OF FUSION OF PARAFFIN WAX VS. MELTING POINT[3]



[1a] H. Rivsan, *Mem. Coll. Sci. Kyoto Imp. Univ.* **A19**, 279 (1936).
[1] Sakhanov, *Neffyanoe Slantsevoc Khoz.* **6**, 820 (1924).
[2] G. Von Kozicki, *Chem. Ztg.* **42**, 147 (1918).
[3] A. Bernę-Allęn and L. T. Work, *Ind. Eng. Chem.* **30**, 813 (1938).

MOLECULAR WEIGHTS AND ANILINE POINTS

ASTM Melting Point		Apparent Oil	Obsvd. Mol. Wt.	Aniline Point	Calcd. Mol. Wt.	Corresponding Hydrocarbon
° *F.*	° *C.*	%		° *C.*		
121	49.4	0.5	332	116.7	330	$C_{23.55}H_{49.1}$
126	52.2	0.5	340	117.8	342	$C_{24.1}H_{50.2}$
131	55.0	0.3	355	119.0	359	$C_{25.2}H_{52.4}$
136	57.8	0.3	372	121.0	370	$C_{26.4}H_{54.8}$
141	60.6	0.3	376	122.2	375	$C_{26.7}H_{55.4}$

The apparent poisson constant of paraffin wax is 0.50.

Electrical Properties

The electrical conductivity of paraffin wax rises to a maximum at 25° C., then falls to a minimum at 35° C., and again rises sharply at 40° C. In the softening zone (40–49° C.), paraffin behaves like amorphous polar substances. "B.P." paraffin wax has a conductivity of 0.00030 at 20° C.

Property Changes

Exposure of paraffin wax to oxidation (air or chemical) or high-frequency discharges reduces its hardness and lowers its melting point.

Preservation

Autoxidation of paraffin wax, at ordinary temperature, is slight and slow, and the products formed diffuse into the air before detection is possible. Small quantities of hydroquinone, malachite green, or sulfur prevent the oxidation. Paraffin wax is used for filling up spaces in explosives so that premature explosion does not occur; for converting explosives to a phlegm-like state so that they are less susceptible to shock; for protecting metals against powder and explosives; for coating papers and cartons used to protect fireworks against humidity and moisture.

Wetting

Paraffin wax is "wetted" with water containing 0.01% or more Saponin.

The addition of fatty acids lowers the interfacial tension of paraffin wax against water.[1]

Expansion

The coefficient of expansion by heat of solid paraffin wax is about 0.005108. Paraffin wax, obtained from lignite tar, has approximately the same coefficient of expansion but, in the molten state, the value is almost double. The variation of the specific gravity, in the case of solutions of paraffin in solvents of high density, would be expressed by the rule of mixtures, but, in the case of solvents of low density, one observes certain irregularities in the neighborhood of the point of fusion. The density of solutions, at temperatures above the fusion point of paraffin wax, may be approximately calculated by the rule of mixtures.[2]

Methods for Increasing or Decreasing Special Properties of Paraffin Wax

A. LENGTH—By length is meant ductility or the ability to distort wax without fracture. Paraffin waxes, in general, are quite brittle and must be compounded with appreciable quantities of an additive to improve them in this respect. Such additives should be quite miscible with paraffin wax such as microcrystalline waxes or petrolatum. The use of oil alone is not satisfactory since this renders paraffin waxes quite crumbly. If large amounts of rubber-like products, such as Vistanex, are used, the ductility of the wax can be improved somewhat. Other resins and hard vegetable waxes cannot be used for this purpose.

Microcrystalline waxes, on the other hand, are quite ductile in themselves and are more easily modified to improve this characteristic. Since microcrystalline waxes have an affinity for oil, their ductility can be improved by the incorporation of oil. A similar effect can usually be obtained with petrolatum. Most resins, unless they are of a soft type, tend to harden the wax rather than to make it more ductile.

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[1] Bhatnagar and Gardner, *J. Soc. Chem. Ind.* **39**, 185 (1920).
[2] Anon., *J. pétrole* **21**, 3 (1921).

B. Body or Viscosity—The body or viscosity of paraffin wax can be increased by incorporating a highly viscous material which is soluble, or partially soluble, in paraffin wax and forms a colloidal dispersion. Such materials are rubber, resins, metallic soaps, Vistanex, etc.

A decrease in viscosity can be obtained only by blending the wax with a material with which it is quite miscible and which has a lower viscosity than the wax in question. For example, the viscosity of a microcrystalline wax can be reduced by blending it with a paraffin wax or a low-viscosity mineral oil.

C. Adhesion—The adhesion or adhesiveness of a paraffin wax can best be increased by adding a resin which possesses some tackiness. The most commonly used resin, for this purpose, is rosin or one of its derivatives such as ester gum or hydrogenated rosin. The increase in adhesiveness is practically proportional to the quantity of additive employed. If the resin is too soluble in the wax, the effect on the adhesiveness is relatively slight. Frequently, the adhesiveness of a mixture of wax and rosin can be improved by the use of small amounts of oil which increase the ductility of the mixture.

D. Slipperiness—In order to increase the slipperiness of the wax, it is necessary to harden it with some additive. With microcrystalline waxes, this can be done best by the use of appreciable amounts of paraffin wax, or by adding materials which become insoluble when the wax solidifies. Such materials are carnauba wax or other vegetable waxes, various hard resins, and the like. With paraffin wax, the problem is much less complicated, since this wax, in itself, is quite hard and slippery. Small amounts of carnauba wax are usually quite effective in hardening the surface of paraffin wax. Sometimes, it is possible to increase slipperiness of paraffin wax by adding small amounts of oil which are generally repelled by the paraffin crystals and, therefore, lie on the surface as an oily film. Such mixtures, however, are usually objectionable due to an increased crumbliness and a loss in tensile strength.

E. Tensile Strength—The tensile strength of waxes is usually of importance only in the case of refined waxes. There are numerous additives which can be used to effect improvement

of tensile strength, but one of the most efficient is microcrystalline wax. Stearic acid and ozokerite are used for this purpose. It will be found that the tensile strength curve, for a blend of refined and microcrystalline waxes, is quite erratic and exhibits two maxima and one minimum. The maxima occur at about 5% and 25% of the microcrystalline wax, whereas the minimum is at about 10%. It should be mentioned, however, that the tensile strengths were determined, in this case, by a Perkins machine where the break results from a fairly rapid pull.

F. PENETRATION OR WETTING—Penetration or wetting properties of paraffin waxes are of interest only when they are in the molten condition. In such a condition, the waxes may be regarded as oils, so that additives, which are normally employed for oils to improve their wetting properties, will also work for the waxes. The list of oiliness agents is quite large, but the use of small amounts of fatty matter, such as stearic acid or high-titer glycerides, is a simple means of improving this characteristic. It will usually be found that 5% or less of these additives is all that is required to obtain maximum wetting properties. Excessive penetration, especially in paper, is prevented by the addition of carnauba wax or Acrawax C, which precipitate on cooling and form a solid barrier against liquid penetration.

G. WATERPROOFNESS—Practically any paraffin wax, when used as a continuous film, is moistureproof and waterproof. The main difficulty, however, is to maintain a continuous film. For example, if paper is coated with a brittle, refined wax to produce a continuous film, this film will be found to be practically impervious to moisture. However, the wax film will always be subjected to forces which tend to rupture it either by creasing the paper or by shock chilling. Cracks in the wax film serve as channels through which moisture can pass quite easily. The problem, therefore, is one of improving the ductility of the wax so that it will resist cracking or flaking. As a consequence, improvements in moistureproofness and waterproofness are related to improvements in ductility. It may be stated, however, that microcrystalline waxes are being used extensively today for improving waterproofness, which use results from their inherent ductility.

H. SHRINKAGE—Elsewhere curves will be found showing changes in the specific gravity of waxes with temperature. These changes are fundamental characteristics and cannot be modified appreciably unless large quantities of additives are used. In general, it can be stated that the higher-melting the wax, the greater will be its shrinkage on cooling from the liquid to the solid state. Conversely, the more closely the wax approaches an oil, the less will be its change in volume, on being cooled over the same temperature range. Sometimes, it is possible to improve waxes by adding materials which by themselves would exhibit little change over the critical temperature range, but the problem is, by no means, a simple one.

Paraffin Wax-Bitumen Data

Paraffin waxes, added to a series of bitumens,[1] lower the drop point; tube wax and especially ceresin raise it. Paraffins affect the Kraemer-Sarnow softening point variably, depending on the consistency of the bitumen; ceresins raise it, tube wax raises it very little or is without influence. The ring and ball softening point is lowered by paraffin wax but raised by ceresins and tube waxes. All three kinds of wax cut down the ductility of the bitumens. The paraffins, again, have a variable effect upon the penetration at 25°, but ceresins and tube waxes alike increase it. No influence upon hardening point or stability can be found with any of the waxes. As to sensitiveness to heat, the paraffin additions increase it, the ceresins and tube waxes reduce it. In general, the ceresins are beneficial in their influence, the tube waxes have the least effect and paraffin wax lowers the physical constants of the bitumens to which they were added.

Compatibility of Additives

Propionic and hydroxystearic acid, which are not compatible with paraffin wax, may be made compatible by dissolving them in a small amount of stearic acid.

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[1] V. T. Cerchez, *Mon. pétrole roumain* **39**, 1535 (1939).

Rendering Paraffin Wax Opaque [1]

Heat the wax, for example, paraffin wax, to a temperature of from about 5° F. to about 50° F. above its melting point, and introduce from about 0.2% to about 10% and preferably from about 0.5% to about 2% of the froth stabilizer [2] to the molten wax. The mixture is then cooled to a temperature within about 20° F. above its solidifying point, and the wax mixture vigorously blown with air, gaseous carbon dioxide, nitrogen or any other suitable gaseous medium. The wax may be allowed to solidify during the blowing. The occluded or dissolved air or gas, in the melted wax, forms minute bubbles when the wax solidifies which imparts to the wax a fine, glossy, opaque appearance. The presence of the froth stabilizer permits the reheating of the wax to a temperature above its melting point and retaining a greater portion of the minute bubbles on resolidification. A colloid mill or other mechanical device may be used to assist in producing the desired froth.

Opaque wax-coated paper and opaque candles may also be obtained by dissolving oxygen, air, carbon dioxide, or gaseous hydrocarbons, such as propane, butane, etc., in the molten wax under pressure, just before the wax is to be applied to the paper or to be poured into the candle molds. As the wax cools, the pressure is released. This causes the occluded gas to be effused from the wax, thus forming minute gas bubbles which are encased in the solidified wax and give the wax an opaque appearance.

For this purpose, the use of a liquefied, normally gaseous hydrocarbon is highly efficient. The liquefied, normally gaseous hydrocarbon, such as propane, butane, or mixtures thereof, may be dissolved in the wax under pressure. As the pressure is released, the liquefied hydrocarbons will vaporize, forming bubbles in the wax, and, at the same time, cool the wax to its solidification temperature.

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[1] U. S. Patent 2,185,046.

[2] Some froth stabilizers are alkaline sulfonic acid soaps, sodium stearate, alkyl xanthates, sodium and potassium soaps, higher fatty alcohols, ammonia and amine soaps.

This process of preparing oqaque waxes is usually applied to mineral waxes and paraffin waxes having melting points ranging from about 110° F. to about 160° F. Paraffin waxes having melting points ranging from about 120° F. to about 145° F. better resist breaking of the emulsion or foam on reheating. The air-wax mixture can be made by comminuting or powdering the wax and extruding or molding the product therefrom, preferably after it has been warmed and softened to a degree which will permit it to cohere. By incorporating a stabilizing agent, at the same time, the wax-air mixture may be remelted without destroying the opacity of the wax. Coloring matter, such as pigments and oil-soluble dyes may be added to the comminuted or emulsified wax to obtain any desired tint.

Rubber-Wax Compositions

Rubber is incorporated into hydrocarbon waxes, like paraffin wax or ozokerite, by first shredding or cutting it into very small pieces and adding it in controlled quantities to the molten wax while it is mixed slowly and continuously. The rubber swells and dissolves very slowly. Depending on the size of the pieces, temperature and type of mixing, the time of solution may be anywhere from hours to days.

Starting with a solution of rubber in a solvent, or rubber latex, the time of solution is considerably reduced, but then the solvent or water must be driven off.

Such compositions are very viscous and stringy when melted. Where this viscosity is undesirable, a non-viscous product may be made by using oxidized or depolymerized rubber. This type of composition is attacked much less by benzol, fats and oils and does not absorb odors as readily as the usual rubber-wax compositions.[1]

Hardening Wax

In paper coating, where paraffin wax is used for waterproofing, certain waxes are melted with paraffin to prevent excessive penetration and to stiffen the finished paper. Waxes, which

[1] Lanigan, U. S. Patent 2,322,242 (1943).

are soluble in hot paraffin wax and insoluble below the latter's setting point, are used, e.g., carnauba wax or Acrawax C.

Microcrystalline Waxes

The designations of microcrystalline and amorphous waxes are now being used synonymously although the former is a more accurate designation. These waxes differ from refined paraffin wax in that their crystal size and structure are different and in that they are tougher, more flexible and have higher tensile strengths and melting points. They are also more adhesive, and less lustrous and greasy. They bind solvents, oils, etc., much better than paraffin wax and thus prevent their sweating-out of compositions.

It should be noted in general that:

1. High penetration value and/or high refractive index are indicative of flexibility.
2. Waxes with high penetration values generally have more "tack."
3. Flexibility is not a function of melting point.
4. Oil content influences flexibility only to a limited degree.

PHYSICAL PROPERTIES OF SOME MICROCRYSTALLINE WAXES

Properties	Brands				
	Quaker State Micro Wax	Barnsdall Special Wax	Syncera Wax	Soconv # 2300	Be Square Special
Melting Point ° F.	145–146	160–165	155–160	155	160–185
Specific Gravity at 60° F.	0.900–0.920	0.920–0.940	0.912	...	0.92–0.94
Specific Gravity at 210° F.	0.780–0.800	0.800–0.820	...	...	...
Viscosity at 210° F. (Saybolt)	75–85	75–100	51	65	75–100
Flash Point ° F.	500 min.	500 min.	425	495	500
Fire Point ° F.	575 min.	575 min.	...	550	575
Saponification No.	0.05–0.10	< 2	0	...	< 2
Acid No.	0.1 max.	0.1–0.2	0	...	0.1–0.2
Iodine No.					1.5
Color	white to amber	white to amber	yellow	yellow-brown	white-black
Penetration No (ASTM) (Petrolatum method –77° F.; 100 g wt.)	...	5–10	...	20–25	5–20

PROPERTIES OF COLWAXES

COLWAX	#15	#21	#29	#58	#68	#70	#71	#85	#87	#89
Melting Point (Drop Method) ° F.	175–177	180–182	189–191	185	189–191	180–185	170–175	175–180	160–165	145–150
Softening Point ° F. (ASTM E28–39T)	170–175	177–181	187–191	185–190	185–190	170–175	160–165	170–175	140–145	130–135
Specific Gravity @ 60° F.	.93–.94	.93–.94	.93–.94	.93–.94	.93–.94	.92–.93	.88–.90	.88–.90	.88–.90	.88–.90
Solubility in Carbon Tetrachloride	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Penetration— 100 g—5 sec 77° F.	55–65	31–37	6–12	30–40	8–12	10–25	10–25	15–30	15–30	15–30
Viscosity @ 210° F. (Saybolt Universal) sec	60–90	90–120	125–150	75–100	75–100	50–75	50–75	50–75	40–65	40–65
Flash Point (C.O.C.) ° F.	355–380	420–450	585–610	475–500	475–500	435–460	425–450	425–450	410–435	410–435
Fire Point (C.O.C.) ° F.	400–415	460–500	660–685	600–625	600–625	485–510	470–495	465–490	445–470	445–470
Iodine Number— Honus Maximum	4.0	4.0	4.0	2.5	4	.5	.5	.5	.5	.5
Saponification Number—Maximum	2.0	2.0	2.0	2	2	1.0	1.0	1.0	1.0	1.0
Acid Number— Maximum	1.0	1.0	1.0	.5	1.0	.5	.5	.5	.5	.5
Ash %	1.0	1.0	1.0	.5	.7	.2	.2	.2	.2	.2
Sulphur %	.25	.25	.25	.1	.2	.1	.1	.1	.1	.1
Color	Brownish Black	Brownish Black	Brownish Black	Brown	Brownish Black	Amber	Amber	Amber	Amber	Amber

PHYSICAL PROPERTIES OF MICROCRYSTALLINE (AMORPHOUS) WAXES

NAME or GRADE	ASTM Penetration @ 77° F.	Refractive Index @ 80° C.	ASTM Melting Point Drop Method	Oil Content	Flexibility Room Temperature	Flexibility @ 34° F.	Flexibility @ 20° F.	Taste	Odor @ 200° F.	REMARKS
Benowax C	21	1.4508	140.2	4.01—3.99	Good	Good	Good	Bad	Burnt	Very Sticky
Micro Wax— Dark Amber	22	1.4491	145.4	1.26—1.56	Good	Good	Good	Poor	Oily	
Micro Wax— White	23	1.4451	146.2	0.66—0.93	Good	Good	Good	None	None	
Standard Oil Syncera— 145/50 Orange	19	1.4341	146.4	....	Good	Brittle	....	Good— Very Little	Slight	Hard
Standard Oil Syncera— 145/50 Yellow	17	1.4330	146.4	0.88—1.06	Good	Brittle	....	Good— Very Little	Slight	Hard
Standard Oil Syncera— 155/60 Yellow	19	1.4382	155.8	....	Brittle	....	....	Good	Slight Oily	Hard
Aristowax 160/65	14	1.4362	160.4	2.53—2.55	Brittle	....	....	None	Slight Propane	
Deep Rock— 160 Lemon Pale	33	1.4480	161.2	11.19—10.87	Good	Fair	Brittle	Poor	Kerosene	Mealy Texture
Wadhams 2305	31	1.4461	162.7	5.40—5.27	Good	Good	Good	Poor	Slight Oily	Sticky
Standard Oil Superla— 165/70 Yellow	12	1.4446	165.8	....	Brittle	....	....	Good	Slight	
Wadhams Petrosene A	23	1.4448	167.8	8.61—8.01	Good	Brittle	....	Good	Slight Oily	
Barnsdall 160/65 Amber	16	1.4481	176.2	6.76—6.56	Good	Brittle	....	None	Good	
Barnsdall 160/65 Plasticized to 32° F.	24	1.4500	177.0	....	Good	Good	Good	None	Good	
Barnsdall 160/65 Plasticized to 40° F.	21	1.4500	177.4	....	Good	Brittle	....	None	Good	
Barnsdall 160/65 Plasticized to 50° F.	17	1.4500	178.1	....	Good	Brittle	....	None	Good	

CROWN WAXES

Color	Black
Melting Point	190° F. min.
Penetration at 77° F. 100 g 5 sec	10 max.
Color	Amber
Melting Point	200° F. min.
Penetration at 77° F. 100 g 5 sec	5 max.
Odor	None

GEM WAXES

Color	From Amber 5 N.P.A. to Yellow 2 N.P.A.
Melting Point	185° F. min.
Penetration at 77° F. 50 g 5 sec	20 min.
Odor	None

PEARL WAXES

Color	From Amber 5 N.P.A. to Yellow 3 N.P.A.
Melting Point	180° F. min.
Penetration at 77° F. 50 g 5 sec	30 min.
Odor	None

Uses of Microcrystalline Waxes

Potting compounds for condensers; insulating (electrical) compound base; waterproofing paper, box-board, textiles, leather, wood, etc.; laminating paper, cloth, etc.; rubber compounding; slushing compounds; auto top dressings; polishes; pattern making (sheets and fillets); binder for pipe coverings; filler for packings; molding wax base.

Miscibility of Various Additives with Microcrystalline Waxes

Microcrystalline waxes are now being employed for a wide variety of purposes. In many applications, it is essential to know their miscibility with various resins and other additives. In the course of work on one specific problem, the solubilities of a number of products in Petrosene C (microcrystalline wax) were determined on a semi-quantitative basis. Table #1 presents data indicating the solubility-temperature relationship for

these mixtures. In all cases, 10% of additive was employed so that no attempt was made to determine the maximum limits of solubility. It is expected that the solubility of any resin, in paraffin wax, will be greater than in Petrosene C, and that in other microcrystalline waxes will be of the same order of magnitude as for Petrosene C. Table #1 is divided into two sections, one listing the additives soluble up to 10% in Petrosene C, at all temperatures above its melting point, and the second listing those which are insoluble or only partially soluble.

MISCIBILITY OF VARIOUS ADDITIVES WITH PETROSENE C (MICROCRYSTALLINE WAX)

Percentages Used: Petrosene C—90%; Additive—10%.

A. *Additives Completely Miscible Above and at Melting Point:*

Product	Product
1. Cumar Resin P-25	10. Chromium Oleate
2. Amberol—Grade ST-137	11. Diglycol Stearate
3. Opalwax 10	12. Lead Linoleate
4. #1 Singapore Damar Gum	13. Copper Stearate
5. Batavia Damar A/D	14. Manganese Naphthenate
6. #1 Singapore Damar Gum	15. Manganese Resinate
7. Santo-Resin	16. Calcium Stearate
8. Burgundy Pitch	17. Zinc Stearate
9. Calcium Stearate	

B. *Additives Insoluble or Partially Miscible:*

Product	Limit of Miscibility, ° F.
1. Cumar Resin V 1½	Above 250
2. Cumar Resin P-70	Above 240
3. Cumar Resin MH 1½	Above 230
4. Amberol M-16	At least above 300
5. Amberol M-82	At least above 300
6. Resin XR9517	Above 270
7. Resin BR8900	Above 230
8. Residuum Pitch	At least above 300
9. Acacia Gum	At least above 300
10. Gum Arabic	At least above 300
11. Gum Kauri	At least above 300
12. Cobalt Linoleate	At least above 300
13. Nuba #2	At least above 300
14. Nubalene Resin	At least above 300
15. Nuba #3	At least above 300
16. Resin #465	At least above 300
17. Nuba #1	At least above 300
18. Cobalt Resinate	At least above 300
19. Aluminum Oleate	At least above 300
20. Aluminum Naphthenate	At least above 300
21. Calcium Oleate	At least above 300

Microcrystalline Wax (Bareco Wax) Blends [1]

Blends were prepared by heating the components together on a water bath until melted, then stirring until solidification took place. Melting points were determined by the capillary method. Open capillaries were used. They were filled with equal amounts, immersed in the water bath to a uniform depth and heated at the same rate for all determinations. The temperature at which the material began to flow, under the hydrostatic pressure, was taken as the melting point.

TABLE I

Melting Points of White Petrolatum Blended with Varying Percentages of Bareco 160 Wax

Per Cent Wax	Per Cent Petrolatum	Melting Point
0	100	110
1	99	112
2	98	116
3	97	119
4	96	121
5	95	122
10	90	134
15	85	140
20	80	144
25	75	148
30	70	150
35	65	152
40	60	154
100	0	168

All melting points given in this and the following tables are in degrees Fahrenheit.

TABLE II

Melting Points of Anhydrous Lanolin Blended with Varying Percentages of Bareco 160 Wax

Per Cent Wax	Per Cent Anhydrous Lanolin	Melting Point
0	100	106
1	99	108
2	98	110
3	97	112
4	96	120
5	95	126
10	90	146
20	80	156
100	0	168

TABLE III

Melting Points of Lard Blended with Varying Percentages of Bareco 160 Wax

Per Cent Wax	Per Cent Lard	Melting Point
0	100	92
1	99	94
3	97	98
5	95	120
10	90	134
20	80	154
100	0	168

TABLE IV

Melting Points of White Petrolatum with Varying Percentages of White Beeswax

Per Cent White Wax	Per Cent Petrolatum	Melting Point
3	97	110
5	95	112
10	90	115
20	80	119
100	0	124

TABLE V

Melting Points of White Petrolatum with Varying Percentages of Yellow Beeswax

Per Cent Yellow Wax	Per Cent Petrolatum	Melting Point
3	97	112
5	95	114
10	90	122
20	80	129
100	0	142

[1] Ice & Harris, *J. Am. Pharm. Assoc.*, Apr. 1943.

The Bareco 160 petro-wax used had the following properties:

Specific gravity at 60° F.	0.92–0.94
Specific gravity at 212° F.	0.80–0.82
Melting point (ASTM D-127-30)	160–165
Saybolt universal viscosity, 212° F.	75–100
Flash, C. O. C.	Above 500° F.
Color	White
Iodine number	Less than 1
Saponification number	Less than 2
Acid number, maximum	0.1
Ash	Trace
Odor	None
Taste	None
Penetration at 77° F.	15/25

Specific Gravities of Microcrystalline Waxes at Various Temperatures

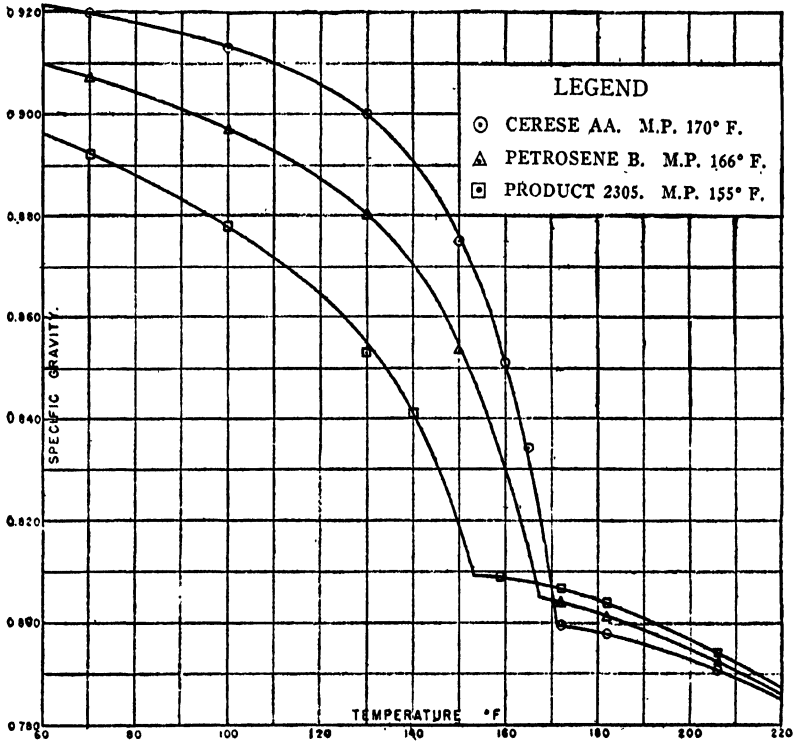
When most compounds solidify, i.e., pass from the liquid to the solid state, a contraction occurs and their specific gravities exhibit a rapid change. This is a characteristic of the microcrystalline waxes which has a bearing on their performance in many applications. Examples are in the impregnation of electrical or other equipment where voids are filled with molten wax. It is frequently essential to determine what contraction will occur upon solidification so that adjustments may be made to avoid loss in waterproofing value. In addition, it may be necessary to determine what volume a given quantity of solid wax will occupy when melted and heated to a definite temperature.

In order to obtain this information, representative samples of microcrystalline waxes were held at definite temperatures and their specific gravities measured. The data so obtained are given in the following graphs. For this purpose, Cerese Wax AA, Petrosene B, and Product 2305 were chosen. These are the intermediate colored waxes in each of the three series. Since the other waxes differ from these only with respect to color, their specific gravities may be considered to be comparable. Due to slight variations from batch to batch, other samples of any wax will probably show slight variations from the figures noted. However, based upon the available data, it is not expected that these variations will exceed 0.005, except for samples of widely

different melting points, in which case, the greatest divergence will be at temperatures near the melting point.

It is interesting to note that, in the solid condition, Cerese Wax AA has the highest specific gravity, whereas in the molten state, it has the lowest. This is, of course, caused by its lower oil content and greater paraffinicity. This phenomenon is further borne out by the fact that, at all times, Petrosene B is intermediate between Product 2305 and Cerese Wax AA.

SPECIFIC GRAVITIES OF MICROCRYSTALLINE WAXES



Viscosity of Microcrystalline Waxes

The viscosity of microcrystalline waxes, when melted, is greatly lowered by small additions of ordinary paraffin wax.

Petrolatum Wax

Petrolatum (mineral jelly), freed from its liquid and semi-liquid hydrocarbons, provides an amorphous, white, translucent, plastic wax. It is commercially available under the name of Protowax or Fybrene. Its plastic and non-crystalline properties make it very useful. It also has good oil-holding capacity and prevents leakage or sweating out of oils. Thus, it can replace ceresin and ozokerite, where their low melting point is not undesirable.

PROPERTIES

	Fybrene Wax White	Fybrene Wax Olive
Specific Gravity @ 60° F.	0.896–0.899	0.896–0.899
API Gravity	26.0–26.5	26.0–26.5
ASTM Melting Point ° F.	128–133	130–135
ASTM Consistency (Method D-217)	50–85	30–50
ASTM Consistency (Method D-5)	150–300	75–200
Flash Point ° F.	460–470	460–470
Fire Point ° F.	520	520
Saybolt Vis. @ 210° F.	50–55	50–55
Color	White	Olive Green
Ash, %	0.03	0.03
Saponification Number	0.3	0.3

Ozokerite (Imported)

Ozokerite is an amorphous hydrocarbon wax occurring naturally, in the earth, in Poland, Austria, Russia, Utah, and Texas among other places. It occurs in Miocene formations, near petroleum deposits. It is separated from earthy matter by melting in boiling water and then drawing off the upper wax layer. The crude wax is purified by treatment with sulfuric acid and bleaching earth to obtain lighter colored products.

The commercial grades of ozokerite are:

1. Unbleached (Black).
2. Single bleached (Yellow).
3. Double bleached (White).

Ozokerite is characterized by its excellent absorbing properties for oil, grease and certain solvents. In this respect, it is superior to paraffin wax which tends to crystallize from admixture and allows fluid components, present in the composition, to

"sweat" out. It is waterproof, alkali and acid resistant, only fuming sulfuric and concentrated nitric acids attack it. Low temperatures do not make it as brittle as paraffin wax. It is not as slippery as paraffin wax and actually has a slight "tack." It becomes harder on aging. It is less resistant to actinic rays than paraffin wax. Ozokerite sets more rapidly and shrinks more than beeswax. To offset these properties Venice turpentine, or another plasticizer, is often added.

The chemical constitution of ozokerite is not definitely known. It appears to be a mixture of solid saturated and unsaturated hydrocarbons of high molecular weight, with some liquid hydrocarbons and oxygenated bodies.

PROPERTIES

Melting Point	149–176° F.
Specific Gravity	0.85–0.95
Acid No.	0
Saponification No.	0
Iodine No.	7.8–9.2
Sulfur	0.2%
Ash	0.16%
Color	White, Yellow, Green, Black
Refractive Index (60° C.)	1.440
Dielectric Constant	2.37–2.55
Effective A.C. Conductivity	10–24
Volume Resistivity	7–40
Penetration at 77° F. (100 g, 5 sec)	14

Soluble in: Benzine, benzol, turpentine, kerosene, toluol, xylol, mineral spirits, carbon disulfide, isopropyl ether, trichlorethylene.

Insoluble in: Ethyl and methyl alcohols.

SOLUBILITY OF OZOKERITE

Solvent	Grams of Ozokerite [1] Dissolved by 100 g Solvent
Carbon Bisulfide	12.99
Petroleum Ether, boiling up to 75° C.	11.73
Turpentine, B.P. 158–166° C.	6.06
Xylene, B.P. 135–143° C.	3.95
Toluene, B.P. 108–110° C.	3.83
Chloroform	2.42
Benzene	1.99
Ethyl Ether	1.95

[1] Pawlewski and Filemonewicz, *J. Chem. Soc.*, Abstr. 82, 1889.

Adulterations

Ozokerite is often adulterated with paraffin wax to reduce its cost (see Ceresin). It is also sophisticated with carnauba wax, resins and asphaltum to increase its melting point or hardness.

OZOKERITE-PARAFFIN BLENDS

Yellow Ozokerite, Melting Point 75° C. } mixed with { Paraffin Wax, Melting Point 50° C.

Proportions					New Melting Points ° C.
4	Ozokerite	1	Paraffin	Wax	73.5
4	"	2	"	"	71.7
4	"	3	"	"	**70.5**
4	"	4	"	"	69.7

White Ozokerite, Melting Point 75.7° C. } mixed with { Paraffin Wax, Melting Point 58.3° C.

Proportions					New Melting Points ° C.
4	Ozokerite	1	Paraffin	Wax	74.4
4	"	2	"	"	73.2
4	"	3	"	"	72.5
4	"	4	"	"	72.0

Uses: High-grade candles, colored lead pencils, for finishing off the heels and soles of shoes, shoe polishes, electrical insulation, acidproof coatings for electrotypers' plates, waxing floors, acidproof bottles, waterproofings, cosmetics.

American Ozokerite

American ozokerite is now produced in large quantities and of qualities equal to the imported. Mid-continent * (Oklahoma, etc.) stocks (long fiber) of 135 to 150° F. melting point are used as starting material. By centrifuging, a very plastic grade, melting up to 165° F., is obtained. By vacuum distillation, harder grades, melting up to 220° C., are produced. The latter are bleached to obtain the so-called American, white ozokerite. The latter differs from the plastic grade in being free from oil and color.

* Pennsylvania and Gulf stocks are far less suitable.

PENETRATION DATA ON AMERICAN OZOKERITE

M.P. 145–180° F.	12–17	M.P. 185–220° F.	3–5

These figures are obtained with a penetrometer at 77° F., using a 100 g weight for 5 seconds.

Ceresin

Ceresin originally was a purified ozokerite. For economic reasons it was adulterated with paraffin wax to reduce its cost. Today commercial ceresin contains 50 to 80% paraffin wax. Some European ceresins also contain rosin and coloring to make it approach the properties of beeswax.

Commercial ceresin varies in color from yellow to white and in melting points from 130 to 170° F., depending on its purity. Its properties of hardness, plasticity, etc., also vary with its purity. Those grades containing large percentages of ozokerite naturally approach ozokerite in its properties.

PROPERTIES
(High Grade Ceresin)

Melting Point	130–175° F.
Specific Gravity	0.88–0.92
Acid No.	0
Saponification No.	0–1
Iodine No.	7–10
Color	White, Yellow
Rrefractive Index	1.4416–1.4465
Dielectric Constant	2.15–2.33
Effective A.C. Conductivity	1–12
Volume Resistivity	$400 > 900$

Soluble in the same solvents as paraffin wax.

Utah Wax

An amorphous mineral (ozokerite-type) wax from Utah. It is obtainable in a number of grades varying in hardness, melting point, and color.

PROPERTIES
(Crude)

Melting Point	73° C.	Acid No.	0
Cloud Point	76° C.	Saponification No.	0
Iodine No.	< 1	Sulfonation Residue	100%

MEASUREMENTS OF HARDNESS BY PENETROMETER WITH STANDARD NEEDLE, 100 GRAM WEIGHT, 15 SECONDS TIME

Temperature ° C.	Penetration in mm	Temperature ° C.	Penetration in mm
20	0.43	50	2.2
30	0.64	60	3.8
40	1.27		

A comparison of these figures with similar measurements of most other waxes shows that Utah wax is softened less by any given increase in temperature.

Dielectric Strength: In excess of 30,000 volts across a 1/10" General Electric standard gap. Retains a high value when melted. Dielectric Constant: (or permitivity) 2.03. Power-Factor: 0.03. Resistivity: 36,000,000 megohms across a 1 cm cube. Coefficient of Expansion: (volume) 0.001 per degree Centigrade between 10–50° C.

Solubility: Slightly soluble in most organic solvents when cold. Solubility increases rapidly upon heating, rendering Utah wax highly soluble in practically all commercial organic solvents, with the exception of methanol, ethyl alcohol, glycol, and glycerin. It is most easily dissolved in carbon bisulfide.

Solutions, made by heating, retain a fluid character when cooled, if the concentration of wax is not too high. Otherwise, they set into pastes or gels of the non-sweating variety.

Uses: Dance-floor wax, floor and furniture polishes, linoleum polish, shoe polish, leather dressings, rubber goods, candles, wax figures, carbon paper, wax bottles, waxed paper, electrical insulation, waterproofing fabrics, impregnation of wood, electrotypers' molding compound, pattern-makers' wax, waxing artificial flowers, wax crayons, salves and face creams.

Montan Wax

Montan wax is a hard, brittle, lustrous wax extracted from lignites, principally in Central Europe. The crude wax is dark brown and the refined wax is of a yellowish color. The so-called white montan wax is a mixture of refined montan wax with paraffin wax.

Chemically, montan wax consists of monohydric alcohol esters and high-molecular-weight acids.

PROPERTIES

Melting Point	72–92° C.
Specific Gravity	1.00
Acid No.	15–85
Saponification No.	58–89
Unsaponifiables	3.5–45%
Iodine No.	7.75
Acetyl No.	11.2
Color	Tan, Brown
Dielectric Constant	2–68
Effective A.C. Conductivity	25–55
Volume Resistivity	270–630

Soluble in: Benzol, carbon tetrachloride, chloroform, dichlorethylene, isopropyl ether, naphtha, tetralin, toluol, trichlorethylene, turpentine, xylol.

Montan wax solutions set more slowly than carnauba wax solutions and, therefore, should be filled into containers at a lower temperature. Pure montan wax can scarcely be scratched by the finger nail. It breaks with a conchoidal fracture. It is a good solvent (when melted) for basic dyes and shows good wetting and flow in oil solutions. It is the hardest of the natural non-vegetable waxes and is fairly resistant to oxidation.

The bleached or highly refined wax loses some of the above characteristics, becoming softer and less easily emulsifiable.

Uses: In place of carnauba wax in many compositions because of its hardness, toughness, high melting point and emulsifiability; polish, rubber, printing-ink.

VEGETABLE WAXES

Botanical Origin of Waxes[1]

Palm Tree Waxes	Palm
Carnauba	Raffia
Ouricury (Uricury)	Cacoa

[1] Ivanowsky, *Oil & Colour Trades J.*, p. 918, Dec. 20, 1940.

Shrub, Cane and Grass Waxes
- Candelilla
- Rhimba
- Ocoxilla
- Banana
- Esparto
- Flax
- Hemp
- Cottonseed
- Kapok
- Cane
- Bamboo Leaf
- Coffee Berry
- Tea
- Opium
- Japan
- Bayberry
- Ocuba
- Apple
- Plum
- Rose
- Jasmine

Ficus and Tree Waxes
- Godang
- Cow Tree

Root Parasite Wax
- Blanophore

Solubility of Vegetable Waxes

True vegetable waxes are soluble in most fat solvents such as chloroform, ether or toluol, but are less soluble than fats. Since they contain no glycerides they do not form acrolein on heating. They do not usually become rancid, like fats and are less easily hydrolyzed than the latter. They can, however, be decomposed by prolonged heating with alcoholic potash. Because of the high molecular weight of their fatty acid components, their saponification numbers are lower than those of fats. They are also characterized by very high amounts of unsaponifiable constituents. The latter consist of sterols and higher saturated alcohols which usually occur as esters.[1]

Carnauba Wax (Palm Wax)

Carnauba wax occurs as a fine powder on the leaves of certain tropical palms. Most of it is produced in Brazil. The leaves are removed from the palm, dried in the sun, and then, the powdery wax is brushed and scraped off and placed in vats of boiling water. The wax melts and floats to the top from which it is skimmed off. This crude wax, containing foreign matter, is

[1] Hass, *Chemistry of Plant Products*, 4th Edition, p. 45. (New York, Longmans, Green Co., 1928.)

dirty yellow, brown, or green in color. It is refined by remelting in water and removing foreign matter. Specially purified grades are produced by treatment with bleaching earths, chemicals, etc. The so called white carnauba wax is a highly refined grade, containing some paraffin wax.

The commercial grades of carnauba wax, as sold in the United States, are:

No. 1 Yellow
No. 2 Yellow
No. 2 North Country
No. 3 North Country
No. 3 North Country, Refined
No. 3 Chalky

The first is the purest and lightest in color. Going down, the other grades progressively are darker and less pure.

Carnauba wax contains varying amounts of water. The refined grades contain from ½ to 1½%. The chalky grade usually contains 5% and some samples have tested up to 11%.

Carnauba wax is amorphous, hard, tough, lustrous and possesses a pleasing odor. It breaks with a clean fracture. Chemically it is composed of a mixture of hydrocarbons, higher alcohols and their esters, and possibly lactones with a smaller amount of inorganic matter. Its exact composition is not yet known. It is saponified by strong alkalies. It is the hardest, highest-melting, natural, commercial wax, except for some crude grades of ouricury wax. It is added to other waxes to increase melting point, hardness, toughness, and luster and to decrease stickiness, plasticity and crystallizing tendencies.

PROPERTIES

Melting Point	184–196° F.
Specific Gravity (15° C.)	0.990–0.999
Acid No.	4–9
Saponification No.	78–87
Unsaponifiable Matter	52–55%
Iodine No.	13.1–13.5
Acetyl No.	51–60
Color	Yellow, Green, Gray, Brown
Refractive Index (60° C.)	1.463
Dielectric Constant	2.67–4.20
Effective A.C. Conductivity	250–310
Volume Resistivity	0.5–4

Soluble in: Hot alcohol, benzol, carbon tetrachloride, ether, dioxane, chloroform, trichlorethylene, isopropyl ether.

Uses: Candles, polishes, lubricants, greases, floor and automobile waxes, insulating materials, carbon paper, chalk, matches, soaps, salves, phonograph records, plastics, cosmetics, protective coatings, paper coating.

The addition of large percentages of cumarone resins to carnauba wax increases its resistance to fracture (toughness) and makes it stringy when melted.

The melting point of carnauba wax is raised 3° C. by the addition of 1% Acrawax. Its flexibility is increased by the addition of 2% or more of B-Z wax, microcrystalline paraffin wax, or oleic acid.

Carnauba wax, dissolved in mineral oil, wets pigments and other insoluble particles quite well—better than most oils. Although the carnauba wax-oil mixture possesses good wetting properties, it sets rapidly (in thin layers) and does not penetrate rapidly into paper, textiles, etc. Solutions of carnauba wax precipitate more readily than other natural waxes on addition of non-solvents. Evaporation of solutions of carnauba wax produces non-continuous powdery layers rather than films.

Properties of Brazilian Grades of Carnauba Wax

In Brazil there are, at present, seven types of carnauba wax, known as: (1) flower, (2) first, (3) medium clear, (4) medium purple, (5) "cauipe," (6) sandy, (7) fat.

"Flower" Wax

The "flower" type exists in a small quantity, hardly appearing in export lists, it is the best quality, with hardly any impurities. In color it is almost the same as the yolk of an egg.

Wax	99.32%	Iodine No.	22.6
Moisture	0.48%	Melting Point	84° C.
Impurities	0.20%		

"First" Wax

The "first" type varies in color from dark to light with an insignificant percentage of impurities.

Wax	99.65%	Iodine No.	24.3
Moisture	0.35%	Melting Point	83° C.
Impurities	0.00%		

"Medium" Wax

The "medium" type is generally of a uniform color, varying from light yellow to light grey, according to the age of the tree and the processes to which it is submitted.

Wax	99.53%	Iodine No.	21.6
Moisture	0.42%	Melting Point	83° C.
Impurities	0.00%		

"Sandy" Wax

The "sandy" type, varying in color from light to dark grey, is rough to the touch.

Wax	97.16%	Iodine No.	16.7
Moisture	1.09%	Melting Point	86° C.
Impurities	1.75%		

"Fat" Wax

The "fat" type is the darkest, being almost black and containing a large percentage of impurities. It is the lowest type. When it is taken from the palm leaves, it is melted to drive off moisture.

Wax	96.91%	Iodine No.	16.00
Moisture	0.59%	Melting Point	85° C.
Impurities	2.50%		

Candelilla Wax

Candelilla wax occurs as a coating on a weed (Pedilanthus pavonis), growing in northern Mexico and southern Texas. The plant is treated with boiling water to melt the wax which is skimmed off. The wax can also be extracted by solvents such as benzine. The crude wax is brown in color and is bleached by sunlight (in thin sheets) or by chemical methods.

The commercial, refined wax is hard, brittle and lustrous and has an aromatic odor. Different grades and shipments exhibit varying degrees of stickiness (on pressure, in solution, and in compositions).

Chemically, candelilla wax is composed of a high proportion of hydrocarbons and resins with a smaller amount of lactones.

PROPERTIES

	Standard	Double Refined
Melting Point	149–156° F.	158–162° F.
Specific Gravity (15° C.)	0.982–0.993	.....
Acid No.	11–19	19.6
Saponification No.	46–66	58.6
Iodine No.	15–36	37.8
Ester Value	.....	39.0
Ash	.....	0.05%
Moisture	.....	0.73%
Unsaponifiable Matter	65–67%	
Color	Gray–Brown	
Refractive Index	1.4555	
Odor	Aromatic	
Moisture	Small Percentage	
Dielectric Constant	2.50–2.63	
Effective Conductivity	19	
Volume Resistivity	120	

Candelilla wax is not quite as hard as carnauba wax and does not emulsify or saponify as readily. The commercial wax often contains a small amount of water which should be driven off, by heating, before using it in non-aqueous compositions. It is very slow in setting, in melted compositions, and often does not reach maximum hardness for a few days. Its stickiness varies with its degree of refinement; different lots showing a variation. Mineral waxes and Acrawax C reduce its stickiness but increase the aging and setting time. It is a good solvent for basic dyes. Additions of oleic or similar acids slow down crystallization and rapidly increase softness. It does not blend well with ouricury wax.

Soluble in: Acetone, carbon tetrachloride, chloroform, turpentine, petroleum (forms a gel on cooling hot solutions in these solvents); alcohol-benzine (2:3 mixture).

Uses: In leather dressing, furniture and shoe polishes, candles, cements, varnishes, sealing wax, electrical insulating com-

positions, phonograph records, paper size, celluloid, rubber; in waterproofing and insect-proofing containers; in paint removers, as a soft wax stiffener, and as a substitute for carnauba wax and beeswax.

Japan Wax

Japan wax is obtained from the berries of certain sumac trees in Japan and China. The berries are aged, crushed and, after the removal of the husks, are crushed again in heated presses to obtain a crude, green, soft wax. It is then refined by melting in hot water, skimming, and bleaching by means of sunlight. The two best known brands are Kitagumi and Chickusan. This wax is often adulterated with varying amounts of local vegetable oils.

Japan wax is not hard but tough, malleable and sticky. It has a tallowy odor and becomes rancid, effloresces and darkens on aging. It breaks easily and the broken surfaces are dull in luster.

Chemically, Japan wax is a fat (glyceride) and is composed of palmitin, palmitic and other high molecular weight fatty acids and their glycerides.

It contains 5.2 to 6.3% (sometimes 7.1%) of dibasic acids of which one having the formula $C_{23}H_{44}O_4$ is predominant. Dibasic acids probably occur in Japan wax as mixed glycerides with oleic acid.

PROPERTIES

Melting Point	122–133° F.	(48–53° C.)
Specific Gravity	0.975–0.984	(0.975–0.992)
Acid No.	6–20	(18–20)
Saponification No.	216–236	(217–230)
Unsaponifiable Matter	1–1.5%	.....
Iodine No.	4–16	(4.5–15)
Acetyl No.	27–31.2	.....
Ratio No.	.....	(10–11)
Hehner No.	.....	(89–91)
Reichert-Meissl No.	.....	(1–3)
Ash	0.02–0.08%	.....
Refractive Index (60° C.)	1.450	.....
Dielectric Constant	3.1–3.2	.....
Effective A.C. Conductivity	33–34	.....
Volume Resistivity	0.4–0.8	.....

It is readily saponified by alkali to give an emulsion.

When Japan wax is melted and allowed to solidify, its specific gravity and melting point are lower. On aging, however, these constants tend to the normal standard values.

Soluble in: Alcohol, carbon disulfide, chloroform, ether, benzol, petroleum ether, carbon tetrachloride, isopropyl ether, naphtha, pyridin, tetralin, toluol, xylol, trichlorethylene, turpentine.

Uses: Wax matches, polishes, creams, substitute for beeswax, as an ingredient in the manufacture of special soaps, laundry glazes, textile finishes, and metal drawing lubricants.

Ucuhuba Wax (Ucuhuba Butter, Ucuhuba Resin, Ucuhuba Tallow)

This wax is obtained from the ucuhuba plant, which grows in Brazil. It is of a yellowish color and of the consistency of butter. An analysis is given below:

	%
Moisture	19.380
Albuminous Substances	11.409
Ether Extract	10.0
Cellulose	3.162
Ash	5.520
Non-Nitrogenous Substance	50.529
Phosphorus—P_2O_5	1.552

PROPERTIES

Melting Point	45° C.
Solidifying Point	40° C.
Saponification No.	219–221
Iodine No.	9–14
Acidity	17.5
Non-Saponifiable Matter	3.2

Bayberry Wax (Myrtle Wax, Laurel Wax, Bayberry Tallow)

Bayberry wax is obtained from the berries of the myrica shrubs on the Atlantic coast of the United States. The berries

are heated in water until the wax melts. The latter is then skimmed off and purified by remelting and filtering.

Commercial bayberry wax is a greenish white, fatty material, more unctuous and brittle than beeswax.

Chemically, bayberry wax is really a fat consisting of stearin, palmitin, myristin and olein (glycerides).

PROPERTIES

Melting Point	102–120° F.
Specific Gravity	0.875–0.980
Saponification No.	206–217
Iodine No.	1.9–3.9
Color	Green–White
Odor	Faint
Taste	Bitter

Saponifies readily with alkali solutions.

Soluble in: Alcohol and turpentine (only slightly).

Uses: In candles, soaps, ointments, etc.; polishing leather; etching; and medicinals.

Ouricury Wax (Uricury Wax)

Ouricury wax is a substance obtained from the exudation of the leaves of a palm called "ouricury," which grows in the northeastern states of Brazil. The wax has chemical characteristics similar to those of carnauba wax. Ouricury wax, however, has a higher resin content, is more soluble in common solvents, has a lower fusion point, and has higher iodine and saponification numbers than carnauba wax. It is not compatible with certain waxes. On melting with other waxes, a resinous precipitate is formed. Its setting point (72–73° C.) is lower than that of carnauba wax (79–80° C.).

It differs from other vegetable waxes in that there is a lag of about 12° between its melting and setting points. Most vegetable waxes only show a lag of 5 to 6°.

Some grades of this wax contain as much as 18% foreign matter, which must be removed by filtering. Double-refined ouricury wax contains a much smaller amount of resin and foreign matter.

PROPERTIES

Melting Point	83–85° C.
Specific Gravity (15° C.)	0.970
Acid No.	5.5–10
Saponification No.	79–242
Iodine No.	8.6–12.8
Ester No.	73–92.5
Color	Brown

Uses: As a substitute for carnauba wax in floor waxes, shoe polishes, miscellaneous polishing products, candles, etc.

Cocoa Butter (Cacao Butter, Oil of Theobroma)

Cocoa butter is a fatty material obtained from roasted cocoa beans, principally as a by-product of chocolate manufacture.

It is a yelowish white, greasy solid of a faint, agreeable odor and a bland, chocolaty taste. It is brittle below 25° C. It consists principally of glycerides of stearic, palmitic, oleic, lauric acids and other lower fatty acids.

PROPERTIES

Melting Point	30–35° C.
Specific Gravity (100–25° C.)	0.858–0.864
Saponification No.	188–195
Iodine No.	35–40
Refractive Index (40° C.)	1.4537–1.4578
Reichert-Meissl No.	0.1
Polenske No.	0.2

Soluble in: Benzol, benzine, chloroform, ether and hot, anhydrous alcohol.

Uses: Cosmetics, pharmaceutical ointments, suppositories.

Fiber Wax (Esparto Wax, Reed Wax)

Fiber wax is a dark tan wax obtained from certain reeds and grasses (alfa and esparto grass) grown in Spain and North Africa. It is somewhat similar to candelilla wax but is less brittle and harder. When melted, it smells like decomposed

straw. It has a grain structure, but much less pronounced than that of carnauba wax. When melted and cooled slowly, the surface is very smooth and flat. It contracts much less than carnauba wax. The purified commercial grade has an average melting point of 75.3° C.

Fiber wax contains about 65 to 70% hydrocarbons of the formula $C_{31}H_{64}$.

PROPERTIES

Melting Point	75–77° C.	(61.2–74° C.)
Specific Gravity	0.978–0.994	(0.965–0.989)
Acid No.	23.9–30.2	(16.5–34.4)
Ester No.	40.6–45.9	.....
Saponification No.	64–69.8	(61.4–75.7)
Iodine No.	15.0–19.2	(13.2–15.3)
Unsaponifiable Matter	16.8%	(66–72)
Ash	0.4–0.6	.....
Color	Brown	.....

Fiber wax gives good wetting and penetrating properties in oil compositions and softer films than carnauba wax. It is a better solvent for basic dyes than carnauba. It can be plasticized by the addition of small amounts of amorphous waxes or oils.

Uses: Replaces carnauba wax in polishes, shoe-finishes, etc.

Cotton Wax

Cotton wax is obtained from the so-called green cotton, in Arkansas, by solvent extraction. It is a hard, yellow, high-melting wax.

PROPERTIES

Melting Point	83–85° C.	(76–80° C.)
Specific Gravity	0.902	(0.9760–1.005)
Saponification No.	2.5	(50–76)
Acid No.	6.7	(21–28)
Iodine No.	12.75	(20–27)
Acetyl No.	.....	(48–83)
Unsaponifiable Matter	.....	(57–68%)
Acetyl No. of Unsaponifiable Matter	.....	(115–124)

Flax Wax

PROPERTIES

Melting Point	67–70° C.	(67.3–69.5° C.)
Specific Gravity	0.971–0.985	(0.936–0.985)
Saponification No.	78–83	(78.4–83.7)
Iodine No. (Hanus)	21–28	(21.6–28.8)
Acid No.	18–23	(17.5–23.8)
Unsaponifiable Matter	70–80%	(20%)

After Distillation with Super-Heated Steam

Saponification No.	70
Acid No.	33
Iodine No.	18

Sugar Cane Wax

Sugar cane wax is obtained from the filter-press cake or mud, which is a by-product of sugar manufacture from sugar cane. The crude wax is sticky, dark, and odorous. The refined wax contains some phytosterols having a melting point of 132° C. It is a little harder and less sticky than beeswax. If most of the fatty components are removed (e.g., by solvent extraction) a product about as hard as candelilla wax is obtained.

PROPERTIES

Melting Point	68–80° C.	(82° C.)
Specific Gravity	0.963–0.985	(0.961–0.984)
Saponification No.	27–135	(40–57)
Acid No.	9.6–23.4	(4–12)
Iodine No.	19.8–31.5	(12.4–16.2)
Aectyl No.	55–95	(55–95)

The wide variation in the above constants is due to varying grades of purity, the higher figures refer to the pure and bleached wax.

SOLUBILITY OF SUGAR CANE WAX [1]

Solvent	%
Skelly-Solve B	0.67
Skelly-Solve C	0.71
Shell #8206	0.82
Shell #8182	0.73
Shell #8196	0.78
Benzol	1.06
Naphtha	0.73
Hexane	0.61
1,2-Dichloroethylene	> 2.00
Cyclohexane	1.30
Methylhexane	0.93
Dioxane	0.29
Isopropyl Ether	0.52
Ethylene Dichloride	0.60
1,1,2,2,-Tetrachloroethane	0.87
Trichloroethylene	> 2.00
Butyl Chloride	1.17
Carbon Tetrachloride	1.24
Benzene	1.04
Toluene	1.43
Acetone	0.11

Nitroethane, nitromethane, and 95% ethanol form gels at room temperature and dissolve less than 2% wax at boiling point.

ANIMAL WAXES

Spermaceti (Cetin; Cetaceum)

Spermaceti is obtained from the cavities in the head and from the fat of the sperm whale. The sperm oil is chilled and the precipitated crude spermaceti is filtered off and refined by boiling with dilute caustic soda solution, separated and washed with hot water until free from alkali. The melted, refined product is run into molds and allowed to crystallize.

Commercial spermaceti is white (translucent), shiny, somewhat greasy, brittle and crystalline. It has a faint odor and a

[1] R. T. Balch, *Sugar J.* **4**, No. 6, 24 (1941).

bland taste. Chemically, it is composed of cetyl palmitate, cetyl alcohol, and esters of high-molecular-weight fatty acids.

PROPERTIES

Melting Point	107–120° F.	(41–52° C.)
Specific Gravity	0.945–0.960	(0.895–0.920)
Acid No.	0.5–1.1	(0.1–0.5)
Saponification No.	122–129	(118–135)
Unsaponifiable Matter	51–54	(47–55)
Iodine No.	2.5–3.9	.....
Acetyl No.	2.7	.....
Color	White (translucent)	
Refractive Index (60° C.)	1.440	.....
Dielectric Constant	6–18	.....
Effective A.C. Conductivity	> 500	.....
Volume Resistivity	0.0006–0.0003	.....
Viscosity at 100° C.	.....	(6.7–7.4)
Fatty Acids	.....	(49–54)

Spermaceti is partially saponified by aqueous alkalies and forms emulsions.

Soluble in: Boiling alcohol, ether, chloroform, carbon disulfide, fixed and volatile oils.

Uses: Cosmetics and ointments.

INSECT WAXES

Beeswax (White Wax, Cera Alba; Yellow Wax, Cera Flava)

Beeswax is produced by the honey bee in the Americas, Africa, Europe, and elsewhere for building its honeycomb. The latter is melted and filtered, or boiled with water and then skimmed off, to obtain a crude wax. The crude wax is refined by remelting and filtering with subsequent solvent extraction or bleaching with chemicals or sunlight. Beeswax produced by wild bees is considered better than that produced by domesticated bees, particularly for use in cosmetic creams.

Crude beeswax varies in color from a deep brown to a light

yellow. The color is dependent upon the type of flower from which the bee has procured the pollen, the age of the hive and the care the hive has been given. Generally speaking, the light yellow crudes are of better quality for the reason that they can be bleached by natural processes. Crude beeswax, when it comes in, is thoroughly washed, which process is known as refining. The resultant refined wax is cast into approximately one-ounce squares, one-pound bricks, and twenty-five-pound slabs, ready for market. Wax to be bleached is shredded by a mechanical process so that the maximum surface of the wax is exposed to the sun. These shavings are then put out into trays where, after a period of exposure to the sunlight, they turn to a white color. The wax is then washed, cast into round, one-ounce discs, one-pound bricks, or twenty-five-pound slabs, ready for use.

The specifications of U.S.P. beeswax are as follows: Melting point 61 to 65° C.; acid No. 16 to 23, ester No. 72 to 79, saponification No. 85 to 101.

Beeswax is often sophisticated with different types of adulterants, including mineral matter. Among others, tallow, stearic acid, Japan wax, carnauba wax, rosin, paraffin wax and ceresin are the important adulterants. The purity of beeswax is tested, as of other waxes, by the ratio of the ester No. to the acid No. Even this value is not reliable if taken by itself. Wax-like mixtures can be obtained which, although free from beeswax, can be made to have the normal ratio, as for example, a mixture obtained by melting together 37.5 parts of Japan wax, 6.5 parts of stearic acid, 6.5 parts of paraffin or ceresin wax. In buying the material, therefore, the safest course is to buy it from a reliable and recognized firm.

Beeswax, mixed with ceresin and some aromatic resins, is used for preparing artificial beehives used for rearing bees in Europe.

Commercial beeswax is supplied in slabs or cakes in the following grades:

1. Crude
2. Refined
3. White, bleached

Chemically, beeswax is composed of myricyl palmitate, cerotic

and homologous acids with small amounts of hydrocarbons, cholesterol esters and ceryl alcohols, pollen and resins. The presence of resins, in undue amounts, renders bleaching difficult. The free fatty acid content is an important factor in emulsifiability.

PROPERTIES

Melting Point	145–158° F.
Specific Gravity	0.952–0.975
Acid No.	16.6–20.7
Saponification No.	90–96
Unsaponifiable Matter	52–56%
Iodine No.	4–12
Acetyl No.	15.1
Ester No.	72–78
Ester-Acid Ratio	3.6–4.3
Color	White, Yellow, Brown
Refractive Index (75° C.)	1.4398–1.4451
Odor	Honey
Dielectric Constant	3.1–3.3
Effective A.C. Conductivity	70–86
Volume Resistivity	0.9–1.5

When beeswax is heated to 150 to 250° C., the acid No. decreases, while the ester No. and saponification No. increase. Continued heating causes reesterification or estolide formation with decrease of ester and saponification Nos.

Beeswax has an aromatic taste and does not adhere to the teeth or become pasty when chewed. It is plastic, when kneaded by the hand, but hard and breaks with a snap when it is bent in the cold.

Soluble in: Benzol, benzine, carbon tetrachloride, chloroform, dioxan, isopropyl ether, tetralin, turpentine, and in hot amyl alcohol and acetone. It is partially soluble in cold ether and hot alcohol. It mixes with fats, oils, resins and other waxes when melted with them. It is easily saponified by alkalies.

Uses: Candle making, adhesive compositions, dressing and polishing leather, modeling fruits and waxes, wax polishes and finishes, transparent papers, pomades, toilet preparations, cosmetics, base for plasters, etc., in medicine, engraving and lithography, sizing and finishing textiles, chewing gums, food products, sweetmeats.

CONSTANTS OF DIFFERENT GRADES OF BEESWAX

	Specific Gravity at 15° C.	Melting Point ° C.	Acid No.	Saponification No.	Ester No.	Ratio No. (ester No. divided by acid No.)	Unsaponifiables %
Yellow Beeswax (Cera Flava)	0.958–0.970	62–64.0	17–23	87.0–97	70–80.0	3.3–4.0	50–56
White Beeswax (Cera Alba)	0.958–0.970	62–64.0	18–24	90.0–102	70–80.0	3.3–4.0	50–56
Extraction Beeswax (Unbleached)	0.953–0.957	61–62.5	23–27	92.0–95	66–70.5	2.4–3.0	50–56
Extraction Beeswax (Bleached)	0.970–0.984	69–72.5	22–30	91.5–104	69–77.5	2.5–3.3	50–56

Chinese Wax (Insect Wax)

Chinese wax is deposited on the branches of a species of ash tree, in China, by certain insects. The wax is scraped off and refined by melting in hot water, skimming off, remelting, filtering and bleaching, if necessary.

Chinese wax is fairly hard, shiny, fibrous, crystalline, and yellowish white in color.

Chemically, it is composed of ceryl cerotate and minor amounts of other esters.

PROPERTIES

Melting Point	149–176° F.
Specific Gravity	0.926–0.970
Acid No.	3–13
Saponification No.	80–92
Unsaponifiable Matter	49–50%
Iodine No.	1.5–2
Color	Yellow-White
Odor	Very Faint
Taste	Very Faint
Refractive Index (40° C.)	1.4566
Dielectric Constant	3.65–3.90
Effective A.C. Conductivity	190–210
Volume Resistivity	0.04–0.18

Soluble in: Alcohol and ether (slightly). In benzol, isopropyl ether, toluol, xylol, trichlorethylene (completely).

Shellac Wax

Shellac wax is a by-product in the production of alcoholic solutions of shellac. It precipitates out of such solutions, as a haze or sludge, and is filtered off and dried.

The commercial product is a hard, tough, brown, lustrous wax containing some shellac and impurities. It approaches carnauba wax in hardness and luster.

PROPERTIES

Melting Point	74–78° C.	(74–80° C.)	82° C.
Specific Gravity	0.971–0.980	(0.974–0.982)	0.972 (20° C.)
Acid No.	12–16	(10.9–25)	1.2
Saponification No.	120–126	(79–85)	46.7
Unsaponifiable Matter	72–76%	(68–72%)	.....
Ratio No.	.....	(7–8.6)	.....
Ester No.	.....	.....	45.5
Iodine No.	.....	.....	1.25
Volatile Matter at 105° C.	.....	.....	0.2–0.4
Ash	.....	.....	0.12

CHAPTER II

MANUFACTURED AND SYNTHETIC WAXES

FATTY ALCOHOLS

CETYL ALCOHOL

Commercial cetyl alcohol is obtained by "splitting" sperm oil or spermaceti, or by the reduction of cetyl palmitate or palmitic acid.

PROPERTIES

Melting Point	45–50° C.
Specific Gravity (15° C.)	0.810
Boiling Point	334° C.
Iodine No.	< 3
Acid No.	0
Saponification No.	0
Unsaponifiable Matter	98–100%
Ash	0
Refractive Index (60° C.)	1.4345
Color	White
Form	Crystalline
Heat of Fusion (Cal./Mol.)	8900

Cetyl alcohol is now obtainable as an odorless and tasteless product that is stable to alkali, acid, light and air. It is a good solvent for basic dyes.

Soluble in: Alcohol, benzol, carbon disulfide, ether, glycol ethers, fats, mineral and vegetable oils.

Uses of Cetyl Alcohol

Cetyl alcohol is an emulsifier for water-in-oil type of emulsions. It has the property of causing particles of water to adhere mechanically thereto, and when it is thus incorporated in viscous

materials, such as petrolatum or hydrogenated oils, it will tend to stiffen the mixture, creating an emulsion containing a larger percentage of water than would otherwise be possible.

Examples

Petrolatum alone will only take up 9 to 15% of water. The addition of about 4% of cetyl alcohol will permit the absorption of 39 to 52% of water.

A mixture of 4% cetyl alcohol, 10% lanolin, and 86% petrolatum is able to take up 82 to 108% of water.

1% of cetyl alcohol more than doubles the water absorbing power of hydrogenated peanut oil, 75% of water being taken up without cetyl alcohol, 170% being absorbed with it.

The addition of 3% of cetyl alcohol to lard increases the amount of water absorbed from 8 to 245%.

Emulsions of the water-in-oil type, with large proportions of water, naturally are less stable than those containing less water, but cetyl alcohol usually has a beneficial effect upon the stability of these emulsions when it is used as an addition to the standard formulae, wherein it will act as an auxiliary emulsifying agent.

The proportions of cetyl alcohol to be incorporated in various types of water-in-oil emulsions will, as a rule, range from 1 to 5%, depending on the individual formula.

Since it acts to promote water-in-oil type emulsions in conjunction with inert materials, cetyl alcohol cannot alone produce the reverse, i.e., oil-in-water emulsions. However, its oil-soluble hydrocarbon radical, when used with standard emulsifying agents, such as soaps, lauryl sulfates, and wetting agents, is very useful in giving body and stability to oil-in-water emulsions, in general, and creams and lotions specifically.

Example

A mixture of equal parts of mineral oil and water, containing about 1% of soap, will soon separate into two, more or less distinct layers; the addition of about 2% of cetyl alcohol (dissolved in the oil) will make a thick, creamy emulsion which will show only slight separation, on long standing.

Although, the stabilizing action is most marked in lotions, the inclusion of a small amount of cetyl alcohol will definitely stabilize brushless shaves, vanishing creams, etc. Approximately 1% is usually sufficient, and here again, it may be stated that cetyl alcohol acts as an auxiliary emulsifying agent.

Because of its ability to become hydrated and to assist the hydration of other components, larger amounts of cetyl alcohol may make a cream softer and more translucent. From ½ to 1% may be added without noticeably altering the physical appearance of the product, but still increasing stability. Properly incorporated, cetyl alcohol will also cause a cosmetic cream to rub out more smoothly on the skin, as a result of the finer dispersion of emulsified ingredients.

"Lanette" Wax

"Lanette" wax is a mixture of cetyl and stearyl alcohols.

"Lanette" wax SX is a mixture of cetyl and stearyl alcohols with a neutral emulsifier.

"Lanette" wax ester consists of mixed palmitic acid esters of cetyl and stearyl alcohols.

"Lanette" wax extra consists of higher fatty alcohols plus free saponifiable fatty acid.

PROPERTIES

Melting Point	50° C.
Specific Gravity	0.81
Acid No.	0
Saponification No.	0
Ester No.	0
Acetyl No.	180–190

Soluble in: Alcohol, benzol, ether.

"Lanette" wax, with soap, sulfonated oils, aromatic sulfonic acids, or other emulsifiers, acts as a stabilizer for emulsions. "Lanette" wax extra, with diluted alkali or soap, acts as an auxiliary emulsifier, particularly for paraffin and ceresin wax emulsions.

"Lanette" wax SX is neutral, melts at about 60° C. and is, by itself, an emulsifying agent. It disperses in hot water. On

cooling, this dispersion thickens or gels. Secondary emulsifiers or stabilizers, such as glue, gelatin, methyl cellulose or gum arabic, are used with it to give increased stability in emulsions. If "Lanette" wax SX is heated above 100° C., it tends to lose its dispersing properties. Small amounts of this wax are said to give better tensile strength and elasticity to varnish films. When it is blended with lanolin, absorption bases are formed which can absorb large amounts of water. Certain drug and cosmetic emulsions, made with this wax, are more stable to weak acids such as boric, carbolic and salicylic acids. It is also more stable to mild oxidizing and reducing agents than soap.

Technical Stearyl Alcohol (Octadecanol; "Stenol")

A white solid wax-like product; mixture of fatty alcohols, stearyl alcohol predominating.

PROPERTIES

Melting Point	54–57° C.
Specific Gravity	Approx. 0.85
Distillation Range	300–375° C.
Hydroxyl No.	Approx. 215
Calculated Mol. Wt.	Approx. 260
Iodine No.	<2

It is practically free from acids and esters.

FATTY ACIDS

Stearic Acid

Commercial stearic acid is not a chemically pure compound, but a mixture of fatty acids in which stearic acid predominates.

Stearic acids are chiefly produced from saponified and distilled animal fatty acids. These fatty acids are usually composed of approximately 60% liquid acid and 40% solid acid. The bulk of the liquid acids are separated from the solid acids by hydraulic pressing. From the first pressing is obtained single pressed stearic acid, from the second pressing double pressed stearic

acids and from the third pressing triple pressed stearic acids. Each successive pressing removes an additional quantity of liquid fatty acids, thereby increasing the purity and quality of the resulting solid stearic acid. The liquid acids present are chemically unsaturated, and the solid acids saturated.

The stearic acid of commerce is frequently called stearin (stearine). This is a misnomer as stearin, chemically, is a glyceride of stearic acid.

PROPERTIES AND COMPOSITION OF COMMERCIAL STEARIC ACIDS

	Single-Pressed	Double-Pressed	Triple-Pressed
Titer	52.2–53.0° C.	53.5–53.9° C.	54.6–55.2° C.
M.P. (Open Tube)	52.8–53.6° C.	54.1–54.5° C.	55.2–55.8° C.
Iodine No. (Wijs)	10–14	7–9	2–4
F.F.A. (As Oleic)	103–104%	104–105%	104–105%
Acid No.	205–207	207–209	207–209
Saponification No.	207–209	208–210	208–210
Unsaponifiable Matter	0.50–0.60%	0.20–0.30%	0.10–0.20%
Average Mol. Weight	272–274	269–272	269–272
Specific Gravity 60°/15°	0.853	0.855	0.857
Flash Point	400° F.	400° F.	405° F.
Fire Point	430° F.	425° F.	425° F.
Unsaturated Content	12–16%	8–10%	2–4%
Lovibond Color—Max.	16 Y–3.0 R	4 Y–1.0 R	2 Y–0.5 R
Lovibond Color—Min.	5 Y–0.6 R	2 Y–0.2 R	1 Y–0.1 R
Myristic Acid Composition	1–3%	1–3%	1–3%
Palmitic Acid	47–48%	49–50%	46–47%
Stearic Acid	28–33%	34–37%	46–48%
Palmitoleic Acid	Trace	Trace	Nil
Oleic Acid	12–16%	8–10%	2–4%

Soluble in: Alcohol, ether, chloroform, carbon bisulfide, carbon tetrachloride, methanol, pyridin.

The acetyl number should be close to 0.0. There should be very little spread between iodine and thiocyanogen numbers as no doubly unsaturated acids are present.

PROPERTIES OF PURE STEARIC ACID

Melting Point	69.3° C.
Iodine No.	0.0
Acid No.	197.5
Refractive Index (80° C.)	1.4300
Specific Gravity (69.3° C.)	0.847
Boiling Point	232° C. (15 mm)
Molecular Weight	284.28
Dipole Moment (25° C.)	0.77

Palmitic Acid

Chemical and Physical Properties

Average chemical and physical properties of commercial palmitic acid compared with the constants for pure palmitic acid are as follows:

	Commercial Palmitic Acid	Pure Palmitic Acid
Chemical Formula	.....	$C_{15}H_{31}COOH$
Mean Molecular Weight	258.0	256.25
Melting Point	58.0° C.	62.85° C.
Iodine No. (Wijs)	3.0	None
Neutralization No.	216.0	219.0
Unsaponifiable Matter	0.5%	None
Dipole Moment (25° C.)	.....	0.77; 1.75 [1]
Color	White	White
Odor	Trace	None
Composition:		
Palmitic Acid	90.0%	.....
Oleic Acid	4.0%	.....
Stearic Acid	6.0%	.....
Approximate weight per U. S. gallon	.....	7½ lb

[1] Bhattacharya, *Indian J. Phys.* 16, 396 (1942).

Palmitic acid occurs naturally as the glyceride in various vegetable and animal fats and oils. It is a hard, crystalline substance lying between myristic and stearic acids in the saturated fatty acid series.

Uses: The metallic salts of palmitic acid are of particular interest in paints, varnishes, lacquers, inks, etc. Aluminum palmitate is one of the best thickening, suspension and flattening agents known. Zinc and calcium palmitate also find many applications in this field.

By mixing palmitic acid with myristic acid or with lauric acid, low-titer, completely saturated fatty acid mixtures can be obtained which are particularly suitable for preparing oxygen-stable greases.

The mono- and di-glycerides are good emulsifying agents, in creams, lotions, brushless shaving compounds, etc. The sodium or potassium soaps are also useful for this purpose as normal changes in temperature do not materially influence their solubility.

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Dipole Moment (25° C.)	.....	0.77; 1.75 [1]
Color	White	White
Odor	Trace	None
Composition:		
Palmitic Acid	90.0%	.....
Oleic Acid	4.0%	.....
Stearic Acid	6.0%	.....
Approximate weight per U. S. gallon	.....	7½ lb

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Myristic Acid

Myristic acid is found as the glyceride in vegetable oils and fats, in varying, sometimes rather small, percentages; e.g., in peanut oil, coconut oil, and some less accessible raw materials. By splitting the raw vegetable oils and submitting the fatty acids to a fractional vacuum-steam distillation, sometimes combined with fractional crystallization, filtration, and deodorization, a fairly pure myristic acid is obtained.

Myristic acid is a hard, crystalline, fatty acid, ranging in color from white to light brown, according to purity. The faint odor of the technical grades is very agreeable, somewhat resembling that of ionone or sweet peas. Special requirements sometimes call for a practically odorless or colorless product, which can be obtained at an increased cost.

PROPERTIES

	Pure	Technical
Formula	$C_{13}H_{27}COOH$	.....
Purity	100	Approx. 80% Myristic Acid
Acid No.	246.1	237–243
Saponification No.	246.1	240–246
Iodine No. (Hanus)	0	7–13
Titer	.....	42–46
Melting Point	53.8° C.	.....
Specific Gravity	$0.8622\frac{54°}{4°}$; $0.8584\frac{60°}{4°}$	0.869 at 50° C.
Refractive Index	$n\frac{60}{d} = 1.43075$; $n\frac{76}{d}.5 = 1.4218$	.....
Molecular Refraction	68.77	.....
Dipole Moment (25° C.)	0.77	.....
Combustion Heat	g Cal./g = 9.34; kg Cal /Mol. = 2084.4	.... ..
Boiling Range	196.5° C. at 15 mm; 250.5 at 100 mm	Approx. 220–230 at 20–30 mm
Color	White	Light Straw
Odor	None	Characteristic, Mild
Weight per Gallon	.....	Approx. 7¼ lb

Technical Myristic Acid is composed of:

Lauric Acid	Approximately 10%
Myristic Acid	" 80%
Palmitic-Stearic Acid	" 5%
Oleic Acid	" 5%

Soluble in: Acetone, benzol, carbon tetrachloride, hexane, methyl alcohol, ethyl alcohol, butyl alcohol, methyl cellosolve, butyl cellosolve, o-dichlorobenzene, etc., and most other hydrocarbons, alcohols and solvents of similar composition. Insoluble in water.

Distilled Fatty Acids

Mixed fatty acids are offered in many grades. Below are given data on a number of such products.

Type	Titer ° C.	F.F.A.	Iodine No.
Animal #1 Grade	40–42	100–102	50–60
Animal #2 Grade	38–39	99–100	50–60
Animal #3 Grade	35–37	98–99	60–70
Cottonseed	34–37	98–100	90–100
Coconut	22–25	128–130	14–16
Myristic	41–44	118–121	8–10
Soya bean	22–26	96–100	130

FATTY ACID SOLUBILITIES

The fatty acids are, in general, more soluble than the glycerides. They are very soluble in ether and soluble in chloroform, carbon tetrachloride, carbon disulfide, aromatic hydrocarbons, paraffin hydrocarbons, acetone, hot alcohol.

The glycerides are also very soluble in ether, but almost insoluble in alcohol.

SOLIDIFICATION POINTS OF BINARY FATTY ACID MIXTURES [1]

Palmitic-Stearic Mixture			Stearic-Arachidic Mixture		
C_{16} Mol. %	C_{18} Mol. %	Sol. Pt. ° C. (Corr.)	C_{18} Mol. %	C_{20} Mol. %	Sol. Pt. ° C. (Corr.)
0.00	100.00	68.85	0.00	100.00	74.35
2.81	97.19	68.15	2.80	97.20	73.65
6.05	93.95	67.20	5.85	94.15	72.80

[1] Schuette and Vogel, *Oil & Soap*, July, 156 (1940).

SOLIDIFICATION POINTS OF BINARY FATTY ACID MIXTURES[1] (*Continued*)

Palmitic-Stearic Mixture			Stearic-Arachidic Mixture		
C_{16} Mol. %	C_{18} Mol. %	Sol. Pt. ° C. (Corr.)	C_{18} Mol. %	C_{20} Mol. %	Sol. Pt. ° C. (Corr.)
9.77	90.23	66.20	7.65	92.35	72.30
14.00	86.00	65.00	13.03	86.97	70.80
18.64	81.36	63.80	14.09	85.91	70.55
18.85	81.15	63.72	16.71	83.29	69.80
24.33	75.67	62.20	21.49	78.51	68.30
31.29	68.71	60.10	23.46	76.54	68.00
34.16	65.84	59.20	26.76	73.24	67.00
38.85	61.15	57.70	28.90	71.10	66.50
39.82	60.18	57.28	30.74	69.26	65.95
42.33	57.67	56.70	35.03	64.97	64.80
44.19	55.81	56.52	38.24	61.76	63.90
45.65	54.35	56.25	39.16	60.84	63.75
47.73	52.27	56.00	42.03	57.97	63.25
49.54	50.46	56.02	43.38	56.62	63.15
50.26	49.74	56.00	46.69	53.31	62.75
52.87	47.13	56.00	46.72	53.28	62.70
56.11	43.89	55.85	48.69	51.31	62.50
58.65	41.35	55.70	50.46	49.54	62.30
62.24	37.76	55.45	52.00	48.00	62.20
65.00	35.00	54.90	54.05	45.95	62.15
65.36	34.64	54.85	55.82	44.18	62.15
68.06	31.94	54.45	58.30	41.70	62.05
68.30	31.70	54.42	60.60	39.40	61.85
68.98	31.02	54.39	62.78	37.22	61.72
70.80	29.20	54.21	63.99	36.01	61.50
71.72	28.28	54.20	66.60	33.40	61.25
73.32	26.68	54.20	69.76	30.24	61.10
73.40	26.60	54.20	72.19	27.81	61.00
74.34	25.66	54.20	74.59	25.41	60.90
76.48	23.52	54.35	76.20	23.80	60.98
77.65	22.35	54.60	76.47	23.53	61.00
80.26	19.74	55.15	79.09	20.91	61.60
85.16	14.84	56.60	85.40	14.60	63.35
90.01	9.99	58.20	88.68	11.32	64.18
94.30	5.70	59.70	88.79	11.21	64.23
97.19	2.81	60.85	93.50	6.50	66.10
100.00	0.0	62.22	97.49	2.51	67.75
			100.00	0.00	68.85

Solidification points of fatty acids containing water are lowered as follows: [1]

Water	Solidification Point, ° C.
MYRISTIC ACID	
0.00	54.01
2.12	53.18
PALMITIC ACID	
0.00	62.41
1.50	61.79
STEARIC ACID	
0.00	69.20
1.28	68.74

SOLUBILITY OF WATER IN MELTED FATTY ACIDS

	% Water	Solution @ ° C.
Myristic	1.70	53.2
Palmitic	1.25	61.8
Stearic	1.02	92.4

POLYGLYCOLS

"Carbowax"

"Carbowax" is the trade-name for certain solid, water-soluble, high-molecular-weight (> 500) polyethylene glycols, that have a waxy appearance and "feel."

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[1] Hoerr, Pool, Ralston, *Oil & Soap*, **19**, 126 (1942).

PHYSICAL PROPERTIES

	"Carbowax" Compound 1500	"Carbowax" Compound 1540	"Carbowax" Compound 4000
Physical Appearance	Soft, waxy solid	Medium-hard, waxy solid	Hard, waxy solid
Density, g per cc at 20° C.	1.151	1.15	1.204
Melting Range	34–37° C.	40–45° C.	50–55° C.
Viscosity Range, Saybolt Universal at 210° F.	60–90 sec.	100–150 sec.	400–600 sec.
Flash Point, Open Cup	430° F.	460° F.	535° F.
Freezing Points of Mixtures Containing, by Weight:			
90% Water	–1.0° C.	–0.5° C.	–0.5° C.
70% Water	–3.0° C.	–3.0° C.	–4.5° C.
50% Water	–15.0° C.	–10.0° C.	–10.0° C.
30% Water	+16.0° C.	+20.0° C.	+30.0° C.
10% Water	+35.0° C.	+37.0° C.	+49.0° C.
Solubility in Water, by Weight:			
At 0° C.	62%	59%	53%
At 20° C.	73%	70%	62%
At 40° C.	95%	94%	80%
At 44° C.	100%	.....	.....
At 45° C.	100%	100%	.....
At 57° C.	100%	100%	100%

SPECIFICATIONS

Melting Point	Not below 34° C.	.....	Not bolow 50° C.
Color, Pt-Co, 5% Aqueous Solution	Not more than 100	.....	Not more than 50
Water Solubility	Clear and substantially free from insoluble matter.		
5% Aqueous Solution			
Acidity	Not more than 0.05%, calculated as acetic acid.		
5% Aqueous Solution			
Alkalinity	Not more than 0.2%, calculated as sodium hydroxide.		
5% Aqueous Solution			

Compatibilities of "Carbowaxes"

It will be noticed from the following table that the compatibility of "Carbowax" 4000 is very limited, nitrocellulose and a few of the Bakelite resins being the only film-forming materials with which it is compatible in the proportions tested. The tests were run by adding a solution of "Carbowax" in alcohol, benzene, or water to a solution of the resin in an appropriate solvent and examining a pour of the mixture on a glass plate for evidences of non-homogeneity. In many cases, these examinations were supplemented by an examination of hot melts of the resin and "Carbowax" in the absence of solvent.

	Ratio of "Carbowax" to Resin		
	5/1	1/1	1/5
Ethyl Cellulose	I	I	I
Methyl Cellulose	I	I	I
Polyvinyl Alcohol	I	I	I
Bakelite XR-3180		I	
Bakelite XR-4357		I	
Bakelite XJ-1434		I	
Bakelite XR-9396		I	
Bakelite XR-4357		I	
Bakelite XR-9392	I	C	C
Bakelite BR-3360	I	C	C
Bakelite BR-8900	I	I	C
Shellac		I	
Manila Loba B		I	
Carnauba Wax, No. 3 Refined		I	
Gum Damar		I	
Gum Accroides		I	
Gum Elemi		I	
Gum Mastic		I	
Batavia Damar		I	
Pale East India Macassar		I	
Gum Arabic	I	I	I
Raw Castor Oil	I	I	I
Tung Oil	I	I	I
White, Heat-bodied, Raw Linseed Oil	I	I	I
Lacquer Linseed Oil (A.D.M. No. 100)	I	I	I
Processed Linseed Oil (A.D.M.-O.K.O. M-17)	I	I	I
Paraffin Wax		I	
Ester Gum		I	
Rosin		I	
Algin S.P.		I	
Halowax No. 1012		I	

	Ratio of "Carbowax" to Resin 5/1	1/1	1/5
Uformite F-224		I	
Petrex No. 5		I	
Teglac Z-152		I	
Rezyl 1102		I	
Beeswax		I	
Mineral Oil		I	
Casein		I	I
Zein		I	
Polyvinyl Alcohol		I	
Nitrocellulose	I	SC	C

I = Incompatible
C = Compatible; completely homogeneous
SC = Partially compatible but with some evidences of inhomogeneity

Uses: Base in cosmetics and ointments, a binding agent, size, softener, humectant, lubricant, preservative, and adhesive, especially for textiles, paper, leather, and other porous materials. It offers possibilities as a plasticizer for such materials as casein, gelatin, glue, cork, special printing inks, and for cellulose transparent films since it will not diminish their transparency. "Carbowax" compound 1500 can be used with excellent results as a lubricant for wire drawing and metal extrusion operations. A small amount of "Carbowax" compound in water, applied as a lubricant to molds in which rubber parts are formed, causes a perfect, quick release when the mold is opened. It imparts an attractive finish to the molded rubber product, and the molds require less cleaning when this releasing agent is used. It can also be used as a water-soluble lubricant in warp sizes for cotton yarn; as a scrubbing liquid in air purification; and as an antisqueak fluid, with or without graphite. In addition, it shows promise in the formulation of carbon paper because it is helpful as a wetting agent in wax mixtures, in belt dressings, and unvulcanized rubber compositions for self-sealing tires and tubes, and for transparentizing tracing-paper stock.

"Carbowax" compound 4000 looks like paraffin wax but is water-soluble. It is not hygroscopic like "Carbowax" compound 1500.

POLYHYDRIC ALCOHOL FATTY ACID ESTERS

Glyceryl Stearates

The commercial, wax-like glyceryl esters are glyceryl tristearate, glyceryl distearate and glyceryl monostearate. The first contains as impurities small amounts of oleic, linoleic and linolenic esters. The second contains varying amounts of monostearate and the third, varying amounts of distearate. The mono and distearates (water dispersible grades only) contain varying amounts of soap.

PROPERTIES

Product	M.P. ° C.	Sp. Gr.	F.F.A. %	Acid No.	Sap. No.	Iodine No.
1. Glycerly Tristearate	58–60	0.92	< 1	< 2	192–196	< 10
2. Glyceryl Distearate	51–52	0.93	< 2	< 4	192–200	< 5
3. Glyceryl Monostearate	56–57	0.97	< 5	< 10	135–140	3–4
4. Monostearin	55–57	0.97	< 4	< 7	177–183	3–4

			Solubility in				
Product	Color	Odor	Water	Alcohol	Naphtha	Mineral Oil	Hardness*
1. Glyceryl Tristearate	White	Faint	I.	P.S.H.	S.H.	S.H.	2
2. Glyceryl Distearate	Cream	Faint	I.	P.S.H.	S.	S.H.	3
3. Glyceryl Monostearate	Cream	Faint	D.	S.H.	S.H.	S.H.	3
4. Monostearin	Cream	Faint	I.	S.H.	S.H.	S.H.	3

* Hardness scale: Carnauba Wax, 1; Candelilla Wax, 2; Japan Wax, 3; Paraffin Wax, 4.

Glyceryl Monostearate S

PROPERTIES

Color and Form	Tan, wax-like solid
Melting Point	56–57° C. (Capillary Tube)
Odor	Faint
pH (3% aqueous dispersion at 25° C.)	9.3–9.7
Specific Gravity (20°/20° C.)	0.97

Soluble in: Hot alcohol, hot hydrocarbons; dispersible in hot water.

Uses: Protective coatings for edible hygroscopic powders,

etc.: Edible powders, crystals and tablets, which absorb moisture from the air, have a tendency to lump, cake, and decompose, on standing. A solution of glyceryl monostearate S, in hot alcohol or other suitable solvent, is sprayed on the powder which can be tumbled in a heated barrel until all the solvent has evaporated. This leaves the product coated with a thin, protective film of glyceryl monostearate S which disperses when the product is thrown into water. "Sun-checking" can be prevented by formulating polybutene-rubber combinations with glyceryl monostearate S, which not only improves light resistance, but also acts as a plasticizer, and increases rate of vulcanization slightly. By using glyceryl tristearate, the compound acquires more rigidity, although still flexible. Development of surface tack on aging can be eliminated from butadiene compounds (Vistanex), by compounding with glyceryl monostearate S. Apparently, the glyceryl monostearate sweats out of the compound at a similar rate to the development of tackiness, and the two properties compensate each other so that the surface presents neither a tacky nor a waxy appearance and feel.

Monostearin (Water-insoluble grade of glyceryl monostearate S)

PROPERTIES

Color and Form	Light, cream-colored, wax-like solid
Melting Point	55.5–56.5° C.
Odor	Faint
pH (aqueous layer when 3% is melted in water)	6.7
Specific Gravity (58° C.)	0.898

Soluble in: Hot alcohol, hot hydrocarbons, hot oils.

Uses: Shortenings, cooking oils, fats, etc.: The addition of small amounts of monostearin is suggested for improving the smoothness and color of these materials. It also enables the incorporation of small percentages of water. It helps prevent leakage of milk, etc., from oleomargarines. Synthetic waxes: A synthetic wax used in blends for waterproofing, insulation, polishes, dental waxes, etc. Enteric coating for tablets: Monostearin replaces shellac for this purpose. It is insoluble in water but readily dispersible in alkali.

Glycol Stearates

The commercial glycol stearates are the mono or distearates of ethylene, diethylene, propylene or polymerized glycols. They usually consist of mixtures of mono and distearates in various proportions. The water-dispersible grades may contain varying amounts of soap.

PROPERTIES

Product	M.P. °C.	Sp. Gr.	F.F.A. %	Acid No.	Sap. No.	Iodine No.
Ethyleneglycol Distearate	60–62	0.94	< 2	< 4	200–203	< 5
Ethyleneglycol Monostearate	59–61	0.96	< 3	< 6	180–190	< 5
Diethyleneglycol Distearate	48	0.96	< 4	< 8	187–190	< 5
Diethyleneglycol Monostearate (Diglycol Stearate S)	51–54	0.96	48–52	96–104	175–185	< 5
Diethyleneglycol Monostearate (S 105)	44–45	0.96	< 3	< 6	167–177	< 4
Propyleneglycol Monostearate (Prostearin)	44–45	0.93	25–30	50–60	145–155	< 4.5
Propyleneglycol Monostearate (S 236)	37–39	0.93	< 5	< 10	171–173	< 4.5
Polymerized Glycol Distearate (S 172)	29–30	1.06	< 3	< 6	115–125	< 3
Polymerized Glycol Monostearate	36–37	1.06	< 1	< 3.5	54–64	< 1

Product	Odor	Color	Hardness	Solubility in: Water	Alcohol	Naphtha	Mineral Oil
Ethyleneglycol Distearate	Faint	Brown	3	N.D.	S.H.	S.H.	S.H.
Ethyleneglycol Monostearate	Faint	Tan	3	N.D.	S.H.	S.H.	S.H.
Diethyleneglycol Distearate	Faint	White	3	N.D.	P.S.H.	S.H.	S.H.
Diethyleneglycol Monostearate (Diglycol Stearate S)	Faint	White	3	D.H.	S.H.	S.H.	S.H.
Diethyleneglycol Monostearate (S 105)	Faint	Cream	4	D.	S.H.	S.	S.H.
Propyleneglycol Monostearate (Prostearin)	Faint	Cream	4	D.H.	S.H.	S.H.	P.S.
Propyleneglycol Monostearate (S 236)	Faint	Cream	6	N.D.	S.H.	S.H.	P.S.
Polymerized Glycol Distearate (S 172)	Faint	Cream	4	S.	S.H.	S.	S.
Polymerized Glycol Monostearate	Faint	Cream	4	S.	S.H.	S.H.	I.

Diglycol Stearate S (Diethylene glycol monostearate)

PROPERTIES

Color and Form	White, wax-like solid
Melting Point	51–54° C. (Capillary Tube)
Odor	Faint, Fatty
pH (3% aqueous dispersion at 25° C.)	6.5–6.8
Specific Gravity (25° C.)	0.96

Contains no free alkalies or amines.

Soluble in: Hot alcohol, hot hydrocarbons, hot oils; dispersible in hot water.

Uses: As a temporary binder for abrasive powders for the manufacture of abrasive and grinding wheels, diglycol stearate S is recommended because of its water dispersibility and the fact that it is completely eliminated on firing. It is dispersed in boiling water to which has been added a small percentage of glycerin. This is mixed with the abrasives prior to firing, enabling the wheel to be molded without crumbling. On firing, the diglycol stearate S burns completely, without residue. Ceramic insulation: Diglycol stearate S acts as an efficient temporary binder for clays prior to firing, enabling the clays to be molded without crumbling. On firing, the diglycol stearate S gives gaseous combustion products, leaving no residue. Diglycol stearate S fires completely under 400° F. Cosmetics: Diglycol stearate S is readily dispersed in boiling water, giving a stable fluid or paste emulsion according to the concentration. Thus one part of diglycol stearate S in thirty parts of boiling water produces on stirring, while cooling, a stable milky emulsion. If glycerin, diethylene glycol or alcohol is incorporated into the water prior to making the dispersion, the resulting products can be used as hand lotions, creams, etc., free from alkali. These preparations can be suitably perfumed and colored. Diglycol stearate S acts as an emulsifying agent for oils, solvents and waxes, where a stable, neutral, viscous, cream-like product is required. This is of interest in cosmetics, polishes, textiles, etc. If a fluid emulsion is desired, the addition of a small percentage of Sulfatate (wetting agent) is necessary. The method of procedure is to melt the oil or wax with the diglycol stearate S. The water, previously

heated to a temperature above the melting point of the wax, is slowly added with vigorous stirring. The stirring is continued until the emulsion is cool. This gives a non-alkaline emulsion. Lubrication: When a dispersion of diglycol stearate S in water is squirted between spring leaves and other places difficult of access, a thin waxy lubricating film is left on evaporation of the water. Diglycol stearate S is a lubricant for drawing aluminum and for the extrusion of aluminum tubing. One part of diglycol stearate S dispersed in six or seven parts of water, at 160° F. is an improvement over a 20% tallow and water mixture. It remains dispersed as a stable emulsion. Small parts, such as collapsible tube blanks, are dipped into the hot dispersion while in a wire basket, and then centrifuged to remove excess lubricant. If a microscopic protective film is required, a small amount of Glyco wax may be added, replacing part of the diglycol stearate S. Paper and cardboard lubrication: In the manufacture of die-formed tops and bottoms of cylindrical containers and cups and cardboard plates, diglycol stearate S dispersions in water give lubrication, preventing the paper from breaking as is often the case in dry die-forming. In addition, the diglycol stearate S "bodies" the paper so that it holds its shape afterwards. Being free from alkalies, it can be used on all types of paper without discoloration. The usual dispersion is about one pound of diglycol stearate S in 5 to 10 gallons of water. This is applied at about 200° F. to the outside surface of the paper by screen rollers. After the paper is rewound it is seasoned for about 24 hours, depending on the type of paper and its use. Pharmaceutical salves, etc.: Many salves and ointments containing lanolin and similar products leave permanent greasy stains on clothing, pillows, etc. If a small percentage of diglycol stearate S is incorporated in the salve, the stain is completely eliminated on washing the soiled article. Pigment and abrasive suspension: Titanium dioxide, carbon black, graphite, silica, etc., can be dispersed readily in the cold in a diglycol stearate S dispersion in water. This gives permanent suspensions of the pigment or abrasive for specialty cleaners, polishes and textile delusterants. Protective coating for hygroscopic powders, etc.: Powders, crystals, tablets, etc., which absorb

moisture from the air have a tendency to lump, cake and decompose on standing. A dispersion of diglycol stearate S in hot alcohol or other suitable solvent is sprayed on the powder which can be tumbled in a heated barrel until all the solvent has evaporated. This leaves the product coated with a thin, protective film of diglycol stearate S which disperses when the product is thrown into water. If the powders, crystals, tablets, etc., are for edible purposes, use glyceryl monostearate S in place of diglycol stearate S. A ½ to 2% dispersion of diglycol stearate S in water is used to prevent sticking of raw rubber sheets. The dispersion may be applied either by spray or dip, and will not affect future working of the rubber. A similar dispersion can be used as a lubricant in the cutting of rubber gaskets. Tin stamping: A 1% dispersion of diglycol stearate S in water is considerably cheaper than the old wax lubricant method. It is applied prior to stamping and permits the stamping of lacquered metal without fracturing the coating. Where preparations containing diglycol stearate S are to be kept for a long time under varying temperature conditions, the addition of a preservative, such as Moldex is advised.

Sorbitol Stearates

The commercial sorbitol stearates consist chiefly of sorbitan and sorbide esters, formed during the esterification process. All of these esters contain varying amounts of mono, di and higher esters along with small amounts of sorbitan.

PROPERTIES

Product	M.P. °C.	Sp. Gr.	F.F.A. %	Acid No.	Sap. No.	Iodine No.
Sorbitol Distearate	49–51	0.96	15–17	30–34	168–178	< 5
Sorbitol Distearate (A)	42–43	0.96	17–21	38–42	175–185	< 5
Sorbitol Monostearate (Arlex G-909)	45–55	0.98	.....	< 5	.....	....

				Solubility in			
Product	Odor	Color	Hardness	Water	Alcohol	Naphtha	Mineral Oil
Sorbitol Distearate	Faint	Cream	3	D.	P.S.	S.H.	S.H.
Sorbitol Distearate (A)	Faint	Cream	3	I.	P.S.	S.H.	S.H.
Sorbitol Monostearate (Arlex G-909)	.....	.....	..	D.H.	S.H.	S.H.	....

Pentaerythritol Stearates

PROPERTIES

Product	M.P. °C.	Color	Solubility in Water	Alcohol	Naphtha
Pentaerythritol Monostearate (S 255)	46–47	Cream	I.	S.H.	S.H.
Pentaerythritol Distearate (S 256)	51–52	Cream	D.	S.H.	S.H.
Pentaerythritol Tetrastearate (S 257)	60–61	Cream	I.	I.	S.H.

Uses: Plasticizer and mold release lubricant for urea-formaldehyde resins, replacing glyceryl monostearate, diglycol stearate, or metallic stearates. Better heat resistance, transparency and mold release is reported for the molded plastic.

Pentawaxes

The Pentawaxes are a series of waxy materials which are modified fatty acid esters of pentaerythritol or polypentaerythritols. Some of their physical properties are shown in the table below.

Pentawax Number	Softening Point ° C.	Flow Point ° C.	Sward Hardness	Compatibility	Soluble In	Insoluble In	Suggested Use
145	60	81	18	X, O	O, W, E	A	Emulsifier
177	70	73	22	X, O	O, H	W, A, E	Polishes
217	63	65	55	X, O	O, H	W, A, E	Carnauba Substitute
218	54	63	10	X, O	O, H *	W	*Beeswax
227	38	80	4	X, O	O, H, E	W, A	Polishes
232	59	65	20	X, O	O, H, E	W, A	Polishes
235	53	54	28	X, O	O, H	W, A, E	Japan Wax Substitute

Soluble or Insoluble refers to following substances at room temperature:
O = oil, W = water, A = alcohols, E = esters, H = hydrocarbons.

Compatibility refers to following, when melted together:
X = other waxes including montan, beeswax, carnauba, "opalwax," ceresin, paraffin.
O = oils, vegetable and mineral.

* PENTAWAX 218 is soluble hot in all classes of organic solvents. It also has an odor similar to that of beeswax. It does not shrink on solidifying.

HYDROGENATED OILS

The complete hydrogenation of cottonseed, coconut, peanut, soyabean, castor, fish, whale, or other vegetable, fish or animal

oils yields wax-like materials. The highest-melting commercial wax is produced from castor oil (Opalwax).

PROPERTIES

Product	Titer °C.	F.F.A. %	Sap. No.	Unsap. %	Iodine No.
Hydrofol Glycerides					
(45–48)	42–45	< 3	190–195	.....	25–35
(54–57)	51–53	< 3	190–195	.....	< 6
(60–63)	57–60	< 1	185–190	.....	25–30
(67–69)	64–66	< 2	185–190	.....	< 6
(80–83)	77–80	< 2	176–178	.....	6–8
Spermofol					
(45)	44–46	< 2	140	30–35	20–30
(52)	50–52	< 2	140	30–35	4–7
Cosmol Hard	48–50	< 1	115	50–52	2–5
Cottonseed Oil (Hydrogenated)	58–60	< 0.1	192–196	5	< 10
Coconut Oil (Hydrogenated)	43–44	0.08	246	.....	6
Opalwax	86–88	< 2	175–185	....	2.5–8.5
Tallow (Hydrogenated)	59.5	0.7	103	0.2	1.5

Uses: Food, candy, baking, polish, cosmetics, molding, lubricants, ointments, etc.

Opalwax (Hydrogenated Castor Oil)

Opalwax consists principally of 12-hydroxy stearin (glyceryl trihydroxystearate) produced by the catalytic hydrogenation of castor oil.

PROPERTIES

Odor	Practically odorless
Color	Pearl-white; clear when melted
Homogeneity	Uniform composition, no extraneous matter
Fracture	Conchoidal and amorphous
Luster	Dull
Apparent Specific Gravity	0.98–0.99 at 20° C.
Melting, Solidification Point	86 to 88° C. (187 to 190° F.)
Hardness	Quite hard
Dielectric Constant	Approx. 12 at 30° C.; 22 at 60° C. (100 cycles)
Acid No.	< 2.0
Saponification No.	175 to 185
Iodine No.	2.5 to 8.5
Ash Content	< 0.005%
Hydroxyl No.	155 to 165

Opalwax is insoluble in solvents. None of the common solvents has been found to dissolve as much as 2% opalwax at temperatures up to 30° C. Toluene, carbon tetrachloride, and carbon bisulphide are the most effective. Opalwax is dissolved, with discoloration, by concentrated sulphuric acid. It is disintegrated and, in part, dissolved by concentrated nitric acid.

Opalwax is only slightly compatible with paraffin wax, but more so with ceresin, ozokerite, montan and carnauba waxes, and many resinous materials, both natural and synthetic, such as rosin, ester gum, coumarone-indene type, n-butyl methacrylate, ethyl cellulose, alkyd, urea-formaldehyde and drying oil types.

Molten Opalwax (100° C.), introduced, with rapid agitation, into about two and a half times its own weight of water, at 85° C., in which a small amount of a suitable emulsifying agent has been thoroughly mixed, in advance, will produce an emulsion that will remain stable when subsequently diluted and yield a continuous film upon drying.

Uses: For impregnating and coating papers, fiber-board, leather, cork, textiles, etc., to make them grease, oil, and waterproof, for electrical insulation; as a lubricant; also in the manufacture of candles, rubber-coated fabrics, polishes and finishes, carbon paper, inks, cutting oils. The addition of 20% naphthalene tetrachloride, behenone or stearone to hydrogenated castor oil (Opalwax) makes the latter approach carnauba wax in hardness, fracture and solvent retention.

PROPERTIES OF HYDROGENATED OILS

Partly Hydrogenated Oils [1]

Oil	M.P. ° C.	Congelation Point ° C.	Butyrorefractometer Reading (40° C.)	Acid No.	Saponification No.	Iodine No.
Coconut	44.5	27.7	35.9	0.4	254.1	1.0
Sesame (techn.)	62.1	45.3	38.4	4.7	188.9	25.4
Whale	45.1	33.9	49.1	1.2	192.3	45.2
Arachis	51.2	36.5	50.1	1.0	188.7	47.4
Sesame	47.8	33.4	51.5	0.5	190.6	54.8
Cottonseed	38.5	25.4	53.8	0.6	195.7	69.7

[1] Bomer and Leschyl-Hansen, *Chem. Rev. Fett-Harz-Ind.* **19**, 218 (1912).

Whale Oil at Different Stages of Hydrogenation [2]

Oil	M.P. ° C.	Congelation Point ° C.	Acid No.	Saponification No.	Iodine No.	Molecular Equivalence of Fatty Acids
Original Oil	Fluid	Fluid	9.50	192.2	144.8	287.7
Artificial Tallow	47.5	38.1	9.88	183.7	56.9	296.4
Artificial Stearin	54.3	47.3	7.80	187.7	11.7	297.0
Hydrogenated Whale Oil	41.9	31.9	5.30	190.9	57.8	282.9

Completely Hydrogenated Oils [3]

Hydrogenated Oil or Fat	M.P. ° C.	Iodine No.	Saponification No.	Fatty Acid, M.P., ° C.
Tallow	62.0	0.1	197.7	64.0
Lard	64.0	1.0	196.8	62.0
Cacao Butter	63.5–64	0.0	193.9	65.5
Arachis	64–64.5	0.0	191.6	67.0
Cod Liver	65.0	1.2	186.2	59.0
Linseed	68.0	0.2	189.6	70.5
Sesame	68.5	0.7	190.6	69.5
Olive	70.0	0.2	190.9	71.0
Poppy	70.5	0.3	191.3	71.0
Almond	72.0	0.0	191.8	71.0

PROPERTIES OF HYDROGENATED COCONUT AND COTTONSEED OILS

	M.P. ° F.	Iodine No.	Sap. No.	Reichert-Meissl No.	Polenske No.	Refractive [4] Index
Hydrogenated Coconut Oil	107.2	2.2	250	8.5	15.5	1.4486 (40° C.)
Hydrogenated Cottonseed Oil	140.7	3.9	195	0.5	0.7	1.4468 (60° C.)

Hydrogenated vegetable oils have dielectric constants between 20–25.[5]

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[2] Sandelin, *J. Soc. Chem. Ind.* **33**, 1097 (1914).
[3] Mannich and Thiele, *Arch. Pharm.* **26**, 36 (1916).
[4] Langwill, *Mfg. Confectioner* **21**, 15 (1941).
[5] Valter, *J. Tech. Phys.* (U.S.S.R.) **10**, 1970 (1941).

PROPERTIES OF HYDROGENATED SARDINE OIL AND TALLOW

	45° Incompletely Hydrogenated Sardine Oil		53° Fully Hydrogenated Sardine Oil		Fully Hydrogenated Tallow	
	Glycerides	Acids	Glycerides	Acids	Glycerides	Acids
Titer	.....	44–46	.....	52–54	.....	56–58
M.P. (open tube) ° C.	43	44.5–46.5	54	52.5–54.5	57	56.5–58.5
Iodine No.	27–34	28–35	2–4	2–4	2–6	2–6
F.F.A. as Oleic	2–5%	95–97%	2–5%	95–97%	3–5%	96–98%
Acid No.	4–10	189–193	4–10	189–193	6–10	191–195
Sapon. No.	185–189	193–199	185–189	193–199	190–193	199–201
Unsaponifiable Matter	0.8–1.0%	0.8–1.0%	0.8–1.0%	0.8–1.0%	0.6–1.0%	0.6–1.0%
Av. Mol. Wt.	896	286	896	286	878	280
Sp. gr. $\frac{60°}{15°}$	0.873	0.895	0.876	0.854	0.856	0.881
Flash Pt. ° F.	530	405	530	385	515	405
Fire Pt. ° F.	580	440	585	425	595	430
Unsaturated Content	37%	38%	3%	3%	4%	4%
Lovibond *	15–35 Y	10–15 Y	10–35 Y	10–15 Y	10–35 Y	10–15 Y
Color	2.5–5 R	2–3 R	2–5 R	2–3 R	2–5 R	2–3 R
Thiocyanogen No.	No data. Should be same as iodine on 53° and hydrogenated tallow, only slightly lower than iodine on 45°.					

*Lovibond readings on glycerides, 5¼" column; fatty acids, 1" column.

COMPOSITION OF HYDROGENATED SARDINE OIL AND TALLOW

	45° Incompletely Hydrogenated Sardine Oil %	53° Fully Hydrogenated Sardine Oil %	Fully Hydrogenated Tallow %
Saturated Acids:			
Myristic	7	7	4
Palmitic	26	30	30
Stearic	18	24	62
Arachidic (C_{20})	8	21	..
Behenic (C_{22})	3	14	..
Unsaturated Acids:			
Myristoleic	0.2	Trace	Trace
Palmitoleic	4	Trace	0.5
Oleic	6	0.5	3.5
Eicosenoic (C_{20})	14	1.0	..
Docosenoic (C_{22})	13	2.0	..

CHLORINATED NAPHTHALENES

Halowax

The chlorinated naphthalene waxes are marketed under the name of Halowax. They are noteworthy because they will not support combustion, are good dielectrics, inert to alkali and acid and non-corrosive. They must be used with caution as they affect many individuals physiologically.

Soluble in: Benzol, toluol, carbon tetrachloride; in general, in chlorinated or aromatic solvents.

Seekay Wax

A British chlorinated naphthalene made in different grades; color, yellow to black; melting point, 65–125° C. They are insoluble in water and soluble in most hydrocarbon solvents.

Uses: Applied to wood, metal, or other surfaces to prevent attack by acids, alkalies, and other corrosive liquids and fumes. Plasticizer and toughener for gums, synthetic resins, waxes, etc. Moistureproof coatings; polishes; flame-proofing; electrical insulation.

Toxic Effects

Poisoning from chlorinated naphthalene may take two forms: Damage to the skin, producing acne, particularly of the face; and toxic jaundice, produced by either an acute or subacute necrosis of the liver, or by acute yellow atrophy of the liver. Twelve cases of dermatitis and one of acute atrophy of the liver arising among workers who were exposed to the fumes or dust of chlorinated naphthalene are reported. If cases of poisoning are to be prevented, the wax must not be overheated and the fumes and dust must be properly carried away by exhaust ventilation.[1]

[1] E. Collier, *Lancet* 72 (1943).

CHLORINATED NAPHTHALENES

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Soluble in: Benzol, toluol, carbon tetrachloride; in general, in chlorinated or aromatic solvents.

SEEKAY WAX

A British chlorinated naphthalene made in different grades; color, yellow to black; melting point, 65–125° C. They are insoluble in water and soluble in most hydrocarbon solvents.

Uses: Applied to wood, metal, or other surfaces to prevent attack by acids, alkalies, and other corrosive liquids and fumes. Plasticizer and toughener for gums, synthetic resins, waxes, etc. Moistureproof coatings; polishes; flame-proofing; electrical insulation.

Toxic Effects

Poisoning from chlorinated naphthalene may take two forms: Damage to the skin, producing acne, particularly of the face; and toxic jaundice, produced by either an acute or subacute necrosis of the liver, or by acute yellow atrophy of the liver. Twelve cases of dermatitis and one of acute atrophy of the liver arising among workers who were exposed to the fumes or dust of chlorinated naphthalene are reported. If cases of poisoning are to be prevented, the wax must not be overheated and the fumes and dust must be properly carried away by exhaust ventilation.[1]

[1] E. Collier, *Lancet* 72 (1943).

PROPERTIES OF HALOWAXES

	Halowax #1012	Halowax #1013	Halowax #1014
Description (68° F.)	Hard Crystalline Solid	Hard Semi-Amorphous Solid	Tough Amorphous Solid
Color	White to Pale Yellow	Pale Yellow	Pale Yellow
Flow Point (ASTM—Ball & Modified Ring ° F.)	203–210	247–252	277–283
Specific Gravity (68° F./68° F.)	1.53–1.59	1.65–1.71	1.75–1.81
Boiling Range (ASTM—° F.)	600–650	615–655	680–730
Flash Point ° F.	284	356	392
Fire Point ° F.	None	None	None
Viscosity	35 sec. @ 212° F. (Saybolt)	31–35 sec. @ 266° F. (Saybolt)	37 sec. @ 302° F.
Maximum Acidity (milligrams of KOH per gram Halowax)	0.1	0.1	0.1
Penetration (200 gram load—5 sec. @ 77 ° F.)	10–15	5–8	5–8
Volatility (gram/sq in./hour @ 221° F.)	0.01	0.004	0.001
Frost Point (ASTM ° F.)	.....	.....	.....
Coefficient of Lineal Expansion in./in. ° C.:			
Liquid	0.00013	0.00012	0.00011
Solid	0.000082	0.000064	0.000049
Coefficient of Cubical Expansion cu in./cu in. ° C.:			
Liquid	0.00049	0.00026	0.00024
Solid	0.00027	0.00018	0.00010
Vapor Pressure (130° F.)	0.2–0.4	0.1–0.2	0.1–0.2
Index of Refraction (D Line) @ 77° F.	.....	.....	.....

ACRAWAXES

The Acrawaxes are complex nitrogen derivatives of the higher fatty acids, some of which have very high melting points.

GENERAL PROPERTIES

Product	M.P. °C.	Sp. Gr. @ 24° C.	Flash Pt. °C.	Color	Hardness
Acrawax	95–97	1.04	230	Tan	2**
Acrawax B	81–84	0.96	235	Tan	3**
Acrawax C	137–139	0.98	285	Cream	2**

		Solubility in					
Product	Luster	Water	Alcohol	Mineral Spirits	Toluol	Turpentine	Mineral Oil
Acrawax	High	I	S.H.	P.S.H.	S.H.*	S.H.	P.S.H.
Acrawax B	Good	I	S.H.	S.H.	S.H.	S.H.	S.H.
Acrawax C	High	I	I	S.H.	S.H.	S.H.	S.H.

* = Gels on cooling. ** = See hardness scale, p. 107.

ACRAWAX

PROPERTIES

Color and Form	Hard, light brown wax
Luster	High
Melting Point	95–97° C.
Flash Point	230° C. (open cup)
Specific Gravity (24° C.)	1.04

Soluble in: Hot alcohol, hot toluol (forms gel on cooling), hot butyl acetate, hot turpentine. Insoluble in water and mineral spirits.

Uses: Replaces carnauba and similar waxes for paste, floor, furniture, and automobile polishes. Dental Waxes: Because of its high melting point, it allows of the incorporation of larger amounts of cheap lower melting point waxes. Record Waxes, Wax Coatings, etc.: Acrawax, itself being immiscible with oils and greases, when blended with ethyl cellulose, becoming even less miscible, has possibilities for hot-melt, greaseproof coating materials, etc. Toughened by ethyl cellulose or other plastics, its use for hot casting of plastics is yet another field awaiting development. Impregnation into various media, such as paper, leather, cloth, by means of hot-melt; eliminates the use of solvents and their subsequent loss, giving properties possessed

both by plastics and waxes. Heat seals are yet other interesting developments of these blends. Polyvinyl butyral and other resins can be made compatible with this wax for producing additional solvent and grease-resistant coatings as well as heat-sealing materials in thermoplastics. Fillers and pigments or dyes can be added to increase the number of applications. Acrawax is used to improve wetting of pigments dispersed in paints, printing inks, or other non-aqueous fluids. In grinding highly pigmented inks, ½ to 4% Acrawax is of great help. It also thickens or bodies oil or wax mixtures. 1% added to carnauba wax raises its melting point 3° C., without altering physical or working properties to any noticeable extent.

Acrawax is compatible and can be blended with carnauba and other vegetable waxes, rosin, shellac, stearic acid and other higher fatty acids, fats, and ester gum. It is not compatible with paraffin or other mineral waxes. Acrawax forms a stable gel when its solution in hot toluol is cooled slowly.

Acrawax B

PROPERTIES

Color and Form	Hard, brown wax
Luster	Good
Melting Point	81–84° C.
Flash Point	235° C. (open cup)
Acid Value	1–2
Specific Gravity (25° C.)	0.955

Soluble in: Hot alcohol, hot toluol, hot butyl acetate, hot mineral spirits (forms gel on cooling) and mineral oil. Insoluble in water.

Uses: Acrawax B has a good luster and is very similar in properties to Acrawax. It differs from Acrawax in that it is compatible with paraffin wax and forms gels with mineral spirits and kerosene. This latter property makes it of interest as a flatting agent for paints. It replaces aluminum stearate and other metallic soaps and carnauba wax for this purpose, giving increased compactness of material at a considerable saving. Finer texture and greater uniformity of the paint are also obtained as well as unusual firmness of the paint film and free-

dom from greasiness and smear. In general, between 2% and 4% of Acrawax B is used either by dissolving in a solvent such as mineral spirits and mixing with the paint in the mill or by making into an oil-solvent mixture with the paint. Grinding, as is necessary when using aluminum stearate or carnauba wax, is completely eliminated. Inorganic powders, which have a tendency to lump and aggregate, can be made free-flowing by coating with Acrawax B, in concentrations of less than 1% based on weight of powder. Dispersion may be accomplished either by hot-solvent-tumbling barrel technique, or by dissolving it in hot alcohol and pouring into water, giving a very fine dispersion, which is then tumbled with the powder and dried at approximately 160 to 170° F. in ovens. It is a gelling agent for chlorinated paraffin-naphtha solutions; such thickening is required for good pigment suspension. Materials, previously used, such as Vistanex, chlorinated rubber, or ethyl cellulose and metallic soaps are apparently "peptized" by the chlorinated paraffin, breaking the gel.

Acrawax B (10–15%) blends with vegetable waxes, paraffin and other mineral waxes.

Acrawax C

PROPERTIES

Color and Form	Lumps	Hard, light brown wax
	Powder	Soft light color
Luster		High
Melting Point		137–139° C.
Flash Point		285° C. (open cup)
Specific Gravity (25° C.)		0.975
		0.83 (at melting point)
Dielectric Resistance		1 mil thickness has a resistance of 428 volts to break down
Moisture Absorption at 96° F. for 48 hrs		0.3 g moisture per 50 g wax
Oxidation Potential		400–500 milli-volts

Soluble in: Hot toluol, hot mineral spirits, hot turpentine (forms gel on cooling). Insoluble in water.

Uses: Acrawax C blends with paraffin wax, carnauba wax, rosin, etc. It is of particular interest where a high-melting wax

which is not brittle, is desired. Because of its high flash point, Acrawax C can be used for many purposes where ordinary waxes are unsuitable due to fire hazards. Acrawax C can be gelled with tricresylphosphate, and up to 4% can thus be incorporated into vinyl coatings giving good calender release, plasticizing and anti-block effects. Acrawax C, in proportions up to 10% may be used as a blending agent for combining Class-A phenol formaldehyde (low thermoset temperature) with vinyl resins and chlorinated paraffin wax for flameproofing and waterproofing of wire coatings. Dental waxes, electrical insulation, lubrication for thermo-setting plastics: Acrawax C (powdered), is mixed with the molding powder prior to filling the mold. Acrawax C does not "spot" on the finished plastic. A "stop off" wax for differential plating, that will withstand a low acid pH and a plating temperature of 70° C., exhibiting good flexibility and adhesion to nickel, aluminum, etc., can be made by using equal parts of Acrawax C and Flexo Wax C. If Acrawax C is used alone, the "stop off" wax will resist boiling water but the adhesion will not be as good. In replacing rubber as a cloth backing in the manufacture of raincoats, life belts, etc., polyvinyl butyral is used with considerable success. However, the characteristic surface tack of this material has to be eliminated without, of course, adversely affecting the other properties. Acrawax C (powdered), when added to the polyvinly butryal in amounts as low as 1%, effectively eliminates this surface tack. The addition of small amounts of Acrawax C to paraffin wax, Halowax or Vinylite increases their softening and melting points. Thus, 2% Acrawax C added to a Vinylite, having a softening point of 60° C., raises the latter to 85° C. It is also used to increase the flow point and softening point of asphalt. In plastic molding powders, as a lubricant in the molding of sintered bearings. The addition of 5% powdered Acrawax C into polystyrene films cast from solvent solutions improves moisture vapor resistance and also acts as a release lubricant. 2% added to phenol formaldehyde varnish doubles salt spray resistance of coating. Acrawax C having a low dielectric value can be blended with gums, resins, and plastics; having good electrical properties, it is suitable for unusual applications

in the field of electrical insulation and coatings for thermoplastic applications, etc. Because it has a melting point of 137 to 139° C. Acrawax C will not be removed by washing in boiling water. In general, the powdered wax is made into a slurry with hot water and applied to the cloth or paper either by dipping or coating. The water is driven off and the material passed between hot rollers to cause the wax to impregnate the cloth or paper thoroughly. Acrawax C prevents crystallization of rosin-paraffin wax mixtures and improves flexibility and coherence. Certain proportions will also improve adhesiveness of such mixtures. It eliminates tackiness or blocking of paper or textiles coated or impregnated with waxes, resins, synthetic rubber, etc.

I. G. WAXES

The I. G. Waxes (made in Germany) cannot be readily classified from a chemical standpoint as they vary greatly in composition. Some are glyceryl, glycol or polymerized ethylenic esters of acids derived from montan wax and other sources. Some contain metallic soaps and other modifiers.

The grades mentioned in the following table are classified as follows:

Hard waxes:

IG Waxes O and OP
" E and EG
" S and L
" Special
" CR
" A

Soft waxes:

IG Waxes B unbleached and bleached
" N and N new

IG Waxes O and OP represent light-colored, solid waxes of high melting point. They have a conchoidal fracture and great hardness, are free from impurities, and always show similar properties, as indicated by the constants specified before. Their outstanding property is their colloidal nature in the presence of organic solvents, as a result of which, they take up and bind

PROPERTIES

Product	*M.P. ° C.	Sp. Gr. 20° C.	Acid No.	Ester No.	Sap. No.	Unsap. %	Color	Remarks
I. G. Waxes:								
O	101–106	1.03	10–15	103–120	111–133	5–8		
OP	101–106	1.03	10–15	103–120	110–132	5–8	Light Yellow	**Hard and non-crystalline**
E	79–82	1.01	17–25	140–156	158–178	5–8	Light Yellow	**Emulsifies well**
EG	72–75	1.01	18–26	135–153	158–173	5–8		
S	80–83	1.01	142–157	10–30	160–175	7–10	Light Yellow	Used in hardening paraffin wax
L	80–83	1.00	127–139	22–37	155–170	7–10		
Special	90–93	1.00	13–18	80–90	95–110	20–22		
CR	80–83	1.00	31–37	84–98	115–130	13–16		
B (Unbleached)	71–74	0.95	13–23	120–140	140–160	22–25		
B (Bleached)	70–72	0.96	66–86	86–106	163–183	21–24		
N	71–74	0.97	78–88	68–82	152–164	16–19		
N (New)	70–74	0.97	33–43	83–95	118–133	22–26		
Z	100–102	0.93	0	0	0	100	White	Hard and tough
KP	80–82	1.02 (70° C.)	25–35	100–120	130–145	12–14	Light Brown	Substitute for carnauba wax
V	50	...	0	10	.....	.....	White	High luster and solubility in turpentine

* Dropping point, Ubbelohde method.

large quantities of these solvents. In this respect, they surpass, by far, the natural waxes. The gels or jellies produced from IG Waxes O and OP with solvents, such as turpentine and turpentine substitutes, give a high gloss and are, therefore, suited, in conjunction with other waxes and waxy substances, for the manufacture of boot polishes, leather dressings, floor polishes, and similar articles.

IG Wax E is a pale yellow wax of crystalline structure. As it may be saponified and emulsified much more readily than IG Waxes O and OP, it is suited for the production of saponified and mixed-saponified preparations.

IG Wax EG is practically identical with IG Wax E, from a chemical point of view. It is a special grade which emulsifies easily and enables the production of thin liquid concentrated emulsions, especially in combination with Emulphor O.

IG Wax S is a crystalline wax of very light color and great hardness. Owing to its crystalline structure, it exercises hardening effect upon softer waxes or wax-like bodies, such as paraffin wax, ozokerite, etc. Its great hardness enables the production of polishes of very high luster, free from haziness. Owing to its high acid number it can form soap-like combinations and emulsions with alkaline bodies. It is also excellently suited for dissolving color bases and, therefore, is used in the manufacture both of boot polishes and carbon papers.

IG Wax L has practically the same properties as IG Wax S but is slightly darker in color. It is, however, considerably harder than the S brand and, therefore, is used for polishing shoe-trees and also for producing flatting pastes, stick polishes, etc.

IG Wax Special is chiefly intended for the production of black boot polishes. It gives a firm binding of shoe polishes, to make these resistant to variations of temperature, to impart a good surface, and to form surface rings, like carnauba wax, under suitable treatment.

IG Wax CR is similar to IG Wax Special in several respects, but it is a little more crystalline. It is very easy to saponify and can, therefore, be used for solid or liquid emulsions where the dark color is not a disadvantage.

IG Waxes B unbleached and B bleached are representatives of soft waxes (like beeswax). The color of the unbleached variety is brownish yellow, similar to that of beeswax; the bleached quality has an ivory-like color. They can be easily molded between the fingers at ordinary temperatures. They are soft and should be used for wax compositions which are required to be elastic and pliable. They are very easily saponified and emulsified and, therefore, suited primarily for the production of saponified and mixed-saponified preparations. They are also used in sizes, finishes, cosmetics and similar products.

IG Wax N possesses the characteristic property of emulsifying in boiling water without the aid of alkali. Further, it absorbs considerable quantities of solvent in the emulsions. Normally, emulsions of the water-in-oil type result. These are practically neutral and show no case of alkaline reaction. The color of the wax is practically white and it is a soft wax. Its specific properties make it suitable for the production of emulsified products, such as skin creams and mixed saponified polishing and lustering agents.

IG Wax N new is identical in properties with IG Wax N, with the only difference that it yields emulsions of the oil-in-water type under normal working conditions. It is used for mixed saponified shoe and floor polishes.

IG Wax Z is a chemically inert product. It is completely colorless, odorless and without taste, very hard, without being brittle, and of excellent luster; the melting point is above 100° C. Accordingly, a slight addition to paraffin wax, stearin or similar substances is sufficient to exercise a considerable hardening effect; it is used for increasing the stability to heat of paraffin candles, waxed papers, and wax flowers. Its application is, however, of particular value where, apart from the hardening effect, extreme purity is essential, as in producing impregnating masses for food and drinking cartons, etc.

IG Wax V is a chemically inert product of high luster. It has an opaque, pure white color. Its most pronounced property is an exceptional solubility in turpentine and turpentine substitutes. IG Wax V is not only soluble itself in high proportions in these solvents but also exerts a liquefying effect on

other waxes which is still maintained at low temperatures. It is suitable for the production of liquid floor polishes, either alone or in combination with the usual wax mixtures.

MISCELLANEOUS SYNTHETIC WAXES

PROPERTIES

Product	M.P. ° C.	Sp. Gr.	Acid No	Sap. No.	Unsap.	Flash Point ° C.
Adheso Wax	90–95	0.80	.....	.....	...	190–200
Albacer	95–97	0.97	.....	180–185	...	285–295
B-Z Wax A	61	0.92	26–28	26–27	...	230–240
Ceraflux	53	0.88	0	0	100	195–205
Durocer	120–127	1.05	15	.....	...	.....
Flexo Wax C	63–68	0.82	0	0	100	257
Flexo Wax C, Light	60	0.82	.....	.....	...	230–240
Glyco Wax A	58–60	0.97	.....	185–190	...	328
Nipocer	46–49	0.93	2–3	146	...	255–265
Ozowax	76–85	0.89	12	39	...	225–235
Rezo Wax A	107–112	1.06	44	.....	...	230
Rezo Wax B	95–100	1.01	52	.....	...	230
Rilan Wax	84–85	0.98–0.99	25	155	...	.....
Stroba Wax, New	98–100	1.04	35–40	.....	...	.....
†Wax S 688	61–62	...	36	.....	...	.....

				Solubility in					
Product	Hardness*	Luster	Color	Water	Alcohol	Toluol	Naphtha	Mineral Oil	Vegetable Oils
Adheso Wax	3	Poor	Cream	I.	I.	S.	S.H.	S.	I.
Albacer	2	High	White	I.	I.	S.H.	S.H.	S.H.	S.H.
B-Z Wax A	2½	Dull	Tan	I.	I.	S.	S.	S.	S.H.
Ceraflux	4	Good	White	I.	I.	S.	S.	S.	S.H.
Durocer	1-2	Fair	Lt. Br.	I.	P.S.	S.H.	S.H.	S.H.	
Flexo Wax C	4	Dull	Yellow	I.	I.	S.	S.	S.	S.H.
Flexo Wax C, Light	4	Dull	White	I.	I.	S.	S.	S.	S.H.
Glyco Wax A	2	Good	White	I.	I.	S.H.	S.H.	S.H.	S.H.
Nipocer	3	Dull	Cream	I.	I.	S.	S.H.	S.H.	S.H.
Ozowax	4	Good	Tan	I.	P.S.H.	S.H.	S.H.	S.H.	S.H.
Rezo Wax A	2	Dull	Tan	I.	S.H.	S.	S.	S.H.	S.H.
Rezo Wax B	2	Fair	Tan	I.	P.S.H.	P.S.	G.H.	S.H.	S.H.
Rilan Wax		Hard	Cream			S.	S.		
Stroba Wax, New	2	Dull	Dk. Tan	I.		S.H.	S.H.	S.H.	
†Wax S 688	1	Good	Brown	I.				S.	

* See hardness scale, p. 107.
† Sets very slowly in mineral oil and flows poorly.

Albacer

PROPERTIES

Color and Form	White, hard wax
Luster	High
Melting Point	95–97° C.

Soluble in: Hot hydrocarbons. The best solvent for Albacer is a mixture of one part ethylene dichloride, six parts toluol and four parts butyl acetate. This mixture will dissolve up to 5% Albacer, most of which will remain in solution even at room temperature.

Uses: The addition of 5 to 10% Albacer to paraffin wax, for wax-coated paper, gives a finish which exhibits considerable "slip." This is of interest for wrapping sticky candies (caramels, etc.). The paraffin wax is heated to 100° C. and the Albacer, in small pieces, is added slowly with stirring until dissolved. Albacer, plasticized with up to 40% castor oil, is used as a paper coating for packaging polybutene (Vistanex type) synthetic rubbers, to prevent adhesion.

When Albacer is melted, it changes to a heavy-bodied non-gelatinous liquid which sets very slowly.

Albacer can be blended with certain synthetic resins, mineral and vegetable oils, and other waxes.

Adheso Wax

PROPERTIES

Color and Form	Light cream colored wax, with a hardness about that of beeswax
Luster	Poor
Melting Point	90–95° C.
Softening Point	47–50° C.

Adheso Wax is a plastic elastic wax, practically odorless and tasteless.

When warmed sufficiently it becomes a viscous fluid. High water and electrical resistance. Turns transparent when heated with oils and some waxes above 120° C.

Soluble in: Hot hydrocarbons.

B. Z. Wax A

PROPERTIES

Color and Form	Tan wax
Luster	Dull
Melting Point	61° C.

Soluble in: Hot hydrocarbons.

Uses: A substitute for beeswax for technical purposes. Readily emulsifies with alkalies to form stable emulsions. The following formula gives a paste emulsion:

B. Z. Wax A	102
Triethanolamine	5
Water	293

Heat the water and triethanolamine and add to the melted B. Z. Wax A at 95° C., with high-speed agitation. Continue stirring till cool.

Ceraflux (Tech)

PROPERTIES

Color and Form	White, hardness—that of paraffin wax
Luster	Good
Melting Point	53° C.

Ceraflux (Tech) is a refined grade of paraffin wax with excellent luster.

Superior to paraffin in flexibility, adhesion, water-resistance and solubility in oils. Free from the characteristic "sour" odor when melted.

Soluble in: Hot hydrocarbons.

DIOLIN (OCTADECANEDIOL)

PROPERTIES

White, small-lump wax; powders with pressure

Melting Point	65° C.
Molecular Weight	286
Boiling Point	172–186° C. at 0.5 mm
Specific Gravity	0.84 at M.P.
Hydroxyl Number	> 350
Iodine Number	< 4
Saponification Number	< 5
Acid Number	< 2

Insoluble in water.

Flexo Wax C

PROPERTIES

Color and Form	Tan, amorphous wax
Luster	Dull
Melting Point	63–68° C. (Ball and Ring)
Melting Point	144.4° F. (A.S.T.M.)
Flash Point	495° F.
Fire Point	565° F.
A.P.I. Gravity (60° C.)	36.5
Viscosity (210° F.)	76 sec
Penetration (77°)	33 (A.S.T.M. Needle)

Flexo wax C is a non-crystalline wax, with high adhesive properties. Because of its amorphous character it is much more waterproof than paraffin wax.

Soluble in: Hot hydrocarbons, toluol.

Uses: Replaces ozokerite, ceresin, and beeswax for most technical purposes. In certain wax mixtures it produces slightly harder and more lustrous products than ozokerite. Also used in buffing compounds, polishes, engraving, lithography, adhesive compounds, leather dressings, textile sizes and finishes, modeling waxes, coatings, etc. Flexo wax is also used in cementing work and as an adhesive for Cellophane, cellulose acetate and other materials resistant to the usual adhesives, to lower viscosity and flow point of asphalt. The incorporation of a 5% solution of Flexo wax, in toluol, into an enamel gives increased slip effects in the manufacture of non-mar enamels. A 5% solution of Flexo wax added to nitro-cellulose lacquers gives excellent water and ink resistance and anti-block effect. "Stop off" wax for differential plating. Flexo wax C, used as a wood impregnant in place of paraffin wax, prevents warpage, decreases the time required for impregnation, and gives increased acid and alkali resistance.

Gelowax

PROPERTIES

Color and Form	Straw-colored, amorphous, about as hard as beeswax
Luster	Poor
Melting Point	63° C. (Softening Point)

Gelowax is very soluble in hot hydrocarbons, carbon tetrachloride and other chlorinated solvents. It melts and sets more slowly than ordinary waxes. When melted, it is very viscous.

Glyco Wax A

PROPERTIES

Color and Form	White wax, harder than beeswax
Luster	Good
Melting Point	58–60° C.
Flash Point	328° C.

Glyco wax A does not smoke or give off much volatile matter on heating to 260° C. It is a quick-setting wax, with a softening point within 1° C. of its melting point.

Soluble in: Hot hydrocarbons.

Uses: Cotton and rayon braid, etc., can be coated with a mixture of Glyco wax A and Flexo wax C to give a highly lustrous finish and great flexibility. The addition of oil-soluble colors will enable the coating to be used for different-colored braids. In general, the braid or lace is run through the melted wax mixture in continuous lengths and then over the brushes on polishing rollers.

Nipocer

PROPERTIES

Color and Form	Tan wax
Melting Point	46–49° C.
Specific Gravity (50° C.)	0.935

Soluble in: Hot toluol and hot mineral spirits.

Uses: Nipocer can be effectively used to replace Japan wax for pump packings because it offers all of the properties necessary for this work: flexibility, water insolubility, gasoline and oil insolubility at room temperature, tackiness, sufficient to hold graphite or other lubricant of a similar nature, lubricating qualities, and good body which are the prime requisites of a satisfactory alternative.

Nipocer blends with Japan wax, paraffin wax, beeswax, carnauba wax, rosin, etc.

Nipocer emulsifies readily with the usual emulsifying agents, giving stable, smooth emulsions.

Ozowax

PROPERTIES

Color and Form	Light brown wax
Luster	Good
Melting Point	76–85° C.
Specific Gravity (80° C.)	0.893

Blends with carnauba wax, paraffin wax, beeswax, rosin and ozokerite.

Soluble in: Hot toluol, hot mineral spirits (forms gel on cooling), hot turpentine (forms gel on cooling).

Uses: Replaces ozokerite in printing ink vehicles in the same proportions to give better spread, slip and anti-blocking effect. Ozowax is an anti-blocking agent for hot-melt vinyl coatings.

Rezo Wax A

PROPERTIES

Color and Form	Hard brown wax
Luster	High (fracture) Dull (surface)
Melting Point	107–112° C. (clear point)
Flash Point	230° C. (open cup)

Rezo wax A is a hard wax with a high melting point. It blends readily with other waxes, resins, etc.

Soluble in: Hot hydrocarbons; dispersible in hot water.

Uses: Suggested for use in recording waxes and for blending with other waxes for special effects.

Rezo Wax B

PROPERTIES

Color and Form	Hard, light brown wax
Luster	Dull
Melting Point	95–100° C. (clear point)
Flash Point	230° C. (open cup)

Similar to Rezo wax A, but somewhat cheaper in price.

Soluble in: Hot hydrocarbons; dispersible in hot water.

Uses: Replaces montan wax for certain purposes. A mixture of Rezo wax A and B, dissolved in mineral spirits or another suitable solvent in such a concentration that, on cooling, a fairly hard cake is obtained, is an excellent medium for producing high luster in the manufacture of linoleum by means of dry-brush application. Rosin may be added to give a non-slip effect, and, if desired, small percentages of paraffin wax can be added to reduce cost even below the very low price of this mixture. (Low in comparison to the customary carnauba-candellila-paraffin combinations that have been used.)

Stroba Wax

A hard light cream-colored wax with definite fracture. Melts to viscous liquid and exhibits good adhesion when in this condition. It has a melting point of 93 to 97° C.

Uses: Flatting agent in paint, varnish and lacquer; polish; insulation; metal drawing lubricant; phonograph records.

KETONES, AMINES, AMIDES AND NITRILES

16–HENTRIACONTANONE

The average molecular weight of the commercial product is 454.7. It consists of 98% ketone divided in about the following proportions:

16-Hentriacontanone	85	18-Tritriacontanone	15

The symmetrical aliphatic ketones are water-white in the pure state. The melting point of 16-hentriacontanone is 82.8° C. and the iodine number 0. Commercial samples have a light, lemon-yellow color, the melting point is 76° C. and the iodine number is 2. The boiling range is 240 to 260° C. at 0.5 mm. It is very heat stable and does not decompose readily.

SOLUBILITY OF STROBA WAX

10 cc Solvent to 1 g of Stroba Wax

	Hot Temp. in ° C.	Cold
1. Mineral Spirits	S-93	Cools milky white changing to a fine-texture translucent gel on standing
2. Turpentine	S-93	Translucent gel
3. Toluol	S-93	Translucent gel
4. Ethylene Glycol	I-130	Transparent flocculent white solid
5. Diethylene Glycol	SS-130	Same as 4 only more soluble
6. Ethylene Glycol Diacetate	SS-130	Same as 4
7. Propylene Glycol	SS-130	Same as 4
8. Triethylene Glycol	VSS-130	VSS
9. Cellosolve	I-115	I
10. Methyl Cellosolve	I-95	PS at BP affecting separation of wax into two components
11. Butyl Cellosolve	PS-97	White, finely divided suspension approaching gel
12. Cellosolve Acetate	I-95	I
13. Methyl Carbitol	PS-130	Similar to 4
14. Butyl Carbitol	I-95	I
15. Carbitol Acetate	I-95	I
16. Methyl Acetate	I-55-BP	
17. Ethyl Acetate	I-75-80-BP	
18. Butyl Acetate	PS-93	PS-MS-SP
19. Methanol	I-60-BP	
20. Butanol	PS-93	PS-MS-SP
21. n-Hexanol	S-93	Partial Suspension
22. Octanol	S-95	Milky White Suspension
23. Methyl Amyl Alcohol	S-93	Finely Divided Suspension
24. 2-Ethyl Butyl Alcohol	PS-95	PS-MS-SP
25. Tetrahydrofurfuryl Alcohol	S-130	Translucent to opaque gel
26. Synasol (Denatured Alcohol)	I-85-BP	Slush (unstable)

PS—Partially soluble. MS—Milky suspension. SP—Solid particles. SS—Slightly soluble. VSS—Very slightly soluble. BP—Boiling Point.

High-molecular-weight, aliphatic ketones are insoluble in water. They are fairly insoluble in most organic solvents at room temperature, but quite soluble above the melting point of the ketone. Because of their high molecular weight, they are inert chemically and do not react readily. They can be halogenated and reactive derivatives made from them.

Their solvent characteristics at elevated temperatures are excellent. The indicated fields of commercial utility are chemical synthesis and intermediates, waxes, polishes, moisture-proofing agents and rust-preventing compositions, oiliness addends, candle dipping, textile lubricating and softening agents.

These ketones do not deteriorate in storage and may be held indefinitely. The chief impurities are n-hexadecane and palmitic acid.

OCTADECYL-HEXADECYL AMINE

Formulas: $CH_3(CH_2)_{16}CH_2NH_2$ and $CH_3(CH_2)_{14}CH_2NH_2$

Molecular Weight (Average)	267
Percentage of Amine by Titration	More than 98%
Specific Monoamine Mixture—Parts—	
Octadecylamine	94
Hexadecylamine	6

PROPERTIES

Color	Water-white to light yellow
Initial Boiling Point	340° C.
90% Over	348° C.
Final Boiling Point	350° C.
Non-Volatile Matter	Trace
Melting Point	53° C.
Iodine No.	< 2
Moisture	None

OCTADECYLAMINE

Formula: $CH_3(CH_2)_{16}CH_2NH_2$; Molecular Weight: 269.5

PROPERTIES

Color	Water-white
Boiling Point (760 mm)	348.8° C.
Boiling Point (2 mm)	166.1° C.
Vapor Pressure (20° C.)	< 0.1 (0.1 mm at 115°)
Melting Point	55° C.
Specific Gravity	About 0.844
Weight per Gallon	About 7 lb

"CD" AMIDES [1]

High molecular weight aliphatic amides are no longer laboratory curiosities. They are now in regular, large-scale commercial production and may be obtained in almost unlimited quantities.

Code	Name	Formula
AD-1080	Octanamide	$CH_3(CH_2)_6CONH_2$
AD-1100	Decanamide	$CH_3(CH_2)_8CONH_2$
AD-1120-A	Dodecanamide	$CH_3(CH_2)_{10}CONH_2$
AD-1140-A	Tetradecanamide	$CH_3(CH_2)_{12}CONH_2$
AD-1160-A	Hexadecanamide	$CH_3(CH_2)_{14}CONH_2$
AD-1180-A	Octadecanamide	$CH_3(CH_2)_{16}CONH_2$
AD-1180-C	25%—Hexadecanamide 75%—Octadecanamide	$CH_3(CH_2)_{14}CONH_2$ $CH_3(CH_2)_{16}CONH_2$
AD-1181-A	9—Octadecanamide	$CH_3(CH_2)_7CH{:}CH.(CH_2)_7CONH_2$
AD-1181.5-C	20%—Hexadecanamide 50%—Octadecanamide 30%—Octadecadienamide	$CH_3(CH_2)_{14}CONH_2$ $CH_3(CH_2)_{16}CONH_2$ $CH_3(CH_2)_4CH{:}CHCH_2CH{:}CH(CH_2)_7CONH_2$
TAD-1181.5-C	40%—Substituted cyclic amide 30%—Octadecanamide 30%—Octadecadienamide	$(CH_3)_2CH(CH_2)_2C_{14}H_{16}CONH_2$ $CH_3(CH_2)_7CH{:}CH.(CH_2)_7CONH_2$ $CH_3(CH_2)_4CH{:}CHCH_2CH{:}CH(CH_2)_7CONH_2$

PROPERTIES

Code	Molecular Weight	Boiling Point °C.	Melting Point °C.	Iodine No.	Purity %	Free Fatty Acid %
AD-1080	143	> 200—d	(106) *	1	95	< 5
AD-1100	171		98 min. (99) *	1	95	< 5
AD-1120-A	199	200, 12 mm	" (102) *	1	95	< 5
AD-1140-A	227	217, 12 mm	" (103) *	2	95	< 5
AD-1160-A	255	236, 12 mm	" (106) *	3	95	< 5
AD-1180-A	283	251, 12 mm	" (109) *	3	95	< 5
AD-1180-C	276	245, 12 mm	" (100) *	3	95	< 5
AD-1181-A	281	> 200	76 min.	90	95	< 5
AD-1181.5-C	280	> 200	60 min.	120	95	< 5
TAD-1181.5-C	289	> 200	44 min.	130	95	< 5

* Figures in parentheses are the melting points of the C. P. amides.

[1] Armour and Company.

All of the above figures are for commercial productions. Normally the melting points range from 99 to 102° C., although 98° C. is taken as a minimum.

The solubility data on the succeeding pages were obtained by work with highly purified C.P. amides. Regular commercial productions will only approximate these figures, although they can be used as a reliable guide.

SOLUBILITIES OF AMIDES

METHANOL				ETHANOL		
10° C.	30° C.	64.7° C.	Amide	10° C.	30° C.	78.5° C.
22.1	53.0	263	A	13.4	32.8	303
6.8	15.2	170	B	4.3	12.0	350
4.2	12.4	206	C	2.9	11.4	370
1.0	2.7	56	D	1.2	3.3	180
0.7	1.2	51	E	0.4	1.5	216
0.4	0.7	23	F	0.2	0.8	124

ISOPROPANOL				n-BUTANOL		
10° C.	30° C.	82.3° C.	Amide	10° C.	30° C.	100° C.
15.7	26.3	288	A	17.1	25.8	1300
6.0	10.9	380	B	3.5	9.1	....
3.7	11.4	357	C	2.2	10.1	3550
1.2	3.2	208	D	0.8	3.8	1150
0.4	1.8	229	E	0.3	1.9	1050
0.2	1.0	172	F	0.1	1.1	590

All figures are gravimetric quantities per 100 g of solvent.

ETHYL ACETATE				BUTYL ACETATE		
10° C.	30° C.	80.1° C.	Amide	10° C.	30° C.	81.4° C.
2.2	5.7	115	A	2.6	6.0	740
0.5	2.2	123	B	0.9	2.9	....
0.5	2.5	133	C	0.4	3.0	2550
0.3	1.0	55	D	0.3	1.2	700
0.2	0.6	65	E	0.2	0.8	670
0.1	0.3	41	F	0.1	0.5	465

A—Octanamide. B—Decanamide. C—Dodecanamide. D—Tetradecanamide. E—Hexadecanamide. F—Octadecanamide.

SOLUBILITIES OF AMIDES (Continued)

TETRACHLOROMETHANE				NITROETHANE		
10° C.	30° C.	76° C.	Amide	10° C.	30° C.	100° C.
...	0.4	42.5	A	1.0	2.1	1600
...	0.2	59.0	B	0.8	1.1	....
...	0.4	72.0	C	0.8	1.1	5100
...	< 0.1	27.6	D	0.3	0.5	1500
...	0.1	46.5	E	0.2	0.3	1075
...	< 0.1	28.4	F	0.1	0.2	61

All figures are gravimetric quantities per 100 g of solvent.

BENZENE				CYCLOHEXANE		
10° C.	30° C.	80.1° C.	Amide	10° C.	30° C.	81.4° C.
0.5	0.6	153	A	...	0.1	53
0.6	0.8	195	B	...	0.4	150
0.6	1.0	238	C	...	0.5	163
0.3	0.4	95	D	...	0.2	61
0.3	0.4	145	E	...	0.3	122
0.3	0.4	89	F	...	0.3	88

ACETONE				2-BUTANONE		
10° C.	30° C.	56.5° C.	Amide	10° C.	30° C.	79.6° C.
3.4	7.8	48.4	A	3.4	8.3	163
2.0	3.8	23.9	B	2.2	3.8	189
1.3	3.4	30.5	C	1.2	3.8	194
0.4	1.0	6.4	D	0.6	1.2	100
0.3	0.8	6.9	E	0.4	1.0	118
0.2	0.5	3.7	F	0.3	0.7	79

A—Octanamide. B—Decanamide. C—Dodecanamide. D—Tetradecanamide. E—Hexadecanamide. F—Octadecanamide.

All figures are gravimetric quantities per 100 g of solvent.

High-molecular-weight aliphatic amides are readily hydrolized to the corresponding fatty acid by boiling in aqueous alkali or acid solutions. This reaction is quantitative over a period of a few hours. Care must be used in planning chemical reactions, to avoid conditions that will favor hydrolysis of the amide, to the exclusion of the desired reaction product.

These amides are unstable at temperatures above 170° C. in

the absence of catalyst, and at lower temperatures in the presence of it. This decomposition is simple, does not change the alkyl chain length, and produces equal molar proportions of the corresponding nitrile, fatty acid, and ammonia.

High-molecular-weight aliphatic amides readily react with organic halogens, to give the corresponding substituted amide, accompanied by the liberation of hydrogen halide.

One or both hydrogens, attached to the nitrogen atom in the amide group, can be substituted when heated with active metals, some organic acids, and metal oxides. This reaction can be widely used for the application of amides as chemical intermediates and in the synthesis of other products.

They are already being used as solvents for organic dyes in carbon paper manufacture. They are excellent neutral, nonionic textile softening and sizing agents when applied from an aqueous dispersion in which ordinary emulsifying agents have been used.

These high-molecular-weight aliphatic amides, because of their high melting points, are partially replacing carnauba, montan and other waxes in commercial waxing and polishing. They are also used, to some extent, in the preparation of waterproof textiles. Because of their high melting points, they should be excellent for candle-dipping and for any use where a soft, plastic, high-melting wax is desirable.

OCTADECANAMIDE—HEXADECANAMIDE

The average molecular weight of this technically pure mixed product is 275. It consists of 95% amide divided in about the following proportions:

Octadecanamide 70	Hexadecanamide 30

The aliphatic amides are water-white in their pure state. Commercial samples have a very light, lemon-yellow color. The melting point is 99° C. and the iodine number 3. The specific gravity is about 0.8. The boiling point is 241 to 251° C. at 12 mm; there is decomposition at this temperature.

High-molecular-weight aliphatic amides are insoluble in

water and almost insoluble in the usual organic solvents, at room temperature. They are quite soluble in most organic solvents, at elevated temperatures, and are themselves excellent solvents for a wide variety of high-melting resinous materials at temperatures above their melting points. They are fairly reactive chemically. Thermal decomposition begins at temperatures above 175° C. which converts half of the amide quantitatively into the corresponding nitrile, whereas the other half is converted into the corresponding free fatty acid. Strong acids and alkalies hydrolyze the amides to fatty acids. They can be condensed with formaldehyde to form substituted amides. The indicated fields of commercial utility are chemical synthesis, substituted amides, water proofing textiles, soft, plastic, high-melting waxes, emulsifiers, textile softening and lubrication, candle dipping.

Amides do not deteriorate in storage and may be held indefinitely. The chief impurity is free stearic acid.

OCTADECANE NITRILE

Formula: $CH_3(CH_2)_{16}CN$; Molecular Weight: 265.4

PROPERTIES

Color	Water-white
Boiling Point, 760 mm	357.4° C.
Boiling Point, 2 mm	174.6° C.
Refractive Index (Solid at 20°)	1.4405^{40}
Vapor Pressure (20° C.)	< 0.1 mm (0.1 mm @ 121°)
Melting Point	41° C.
Specific Gravity (41° C.)	0.8147
Weight Per Gallon	About 7 lb

OCTADECANE-HEXADECANE NITRILE

Formulas: $CH_3(CH_2)_{16}CN$ and $CH_3(CH_2)_{14}CN$

Molecular Weight (Average)	263
Per Cent of Nitrile	99%
Specific Nitrile Mixture—	
Octadecane Nitrile	94
Hexadecane Nitrile	6

PROPERTIES

Color	White to light yellow
Distillation—	
Initial Boiling Point	345° C.
95% Over	355° C.
Final Boiling Point	357° C.
Non-Volatile Matter	Trace
Melting Point	39° C.
Iodine No.	< 3
Moisture	None

SANTOWAXES

The Santowaxes are a series of solid hydrocarbons ranging in melting point from a little above room temperature to as high as 210° C. (410° F.). To facilitate selection of the proper Santowax for a specific purpose, the physical properties are tabulated as follows:

PHYSICAL PROPERTIES OF THE SANTOWAXES

Santowax	O	M	P
Color—NPA	< 1.8	2.2–4.2	0–1.25
Density—g/cc	1.14	1.164	1.236
Melting Point:	Santowaxes do not have sharp melting points.		
Begin to Soften	35° C. (95° F.)	75° C. (167° F.)	200° C. (392° F.)
Completely Liquid	50° C. (122° F.)	85° C. (185° F.)	215° C. (419° F.)
Solidification Temp.			
First Crystals	.....	< 90° C. (< 194° F.)	209–213° C. (408–415° F.)
Hold Point	52–54° C. (125.6–129.2° F.)	83–85° C. (181–185° F.)	
Distillation Range ASTM D-20 (corr.)	330–345° C. (626–653° F.)	370–378° C. (698–712° F.)	381–388° C. (718–730° F.)
Flash Point	171° C. (340° F.)	207° C. (405° F.)	207° C. (405° F.)
Flame Point	193° C. (390° F.)	229° C. (445° F.)	238° C. (460° F.)
Viscosity at 210° F. (Saybolt Univ. Sec.)	40.6	39.3 (See chart)	28.8 (225° C.)

Stability: No detectible effect on Santowaxes from boiling 10% sulfuric acid or caustic soda.

VAPOR PRESSURE—MILLIMETERS OF MERCURY

	mm Hg			
T° C.	O	M	P	
90	0.17	....	....	
100	0.3	....	....	
110	0.5	0.15	....	
120	0.9	0.3	....	
130	1.5	0.5	....	
140	2.4	0.8	0.15	Solid
150	3.7	1.3	0.3	
160	5.7	2.0	0.6	
170	8.2	3.0	1.0	
180	12.0	4.6	1.9	
190	18.0	6.8	3.2	
200	25.0	9.8	5.5	
210	35.0	14.0	9.1	
220	46.0	19.0	14.0	
230	62.0	26.0	19.0	
240	82.0	36.0	26.0	
250	110.0	48.0	35.0	
260	140.0	63.0	46.0	
270	180.0	83.0	61.0	
280	230.0	110.0	80.0	
290	290.0	140.0	101.0	
300	360.0	180.0	130.0	
310	450.0	220.0	165.0	
320	550.0	270.0	210.0	
330	670.0	340.0	260.0	
340	810.0	410.0	320.0	
350	990.0	500.0	390.0	
360	1160.0	610.0	470.0	
370	1390.0	730.0	570.0	
380	1600.0	870.0	680.0	

ELECTRICAL PROPERTIES

	Dielectric Constant	Resistivity—ohm/cm³ 100° C.	250° C.
Santowax O	2.54	$8{,}200 \times 10^9$	.....
Santowax M	2.62	$2{,}600 \times 10^9$	.....
Santowax P	...	.....	30×10^9

COMPATIBILITY OF THE SANTOWAXES

Santowax M

Other Component	% Santowax M in Mixture 10	25	50	75	90
Paraffin Wax (120/125° F.)	Incompatible with 2% or more Santowax M				
Barnsdall Wax (160/165° F.)		C	B	I	I
Ceresin	I		I		I
Carnauba Wax	C		C	C	I
Candelilla Wax	C	C	I		I
Montan Wax	I		I		I
Beeswax	I		I		I
Japan Wax	C	I	I		
Opal Wax	C	C	I		I
I. G. Wax O	I		I		I
Stroba Wax	I		I		I
Acrawax	C		C		B
Stearic Acid	I		I		I
Shellac	C		I		I
Manila Resin (Loba B)	C		I		I
Ester Gum	C		I		I
"N" Wood Rosin (Hercules)	C	C	I		I
Piccolite Resin (85° C.)	C		I		I
Staybellite Resin	B		I		I

Santowax O

Other Component	% Santowax O in Mixture 10	25	50	75	90
Paraffin (120/125° F.)	C		C		C
Barnsdall Wax (160/165° F.)	C		C		C
Beeswax	C	C	C		I
Opal Wax	C		I		I
Stearic Acid	I	I	I		I
"N" Wood Rosin	C	C	I	I	

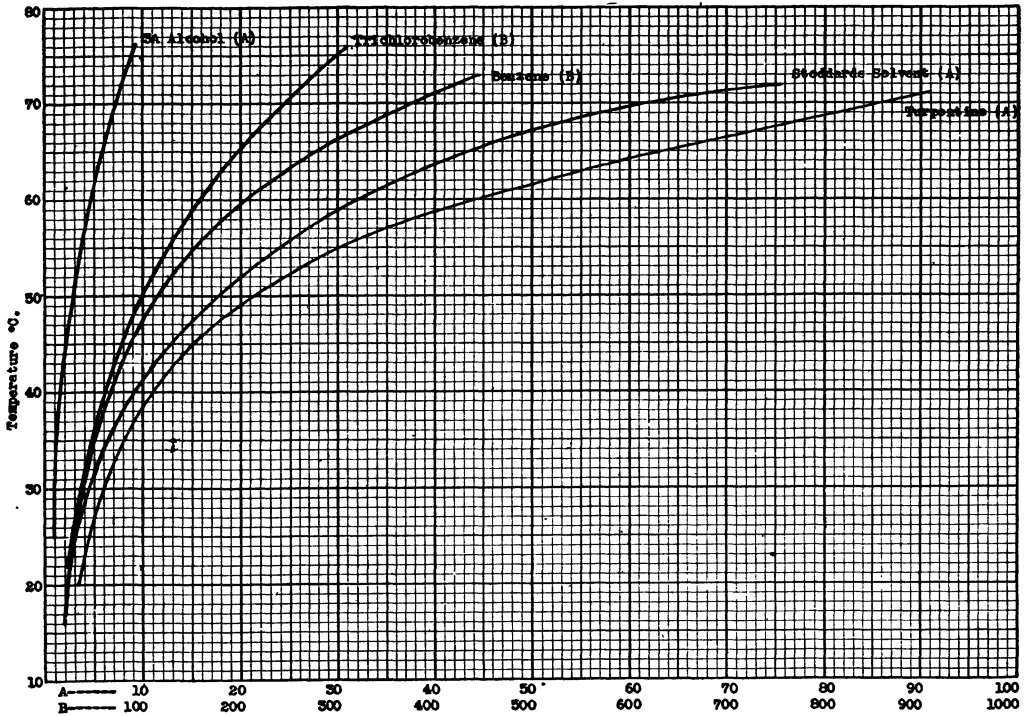
Santowax P

Other Component	% Santowax P in Mixture 0.5	1–2	3	5	10–75
Paraffin Wax (120/125° F.)	I				
Paradene No. 1				C	I
Paradene No. 2		C	I		
"N" Wood Rosin					I

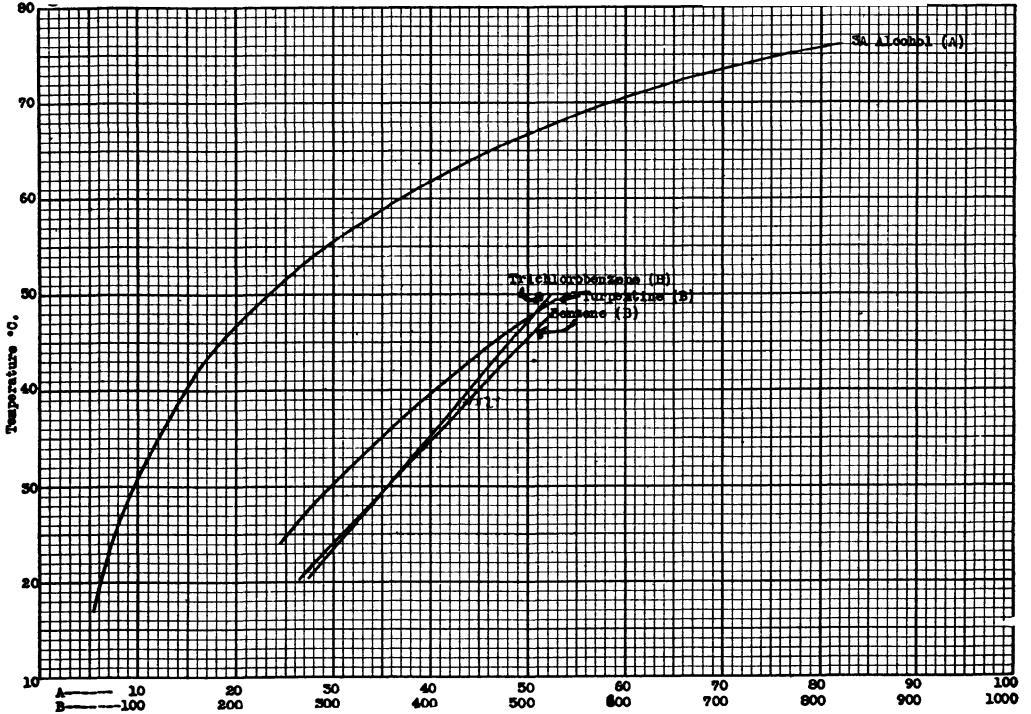
C = Compatible; I = Incompatible; B = Almost Compatible.

Uses: Santowax O—Rust-inhibiting coatings for steel; Santowax M—Moistureproofing compositions for paper; Santowax P—High-melting, moistureproof, impregnation compositions for paper and strawboard.

SOLUBILITY OF SANTOWAX M



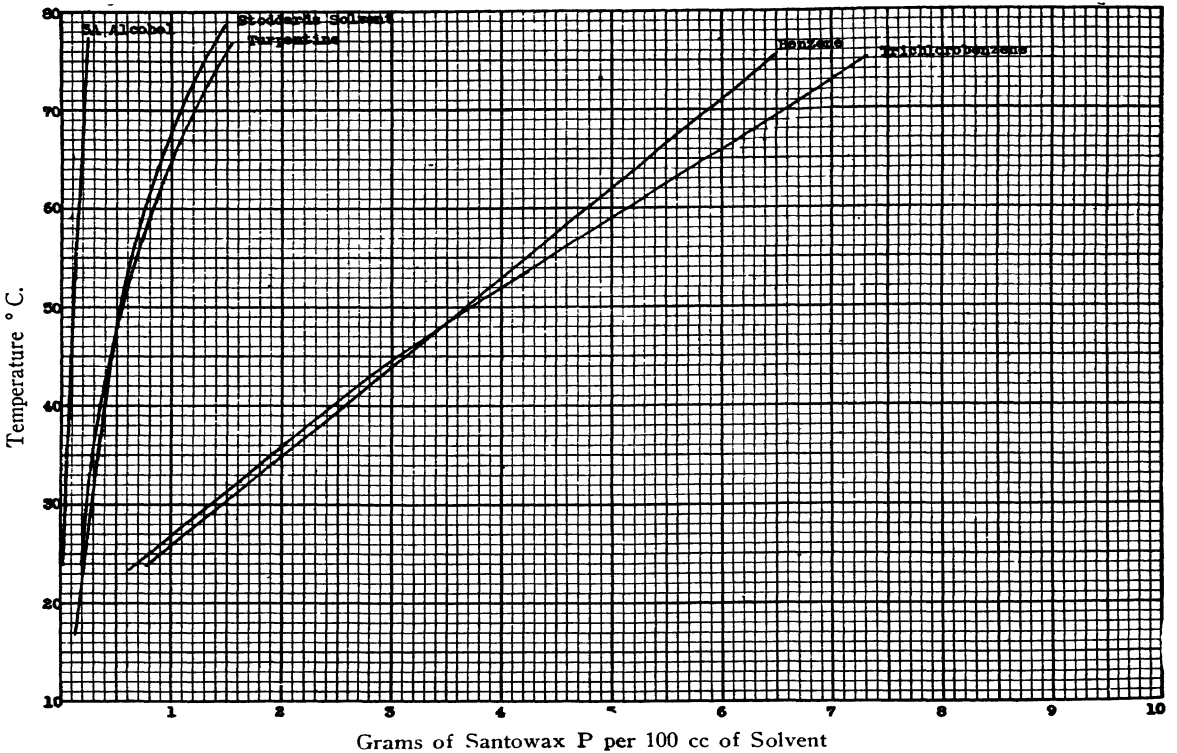
SOLUBILITY OF SANTOWAX O



Grams of Santowax O per 100 cc of Solvent

VISCOSITY OF SANTOWAX O

SOLUBILITY OF SANTOWAX P



SANTOWAX OSA AND SANTOWAX PSA

PROPERTIES

	OSA	PSA
Color in 25% n-butyl alcohol—NPA	1.0	2.0–2.2
Density g/cc	0.99 @ 29.5° C.	1.04 @ 28.9° C.
Refractive Index	.....	1.58
Softening Point	59–59.2° C.	139.2–139.5° C.
Crystallizing Point	50–52.2° C.	135.5–136° C.
Flash Point	246° C.	268° C.
Fire Point	279° C.	318° C.
Decomposition Point	232° C.	193–204° C.
Acid No.	4.7	0–1

Penetration ASTM–D5–25 Load	50 g	100 g	150 g	200 g	50 g	100 g	150 g	200 g
cm × 10^{-2} at 25° C. for 60 sec	4.4	10.0	13.2	17.3	15.8	25.9	32.2	36.2

Solubility at ° C.	25	75	25	75
Benzene	sol.	sol.	ins.	sol.
Ethanol	ins.	ins.	ins.	ins.
Naphtha	sol.	sol.	ins.	ins.
Trichlorobenzene	sl. sol.	sol.	ins.	sol.
Turpentine	sol.	sol.	ins.	ins.

ins. = less than 5% (by weight). sl. sol. = 5–10%. sol. = more than 10%.

Uses: Polishes, wax finishes, paints, cosmetics, paper coating, opacifier, sealing compounds.

SANTOWAX R (REGULAR)

Santowax R is a high-melting hydrocarbon wax of unusual stability toward heat. There is no detectible action on Santowax R from boiling 10% H_2SO_4 or boiling 10% NaOH.

PROPERTIES

Density @ 25° C.—g/cc	1.133
Color—NPA	4–5
Melting Point	
Santowax R does not have a sharp melting point.	
Begins to Soften	60° C. (140° F.)
Completely Liquid	140° C. (284° F.)
Solidification Temp.	
Upper Hold Point	140–145° C. (284–293° F.)
Lower Hold Point	60– 65° C. (140–149° F.)
Distillation Range D-20 Modified (Corrected)	364–418° C. (687–784° F.)
Flash Point	191° C. (375° F.)
Flame Point	238° C. (460° F.)

VAPOR PRESSURE—MILLIMETERS OF MERCURY

T ° C.	mm Hg	T ° C.	mm Hg	T ° C.	mm Hg
150	1.3	230	26	310	220
160	2.0	240	36	320	270
170	3.0	250	48	330	340
180	4.6	260	63	340	410
190	6.8	270	83	350	500
200	9.8	280	110	360	610
210	14.0	290	140	370	730
220	19.0	300	180	380	870

ELECTRICAL PROPERTIES

Dielectric Constant		2.58
Resistivity—ohm/cm[3] @	100° C.	$140{,}000 \times 10^9$
	135° C.	$35{,}000 \times 10^9$
	155° C.	550×10^9

COMPARATIVE HARDNESS

(Smaller figure denoting greater hardness)

Wax	Average penetration in cm $\times 10^{-2}$ in 60 seconds at 25° C. under load indicated. ASTM D-5-25. Load 50 Grams	150 Grams	250 Grams
Santowax M	0	0	2.3
Santowax P	0	0	3.3
Carnauba Wax	0	2.3	4.7
Candelilla Wax	0	3.3	4.7
Santowax O	1.3	4.0	10.7
50% Paraffin Wax & 50% Santowax M	3.7	12.3	18.0
75% Paraffin Wax & 25% Santowax M	7.3	18.0	25.3
Ceresin Wax	9.3	15.7	26.0
95% Paraffin Wax & 5% Santowax M	10.7	21.0	29.7
98% Paraffin Wax & 2% Santowax M	11.7	26.0	32.7
Paraffin Wax	14.3	23.3	31.3
Santowax R—aged 24 hrs.	28.7	...	...
Santowax R—non-aged	60.0	...	...

SOLUBILITY

Solvent	Grams Santowax R per 100 ml of Solvent 25° C.	75° C.
3A Alcohol	0.008	0.6
Turpentine	1.2	9.0
Fuel Oil, API 36° SUS 100° F.—38	1.66	8.4
Benzene	6.0	42.0
Trichlorbenzene	9.0	45.0
Stoddard's Solvent	0.7	8.0
Nitromethane	0.2	7.5
Nitroethane	2.0	15.0
1-Nitropropane	2.0	20.0
2-Nitropropane	2.0	20.0

COEFFICIENTS OF THERMAL EXPANSION OF SANTOWAX R

Temp. Range ° C.	Coefficient of Cubical Expansion Vol./Unit Vol./° C.	Coefficient of Linear Expansion Length/Unit Length/° C.
25–60	8.3×10^{-4}	2.8×10^{-4}
60–77	11.5×10^{-4}	3.8×10^{-4}
25–77	9.4×10^{-4}	3.1×10^{-4}

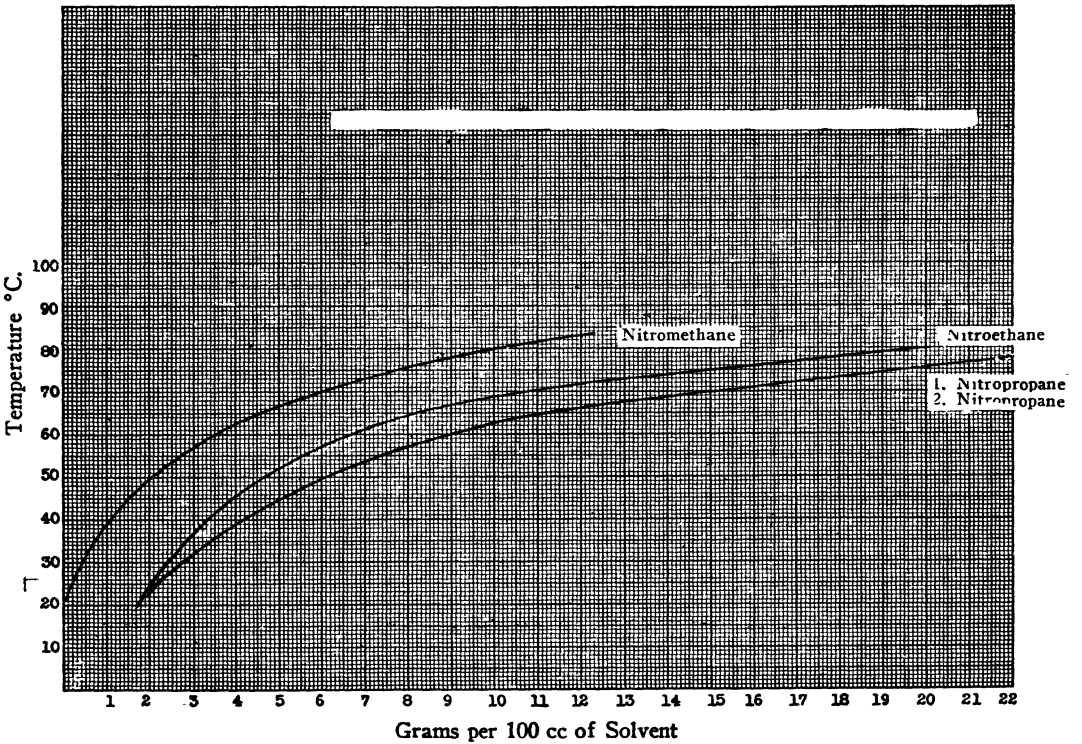
SOLUBILITY

20% Solution of Santowax R

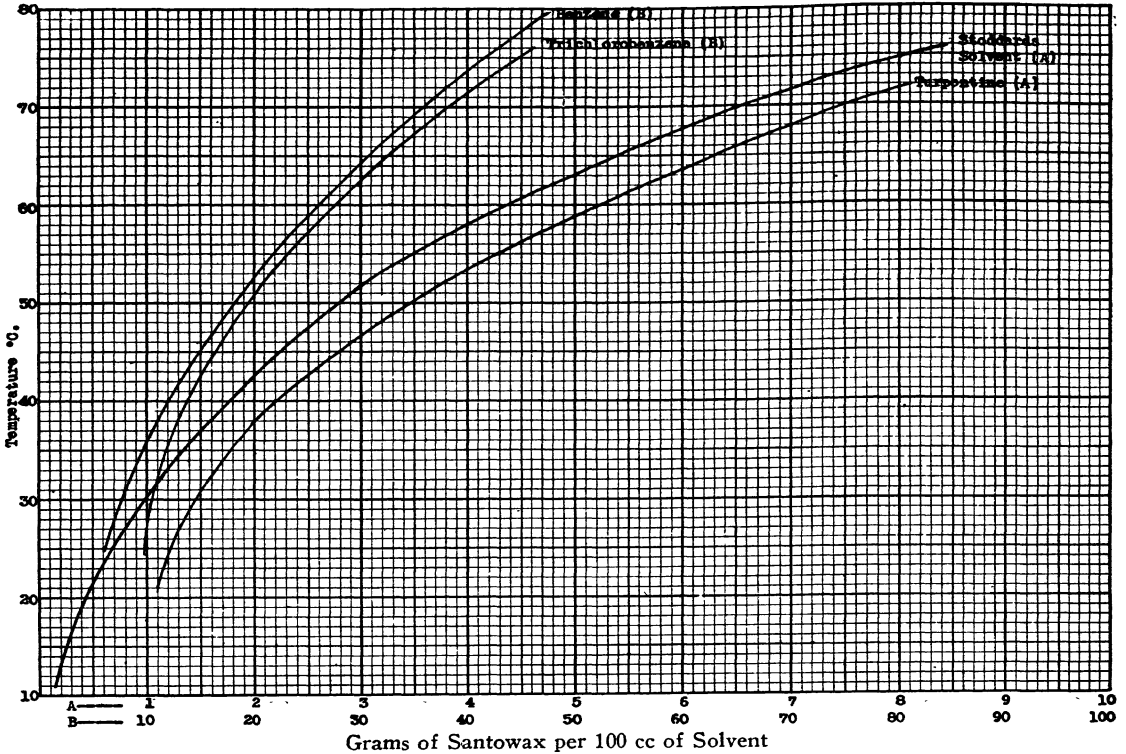
Solvent	Minimum Temp. ° C. for Complete Solution (20 g Santowax R and 80 g Solvent)
Tetrachlorethane	53
Dioxane	58
Orthodichlorbenzene	58
Benzoyl chloride	60
Monochlorbenzene	60
Trichlorbenzene (mixed isomers)	60
Benzyl chloride	62
Benzene	64
Trichlorethylene	64
Pyridine	66
Chlornaphthalene	72
Furfural	72
Xylene	72
Bromonaphthalene	73
Diphenyl oxide	76

Uses: Impregnant for paper to increase moisture resistance and as a plasticizer in synthetic resin-bodied paints

SOLUBILITY OF SANTOWAX R (REGULAR) IN NITROPARAFFIN SOLVENTS



SOLUBILITY OF SANTOWAX R (REGULAR)



CHAPTER III

PHYSICAL PROPERTIES OF WAXES AND WAX COMPOSITIONS

INCREASING VISCOSITY OF MOLTEN WAXES

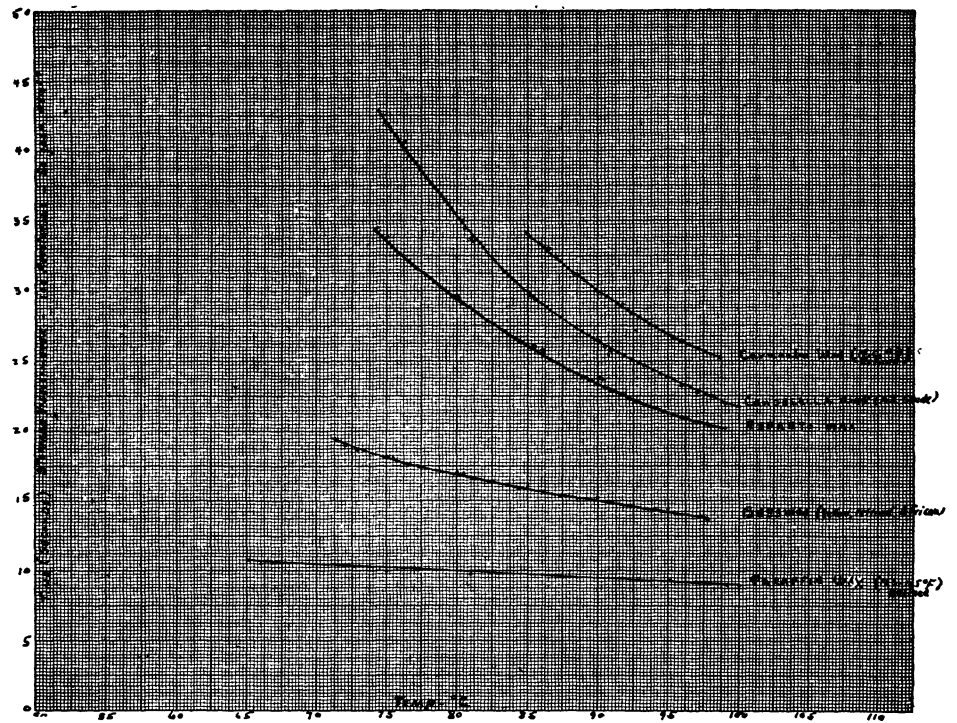
In certain hot-wax operations, it is desirable to increase the viscosity of the wax melt in order to decrease penetration, to increase the coating thickness, to facilitate pickup by rollers, brushes, etc., or for other reasons. To attain this end, the wax is melted and there is incorporated therein, with further heating and mixing, a metallic soap [1] (e.g., aluminum stearate), rubber, polybutenes, methacrylate polymers, synthetic resins, cellulose ethers, Acrawax, Strobawax or other bodying ingredients.

STORMER VISCOSITIES OF WAXES AT 95° C.
50 Gram Wt. (Baffled Cup)

	Stormer Seconds/100 Revolutions
Socony Paraffin Wax 123 to 125° F.	9¼
Dallawax (Black 190° F.) (Dallas Laboratories)	27¼
Candelilla Wax (Prime A1 Grade)	22
Z–52 Wax (Allied Asphalt)	15½
Utah Wax	24¼
Carnauba Wax N C #3 (Settled Crude)	39¾
Ouricury Wax (Settled Crude)	80½
Norcowax 26 (Neatsfoot Oil Refineries)	35¼
Gulf Process Wax #4	14.0
Dallas Soft Wax (Black)	9¾

[1] Where the wax composition contains some free higher fatty acid (e.g., stearic acid) or an ester of the same, a metallic soap is formed *in situ*, by mixing in a metallic oxide, hydroxide, or carbonate (e.g., magnesium oxide) and heating above 100° C. with stirring.

STORMER VISCOSITY OF WAXES



PENETRATION

Candelilla and paraffin waxes have very good wetting or penetrating qualities, when applied to paper. The addition of small amounts of Acrawax to certain wax or oil compositions often assists penetration. Increasing the temperature, lowering the viscosity or the addition of solvents will also increase penetration. In certain cases, as in the use of insulating compounds, the material is pre-heated or treated in a vacuum to remove moisture, air or other substances which would hinder the wetting or penetration of wax.

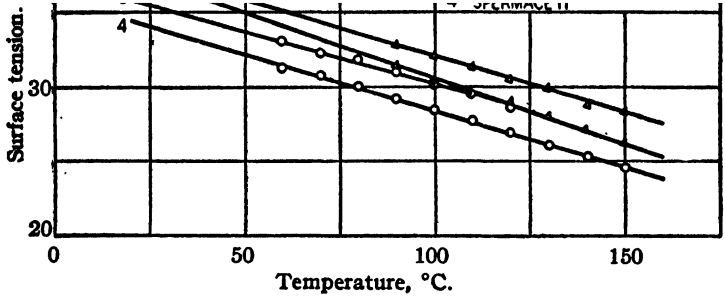
Where only a surface coating, with a minimum of penetration is desired, it is necessary to apply the wax composition at the lowest possible temperature. Other methods are to increase the viscosity; to apply to a chilled or damp surface; or the addition of a suitable, high-melting material. Carnauba wax or Acrawax C is used for this purpose. Either of these, for example, is added to paraffin wax and heated until just dissolved. On application, the high-melting waxes precipitate first, at a temperature above the melting point of the paraffin wax, and form a solid layer on the surface of the material being coated. This prevents penetration of the paraffin wax. As the higher-melting waxes are hard, a stiffening effect, beyond that obtainable with paraffin wax, results.

SURFACE TENSION OF WAXES[1]

Most waxes exhibit low surface tensions. Carnauba wax and opal wax give large contact angles with water and high-surface-tension organic liquids. Soft waxes, of low surface tension, are wetted more readily by liquids than hard waxes of higher surface tension.

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[1] F. E. Bartell and H. H. Zuidema, *J. Am. Chem. Soc.* **58**, 1453 (1936).



CONTACT ANGLES IN AIR AND INTERFACIAL CONTACT ANGLES FORMED BY A SERIES OF LIQUIDS ON WAXES

	Carnauba Wax		Opalwax	
	θ 1n	θ n3	θ 1n	θ n3
Water	107°		119°	
Methylene Iodide	70°	128°	77°	123°
Acetylene Tetrabromide	65°	140°	72°	136°
α-Bromonaphthalene	57°	146°	65°	149°
Benzyl Alcohol	58°	142°	67°	134°
Ethylene Dibromide	49°	145°	50°	151°
Bromobenzene	45°	148°	35°	156°
Chlorobenzene	35°	153°	27°	159°
Toluene	26°	154°	26°	161°
Butyl Acetate	0–10°	166°	24°	153°
Amyl Alcohol	0°	149°	25°	120°
Benzene		152°		157°

CONTACT ANGLE MEASUREMENTS ON WAXES [2]

	Temp. ° C.	Contact Angle Degrees	Effective Adhesion Tension Dynes/cm
Paraffin Wax, Amorphous	31	110.2	-24.9
Ozokerite, Yellow	29	110.0	-24.6
Ozokerite, Bleached	29	113.2	-28.4
Beeswax	30	107.6	-21.8
Carnauba Wax, Crude	28	122.8	-39.0
Carnauba Wax, Refined	27	125.3	-41.6
Candelilla Wax	29	111.5	-26.4
Spermaceti	26	110.2	-24.9
Japan Wax	27	102.9	-16.1
Montan Wax, Crude	..	139.8	-55.0

ADHESIVENESS

Most waxes are non-adhesive and slippery. Flexo wax C (a hydrocarbon wax) is one of the few unblended waxes that possesses adhesive properties. It is only a weak adhesive but is suitable for certain laminating and other uses. Waxes can be given various degrees of adhesiveness by compounding with oils, rubber (natural and synthetic), resins (natural and synthetic) and various organic compounds such as resin esters, cellulose esters, rubber derivatives, shellac, chlorinated diphenyls, etc.

The inclusion of Staybelite esters in paraffin waxes increases their gloss, transparency, and adhesion to various supporting substrata. The effect on physical properties, as measured by degree of hardness, of the inclusion of 5% of each of the Staybelite esters on 125° F. M.P. paraffin, is given in the table below.

It will be noted that Staybelite ester No. 10 causes relatively little change in the hardness or embrittlement of paraffin, its chief function being to add gloss, transparency, and adhesion.

Depending on the ester chosen, Staybelite esters No. 1 and No. 2 show a definite softening action on paraffin, while Staybelite ester No. 3 exerts exceptionally powerful plasticizing action on this wax. On exposure at 0 to 3° C. the Staybelite ester No. 3 modified paraffin film after storage for 24 hours showed no exudation of the plasticizer. It appears that this ester may have some effect in increasing the low temperature flexibility of paraffin. These resins may be used in preparing wax adhesives, sizes, coatings, and laminating formulations.

Hercules Staybelite esters No. 1, 2, 3, and 10 show less tendency to sludge in molten paraffin blends than similar unhydrogenated rosin esters.

PENTRATION * OF MODIFIED 125° F. M.P. PARAFFIN WAX

Type Modification	At 32° F.	At 77° F.
Control (100% Paraffin Wax)	14	22
Staybelite Ester No. 10 (5%)	14	21
Staybelite Ester No. 1 (5%)	15	25
Staybelite Ester No. 2 (5%)	18	27
Staybelite Ester No. 3 (5%)	18	28

* As measured by ASTM Penetrometer.

INCREASING COMPATIBILITY

Certain waxes are incompatible with other waxes, resins or other materials. The addition of another mutually soluble or thickening agent often produces compatibility.

Approximately 1% of aluminum stearate stirred into a mixture of melted waxes until the entire mixture is uniform will prevent separation of some waxes. Thus 10% Acrawax and 89% paraffin wax are held together by this treatment. Considerable variation is permissible. The viscosity of the melt is increased and clarity is not perfect, but compatibility is maintained, apparently indefinitely. This procedure may be of interest when applied to other incompatible waxes.

INCREASING MELTING POINTS OF WAXES

The admixture of higher-melting materials does not necessarily raise the melting point of waxes proportionally. In some cases the melting point is only increased slightly. In other cases the melting point may even be reduced.

The addition of carnauba wax or ozokerite to other waxes is practiced to increase the melting point, particularly of hydrocarbon waxes like paraffin. The addition of 1% Acrawax to carnauba wax raises the latter's melting point 3° C.

Fatty acid or fatty acid ester waxes are treated with small amounts (~ 1.2%) of metallic oxides, hydroxides or carbonates at ~ 100° C. to increase their melting points, e.g., beeswax with magnesium oxide. The metal reacts with the fatty acid to form a metallic soap.

Ethyl cellulose has an unusual effect in increasing the melting point of waxes, as well as increasing the toughness, hardness and luster. In the table below one can observe the effect of adding 25% of a low viscosity ethyl cellulose to various waxes.

	M.P. ° C.	M.P. ° C. With 25% Ethyl Cellulose
Glyco Wax A	58–60	142.5
Glyceryl Monostearate	56–57	125.0
Gelowax	63	128.0
Diglycol Stearate S	52–55	110.0
Acrawax B	81–84	120.5
Acrawax	95–97	134.7

EFFECT OF ETHYL CELLULOSE ADDITION ON MELTING POINT OF WAXES

Composition %		Drop Melting Point ° C.		
Wax	Ethyl Cellulose	Purified Montan Wax	Bleached Beeswax	Stearic Acid
100	..	69.5	62.5	55.0
90	10	86.5	103.5	56.0
75	25	115.0	144.0	71.0
66.7	33.3	117.5	....	87.0
50	50	134.5	182.0	114.0

EFFECT OF CARNAUBA WAX ADDITION ON MELTING POINTS OF WAXES

Carnauba Wax M.P. 85 ° C. % Added	Ceresin Wax M.P. ° C.	Paraffin Wax M.P. ° C.
0	72.7	60.1
5	79.1	73.90
10	80.56	79.20
15	81.60	81.10
20	82.53	81.10
25	82.95	81.10

INCREASING MELTING POINT OF PETROLATUM

Maximum increase in degrees, per percentage of wax added, usually runs around 3 to 5% of wax addition, for a variety of materials. But for white beeswax, 5% increases melting point 2°, 10% increases 5°, 20% increases 9°; obviously, the optimum amount is somewhere between 10 and 20% beeswax. In the case of yellow beeswax, 5% increases melting point 2°, 10% increases 10° and 20% increases 17°. It may be seen that yellow beeswax is better than white beeswax for increasing the melting point of petrolatum.

WAX SHRINKAGE

Wax	Volume When Melted	Volume When Cold (22° C.)	% Expansion on Melting
Carnauba Wax	26.0	20.2	29.9
Ouricury Wax	26.0	20.0	30.0
Fiber Wax	24.0	20.0	20.0
Paraffin Wax (M.P. 125° F.)	23.5	22.2	5.9
Montan Wax	24.0	15.8	60.5
Utah Wax #4 Yellow	28.0	24.0	16.6
B.Z. Wax A	27.0	20.0	35.0

ANILINE POINT OF WAXES[1]

Beeswax	62–65
Carnauba Wax	78
Japan Wax	36–37
White Wax	61
Paraffin Wax	115–117

WATER ABSORPTION OF WAXES AND OTHER MATERIALS

(After Six-months Immersion)

Material	Final Water Content	Difference in Initial and Final Weights
	Per Cent	Per Cent
Candelilla Wax	0.13–0.20	0.00
Carnauba Wax	0.72–0.90	0.00
Montan Pitch	0.09–0.11	+0.22 to +0.27
Montan Wax	0.62–0.67	+0.02
Japan Wax	0.26–0.58	–1.02 to –1.4
Chinese Wax	0.75–1.16	–0.53 to –0.81
Bayberry Wax	6.1	–0.50
Beeswax	0.42–0.43	–0.13 to –0.20
Ozokerite	0.85–1.20	–1.0 to –1.3
Ceresin	0.04–0.05	0.00 to –0.05
Paraffin Wax	0.04–0.06	–0.43 to –0.66
Paraffin Wax	0.06–0.11	–0.66 to –0.71
"Superla Wax"	0.00–0.03	–0.02
"Naudella Wax"	0.50	+0.15
Zinsser's Insulating Wax	1.72–2.21	–0.03 to 0.00
Zinsser's Insulating Wax—Beeswax	1.5 –2.4	–1.4 to 2.4
Paraffin—Beeswax	0.11–0.54	–0.18 to –0.31
Paraffin—Rosin—Rosin Oil—Carnauba	0.32–0.33	–0.42 to –0.48
Paraffin—Rosin—Hydrated Lime	0.17	+0.50
Zinc Stearate	3.0	+0.45
Aluminum Stearate	2.7	+0.20
Blown Gilsonite and Residual Petroleum Oil	3.3	+0.63
Cumar Resin	0.41	–0.04 to 0.00
Rosin	0.46	–0.28
Manila Copal	0.41–0.60	0.00
Stearin Pitch	1.23–1.40	+0.30 to +0.48
Soft Blown Petroleum Asphalt	0.47–0.52	–0.02 to 0.00
Soft Blown Petroleum Asphalt—Rosin—Rosin Oil	0.44–0.56	–0.05 to 0.00
Spermaceti Wax	1.27–2.11	–0.37
Shellac	4.3 –5.1	–1.9 to 0.00
Halowax	0.20–0.28	–0.15
Stearic Acid	3.2 –4.0	–0.2 to –0.4

[1] C. G. Katrakis, *Praktika Akad. Athenon* **5**, 311 (1930).

EFFECTS OF WAX SIZE ON MOISTURE ABSORPTION OF INSULATING BOARD [1]

The results of wax sizing are shown in the following table. Two per cent wax produces a board having a moisture absorption in one-half hour of 30.7%, which, although not satisfactory, shows definite sizing action. The absorption with 4.4% wax is 18.7% which is still somewhat high. When 6% wax is used, the sizing is excellent, there being an absorption of only 11.4%. The hydrogen ion content of the white water (that is the water drained away from the board in the process of formation) varies from *p*H 7 to 8 or nearly neutral.

EFFECT OF WAX SIZE ON THE MOISTURE ABSORPTION OF CORNSTALK INSULATING BOARD

Board No.	Per Cent Wax Used	Per Cent Moisture Absorption in ½ Hour
1	2.0	30.7
2	4.4	18.7
3	5.5	13.0*
4	6.0	11.4
5	7.1	9.8
6	8.8	11.0

* Board only ¼ inch thick; other boards ½ inch.

The wax emulsion used for sizing is made as follows: 300 cc of water, 3 g of triethanolamine, and 9 g of stearic acid are boiled gently with stirring. To this is added 88 g of melted paraffin wax, with vigorous stirring. The wax sizing emulsion is added to the pulp in the usual manner but is precipitated on the fibers by the addition of calcium chloride, 3 g of calcium chloride to 25 g of wax giving good results.

PLIOLITE—PARAFFIN WAX COMPOSITIONS

The addition of 5% Pliolite to paraffin wax compositions improves the waterproofing qualities for paper. However, the

[1] Arnold, *Paper Ind.* **25**, 156 (1943).

Pliolite seems to hinder penetration so that, under certain methods of treatment, its beneficial effect is cancelled by its lack of penetration. Oxidation inhibitors are ineffective in preventing the oxidation of paraffin wax in the presence of Pliolite. This prevents the use of Pliolite-paraffin wax compositions where the waxes must be held at a high temperature for a long period of time.

REFRACTIVE INDICES (n^t_D) OF NORMAL SATURATED FATTY ACIDS [1]

Acid	20.0° C.	25.0° C.	30.0° C.	40.0° C.	45.0° C.	50.0° C.
Caproic	1.4170	1.4150	1.4132	1.4095		1.4054
Enanthic	1.4230	1.4209	1.4192	1.4155		1.4114
Caprylic	1.4280	1.4260	1.4243	1.4205		1.4167
Pelargonic	1.4322	1.4301	1.4287	1.4250		1.4210
Capric				1.4288		1.4248
Hendecanoic				1.4319		1.4279
Lauric					1.4323	1.4304
Tridecanoic						1.4328

Acid	55.0° C.	60.0° C.	65.0° C.	70.0° C.	80.0° C.
Caproic		1.4012		1.3972	1.3931
Enanthic		1.4073		1.4037	1.3993
Caprylic		1.4125		1.4089	1.4049
Pelargonic		1.4171		1.4132	1.4092
Capric		1.4210		1.4169	1.4130
Hendecanoic		1.4240		1.4202	1.4164
Lauric	1.4288	1.4267	1.4250	1.4230	1.4191
Tridecanoic	1.4310	1.4290	1.4272	1.4252	1.4215
Myristic	1.4329	1.4310	1.4291	1.4273	1.4236
Pentadecanoic	1.4348	1.4329	1.4310	1.4292	1.4254
Palmitic			1.4328	1.4309	1.4272
Margaric			1.4340	1.4324	1.4287
Stearic				1.4337	1.4299

DENSITIES OF NORMAL SATURATED FATTY ACIDS AT 80° C.

Acid	d^t_4	Acid	d^t_4
Caproic	0.8751	Tridecanoic	0.8458
Enanthic	0.8670	Myristic	0.8439
Caprylic	0.8615	Pentadecanoic	0.8423
Pelargonic	0.8570	Palmitic	0.8414
Capric	0.8531	Margaric	0.8396
Hendecanoic	0.8505	Stearic	0.8390
Lauric	0.8477		

[1] A. Dorinson, M. R. McCorkle, A. W. Ralston, *J. Am. Chem. Soc.* **64**, 2739 (1942).

ELECTRICAL CONSTANTS OF WAXES AND OTHER MATERIALS[1]

Dielectric Constant

No.	Material	Initial [a]	After Immersion [b]	Final [c]
1	Candelilla Wax	2.38–2.49	2.50–2.62	2.45–2.56
2	Carnauba Wax	2.66–2.83	3.84–4.19	2.82–2.83
3	Montan Pitch	2.60–2.62	2.63–2.68	2.60–2.62
4	Montan Wax	2.62–2.67	2.88–3.05	2.68
5	Japan Wax	2.96–2.99	3.15–3.20	2.91
6	Chinese Wax	2.94–2.98	3.62–3.89	2.95–2.97
7	Bayberry Wax	3.22–3.27	10.4	3.31
8	Beeswax	2.87–2.88	3.11–3.26	2.84–2.90
9	Ozokerite	2.37–2.43	2.50–2.55	2.40–2.47
10	Ceresin	2.16–2.24	2.29–2.32	2.28–2.29
11a	Paraffin Wax	2.21–2.24	2.31–2.38	2.24–2.27
11b	Paraffin Wax	2.19–2.24	2.37–2.55	2.26–2.30
12	"Superla Wax"	2.32–2.35	2.36–2.37	2.34–2.35
13	"Naudella Wax"	2.50	3.37	2.63
14	Zinsser's Insulating Wax	3.98–4.27	21	5.2 –6.5
15	Zinsser's Insulating Wax—Beeswax	3.21–3.40	14.0–14.2	3.64–3.83
16	Paraffin—Beeswax	3.50–3.55	3.55–3.61	2.53
17	Paraffin—Rosin—Rosin Oil—Carnauba	2.45–2.47	2.58–2.58	2.48
18	Paraffin—Rosin—Hydrated Lime	2.67	2.64–2.69	2.60–2.68
19	Zinc Stearate	2.58	5.83	
20	Aluminum Stearate	2.62–2.78	4.93–5.27	2.57
21	Blown Gilsonite and Residual Petroleum Oil	2.53–2.54	2.92–3.03	2.58
22	Cumar Resin	2.79–2.80	2.87–2.92	2.66
23	Rosin	2.69–2.76	2.81–2.87	
24	Manila Copal	3.05–3.09	3.22–3.38	2.63
25	Stearin Pitch	3.34–3.41	3.55–3.60	3.26
26	Soft Blown Petroleum Asphalt	3.07–3.12	2.90–3.03	2.96
27	Soft Blown Petroleum Asphalt—Rosin—Rosin Oil	3.07–3.22	2.94–3.04	2.88
28	Spermaceti Wax	3.60–3.75	6–17	3.74–3.89
29	Shellac	3.62–3.71	7.7 –> 20	3.58
30	Halowax	3.63–3.83	4.24–6.37	3.97–4.23
31	Stearic Acid	2.37–2.41	> 20	2.33–2.38

[1] J. A. Lee & H. H. Lowry, *Ind. Eng. Chem.* **19**, 304 (1927).

Effective A-C Conductivity
(Unit = 10^{-12} mho cm)

No.	Material	Initial [a]	After Immersion [b]	Final [c]
1	Candelilla Wax	6.0–6.4	18	9.3–9.4
2	Carnauba Wax	4.9–5.3	240–300	74–75
3	Montan Pitch	20–21	25–26	24
4	Montan Wax	29–31	45–55	25
5	Japan Wax	9–12	33–34	13
6	Chinese Wax	125–137	189–210	120–123
7	Bayberry Wax	89–105	6000	110
8	Beeswax	45–48	70–85	56–58
9	Ozokerite	10–12	19–24	15
10	Ceresin	< 0.37	10–12	1.1
11a	Paraffin Wax	< 0.37	3–7	0.74–0.8
11b	Paraffin Wax	< 0.37	16–22	< 0.74–0.9
12	"Superla Wax"	4.2–4.6	2.1	0.37
13	"Naudella Wax"	16	110	16
14	Zinsser's Insulating Wax	48–60	600–2500	250–375
15	Zinsser's Insulating Wax—Beeswax	80–95	2000–2800	89–120
16	Paraffin—Beeswax	22–26	30–39	15–18
17	Paraffin—Rosin—Rosin Oil—Carnauba	23–24	30–32	18
18	Paraffin—Rosin—Hydrated Lime	3.2–3.9	18–20	8
19	Zinc Stearate	5.7	210	
20	Aluminum Stearate	13–17	74–130	12
21	Blown Gilsonite and Residual Petroleum Oil	14	126	22
22	Cumar Resin	9.0–9.7	15–17	1.0
23	Rosin	2.4–6.2	7.4–7.7	4.2–5.0
24	Manila Copal	7–15	21–23	17
25	Stearin Pitch	67–75	77–81	57
26	Soft Blown Petroleum Asphalt	35–43	32–42	30
27	Soft Blown Petroleum Asphalt—Rosin—Rosin Oil	36–43	56–58	33–35
28	Spermaceti Wax	6.0–6.6	500–100,000	10–12
29	Shellac	16–17	40,000–910,000	17
30	Halowax	4.4–7.4	24–40	3–4
31	Stearic Acid	4.4–12	> 130,000	5–6

Volume Resistivity

(Unit = 10^{13} ohms cm)

No.	Material	Initial [a]	After Immersion [b]	Final [c]
1	Candelilla Wax	> 290	> 110	> 630
2	Carnauba Wax	60–120	0.3–4	270
3	Montan Pitch	> 290	75–160	> 1200
4	Montan Wax	> 290	> 270	> 610
5	Japan Wax	6–7	0.40–0.75	21
6	Chinese Wax	1–2	0.03–0.16	1–2
7	Bayberry Wax	2–5	0.00054	0.96
8	Beeswax	5–12	0.8–1.4	7–8
9	Ozokerite	30–40	7–9	30–40
10	Ceresin	> 290	400–> 600	> 900
11a	Paraffin Wax	> 290	150	> 900
11b	Paraffin Wax	> 290	18	> 660
12	"Superla Wax"	> 460	> 560	> 1000
13	"Naudella Wax"	> 610	2.6	> 1000
14	Zinsser's Insulating Wax	> 490	0.00031	60–90
15	Zinsser's Insulating Wax—Beeswax	140–> 290	< 0.00031	130–150
16	Paraffin—Beeswax	20–27	8–10	31–33
17	Paraffin—Rosin—Rosin Oil—Carnauba	> 450	100–> 500	> 500
18	Paraffin—Rosin—Hydrated Lime	> 910	> 740	> 900
19	Zinc Stearate	640	0.0003	
20	Aluminum Stearate	400–> 900	4–12	> 1000
21	Blown Gilsonite and Residual Petroleum Oil	> 290	50–95	> 560
22	Cumar Resin	> 300	640	> 1000
23	Rosin	550	300–700	
24	Manila Copal	> 410	720	> 800
25	Stearin Pitch	14–18	6.5–7.0	39
26	Soft Blown Petroleum Asphalt	50–72	40–52	1000
27	Soft Blown Petroleum Asphalt—Rosin—Rosin Oil	14–18	7.9	26–33
28	Spermaceti Wax	3–4	0.00059–0.00031	9–15
29	Shellac	> 560	< 0.00031	> 1000
30	Halowax	4–9	0.4	0.1–0.7
31	Stearic Acid	3–7	< 0.00031	1–6

a After drying over calcium chloride.
b After 6-months' immersion in 3.5 per cent sodium chloride solution.
c After redrying.

SPECIFIC HEAT OF PETROLEUM WAXES

The specific heat of petroleum waxes can be calculated from the following formula: [1]

$$S = 0.492 + 0.0009\,t$$

where t is the temperature in ° C.

MELTING POINTS AND SPECIFIC GRAVITIES OF COMMERCIAL WAXES (ARRANGED IN THE ORDER OF DECREASING MELTING POINTS)

Wax	M.P. ° C.	Sp. Gr. (25° C.)
Santowax P	209–213	1.100
Santowax PSA	136–139	1.040
Acrawax C	134	0.975
Santowax DF	125–130	0.990
Durocer	120–127	1.050
Rezowax A	107–112	1.060
Stroba Wax	98–100	1.040
Albacer	98	1.010
Acrawax	97	1.040
Rezowax B	95–100	1.010
IG Wax OP	91	1.020
Adheso Wax	90–95	0.800
Opalwax	87	0.980
Rilan Wax	84–85	0.985
Acrawax B	84	0.955
Ouricury Wax, Crude	84	1.090
Santowax M	83–89	1.100
Carnauba Wax	81	0.995
Wax B-430	81	1.120
Ouricury Wax, Refined	80	0.995
Montan Wax, Crude	78	1.020
Ozowax	76–85	0.890
Fiber Wax	71	0.996
Crude Sugar Cane Wax	70	0.993
Esparto Wax	70	0.993
Utah Wax #1	68	0.952
Flexo Wax C, Light	67–70	0.820
Candelilla Wax, Crude	66	0.980

[1] C. M. Gateley, *Fuel* **12. 26 (1933).**

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAX-CERESIN COMPOSITIONS

	Wax Mixtures Used					
125–127° F. Paraffin Wax	330	275	220	165	110	0
138–140° F. Paraffin Wax	0	55	110	165	220	330
180–185° F. Imported Ceresin	2	2	2	2	2	2
A.S.T.M. Softening point[1]—regular	123.8	124.1	124.9	125.7	127.2	130.3
A.S.T.M. Softening point[1]—sloping	129.0	130.2	130.6	132.4	134.6	138.4
Hardness at 90° F.[2]	78	65	54	44	31	16
Hardness at 100° F.	2 sec.	2 sec.	2 sec.	2 sec.	2½ sec.	95
Tensile strength at 90° F.[3]	21.7	22.9	25.7	28.0	28.6	26.5
Stretch at 90° F.[4]	28	1¼	1–	¾–	½–	¼

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAX-CERESIN COMPOSITIONS

Domestic 133–135 ° F.	Imported 133–135 ° F.	Domestic 135–137 ° F.	Ceresin	Softening Point[1] Regular	Softening Point Sloping	Hardness[2] 90° F.	Hardness[2] 100° F.	Tensile Strength[3] 90° F.	Stretch[4] 90° F.
....	100%	.....	..	136.4	138.2	21	69	46.4	¼
....	100%	.....		134.4	138.2	19	67	43.1	¼
73%	.....	100%	1	133.3	138.0	27	206	48.8	½
73%	.....	73%	1	136.0	138.4	21	154	53.5	½

[1] A.S.T.M. Ball and Ring Method.
[2] Penetrometer.
[3] lb per ¼ sq in. cross section.
[4] In millimeters.

MELTING POINT AND SPECIFIC GRAVITY OF VARIOUS WAXES

Wax	M.P. ° C.	Sp. Gr. (25° C.)
Diolin	65	0.920
BZ Wax A	63	0.922
Glyco Wax A	63	0.926
Palmitic Acid	62.2	0.846
Beeswax, Refined	60	0.954
Glyceryl Tristearate	58–60	0.920
Glyceryl Monostearate	56–57	0.970
Monostearin	56–57	0.898
Ozokerite	56	0.860
Steryl Alcohol	54–57	0.850
Stearic Acid, Triple Pressed	54	0.950
Diglycol Stearate S	51–54	0.960
Santowax OSA	50–59	0.990
"Carbowax" 4000	50–55	1.204
Ceraflux	50–51	0.880
Paraffin Wax	50	0.970
Nipocer	46–49	0.930
Cetyl Alcohol	45–50	0.810
"Carbowax" 1500	34–37	1.151

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAXES AND WAX COMPOSITIONS

Imported 125–130 ° F.	Domestic 133–135 ° F.	Imported 133–135 ° F.	Domestic 135–137 ° F.	Ceresin	A.S T.M. Ball and Ring Softening Point Regular	A.S T.M. Ball and Ring Softening Point Sloping	Hardness 90° F.	Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
...	...	...	100	. .	133.2	136.7	23	165	31.7	½
...	100	...	...	...	132.2	136.9	29	258	52.2	½
...	100	...	...	...	131.3	136.0	30	266	48.9	½
...	100	...	...	...	133.8	138.0	22	191	51.8	½
...	73	...	73	1	136.6	138.8	21	110	44.7	½
...	73	...	73	1	135.5	138.8	29	133	46.0	½
...	146	...	...	1	136.3	139.2	25	136	51.6	½
...	146	...	...	1	136.8	139.6	24	87	45.5	½
100	...	...	...	...	132.8	134.4	36	2 sec.*	36.8	½
100	...	...	...	...	129.4	133.0	35	2 sec.*	36.1	½
100	...	...	...	...	129.6	133.2	33	2 sec.*	38.2	½
...	...	100	...	...	133.2	138.2	16	69	50.3	¼
...	...	100	...	...	133.2	139.9	17	62	47.2	¼
70	...	70	...	...	133.8	139.9	18	65	60.5	¼
70	...	70	...	1	134.2	136.7	19	160	54.4	½
70	...	70	...	1	134.2	136.1	22	211	54.1	½
70	...	70	...	1	134.5	136.7	22	152	53.4	½
70	...	70	...	1	132.1	135.2	22	232	49.6	½

* Time required for needle to fall through sample.

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAXES AND COMPOSITIONS

Paraffin Wax 128–130° F.	Paraffin Wax 133–135° F.	Added Wax	A.S.T.M. Ball and Ring Softening Point Regular	A.S.T.M. Ball and Ring Softening Point Sloping	Penetrometer Hardness 82° F.	Penetrometer Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
20		1 Carnauba	147.6	154.0	26	125	40.2	39
20		1 Carnauba	149.0	150.2	22½	133	31.3	41
110	67	2 Carnauba	130.2	134.0	24	273	53.2	2–24
110	67	2½ Carnauba	130.8	134.5	23	265	58.9	2–15
110	67	3 Carnauba	131.3	135.4	22	228	58.6	13
110	67	4 Carnauba	130.1	135.0	21	200	56.7	14
110	67	5 Carnauba	131.3	138.2	19	170	56.8	15
110	67	6 Carnauba	133.2	146.2	18	145	57.6	17
110	67	4 Carnauba / 3 Palm Wax	131.8	137.0	15	196	31.3	36
73⅓	67	3 Carnauba / 2 Palm Wax	132.0	136.8		165	55.1	10
20		1 Isco Wax	140.7	148.8		139	26.1	43
110	67	5 Isco Wax / 2 Ceresin	132.1	139.0	19	146	51.5	21
110	67	5 Carnauba / 2 Palm Wax	132.2	138.8		176	48.2	16
20		1 Palm Wax	127.3	132.0	28	281	26.1	35
10		1 Palm Wax	129.2	134.8	24	250	52.3	8
110	67	4 Palm Wax / 2 Ceresin	131.1	134.6	20	146–200 (4 sec.)	45.4	2–10
110	67	4 Palm Wax / 4 Ceresin	131.9	135.3	16	246	43.1	1–5
55	67	5 Palm Wax	131.8	137.4	18	222	55.1	1–5
110	67	0	132.2	142.9	35	141	64.3	10
11	67	0	134.5	137.5	20	223	50.7	½
11	67	1 Ceresin	134.5	137.0	15	197	51.7	½

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAXES AND COMPOSITIONS (*Continued*)

Paraffin Wax 128–130° F.	Paraffin Wax 133–135° F.	Added Wax	A.S.T.M. Ball and Ring Softening Point Regular	A.S.T.M. Ball and Ring Softening Point Sloping	Penetrometer Hardness 82° F.	Penetrometer Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
22	134	1 Palm Wax	135.3	137.5	19	209	65.2	½
11	67	1 Palm Wax	134.1	137.5	19	194	66.1	½
11	67	2 Palm Wax	133.9	138.8	16	171	61.4	½
11	134	1 Carnauba	134.9	137.7	14	129	74.6	½
11	134	1 Carnauba 1 Ceresin	135.3	139.1	12	85	70.7	½
11	134	1 Palm Wax 1 Ceresin	136.3	138.4	16	102	65.1	½
11	134	2 Palm Wax 1 Ceresin	135.9	138.5	15	87	61.5	½
22	134	1 Carnauba	134.6	137.4	14	152	57.5	½
22	67	1 Carnauba	133.5	137.2	19	206	71.8	½
20		1 Carnauba	147.4	153.9	53	127	39.4	40
20		1 Dark Carnauba	138.1	151.0	55	127	36.9	41
	134	0						
	134	1 Carnauba	135.8	139.5	16	66	71.7	½
11	134	1 Carnauba	135.2	139.0	17	113	68.5	½
11	134	2 Carnauba	135.6	139.0	13	78	65.1	½
22	134	1 Carnauba	135.2	138.0	18	151	67.6	½
33	134	1 Carnauba 1 Ceresin	136.2	137.8	19	152	60.8	½
11	67	2 Palm Wax	136.5	138.8	19	138	69.1	½
11	134	2 Palm Wax	136.1	139.0	19	117	65.7	½
110	67	6	134.1	145.1	27	136	68.7	8
20		1 Carnauba	144.8	153.9	36	119	48.1	20
	134	7 Carnauba 2 Ceresin	144.7	158.8	10	40	88.5	½

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAXES AND COMPOSITIONS (*Continued*)

Paraffin Wax 128–130° F.	Paraffin Wax 133–135° F.	Added Wax	A.S.T.M. Ball and Ring Softening Point Regular	A.S.T.M. Ball and Ring Softening Point Sloping	Penetrometer Hardness 82° F.	Penetrometer Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
20		1 Crude Montan	131.3	140.0	25	178	40.0	25
15		1 Crude Montan	134.1	146.0		155	35.0	34
10		1 Crude Montan						
20		1 I.G. Wax S	130.0	133.6	24	125	45.4	2
20		Refined #1						
		1 Montan	129.7	132.0	24	295	25.8	1
20		Refined #2						
		1 Montan	128.7	128.8	32	3 sec.	22.4	30
20		1 Candelilla	127.9	131.6	29	246	29.3	2–25
10		1 Candelilla	130.9	136.2		236	27.5	42
20		1 Esparto	129.8	132.2	31	272	26.9	37
20		1 Adurco #1	128.2	133.0	28	179	28.3	34
20		1 Adurco #3	127.7	131.0	30	249	24.2	34
20		1 Shellac Wax	129.8		33	4 sec.	24.8	34
20		1 Shellac Wax	131.1	142.2	29	285	27.5	35
20		1 Opal Wax	126.6	135.0		263	21.8	31
20		1 Carnauba	145.0	153.0	44	121	39.8	33
110	67	6 Carnauba	132.5	143.3		130	60.8	10
11	134	0	135.1	138.4	15	143	53.4	½
11	134	1 Carnauba	136.0	138.4	13	92	65.0	½
22	134	1 Carnauba	134.2	136.4	17	154	67.1	½
11	134	1 Candelilla	135.8	136.5	15	136	57.1	½
22	134	1 Candelilla	134.1	136.2	16	204	58.7	½
11	134	1 Cumar	135.5	137.3	14	135	51.8	½
22	134	1 I.G. Wax	134.7	136.9	16	161	66.2	½
11	134	1 Shellac Wax	135.2	138.1	17	112	51.6	½
20		1 Carnauba	145.0	153.0	44	121	39.8	33
10		1 Carnauba	168.0	170.0	31	71	51.9	22
20		1 Carnauba	143.6	154.5	46	109	37.6	35

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAXES AND COMPOSITIONS (*Continued*)

Paraffin Wax 128–130° F.	Paraffin Wax 133–135° F.	Added Wax	A.S.T.M. Ball and Ring Softening Point Regular	A.S.T.M. Ball and Ring Softening Point Sloping	Penetrometer Hardness 82° F.	Penetrometer Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
20		1 Carnauba	147.1	152.5	45	138	42.5	30
10		1 Carnauba	163.0	168.0	36	70	50.4	15
22	134		134.6	137.8	17	165	58.8	½
11	134		136.0	139.8	14	93	56.2	½
0	134		136 2	139.4	15	56	61.3	½
0	134		136.1	139 6	10	54	48.6	¼
0	134	2 Carnauba	137.4	141.8	11	43	67.4	½
0	50	1 Ceresin 1 Carnauba	135.7	141.0	11	42	69.2	½
0	134	1 Ceresin 5 Carnauba	136.2	146.3	8	41	70.4	½
0	134	2 Ceresin 7 Carnauba	150.3	157.0	7	41	97.0	½
0	14	1 Carnauba	161.1	166.0	23	74	83.4	3
0	10	1 Carnauba	165.5	170.0	18	53	91.6	2
20		1 Carnauba	146.8	151.8	39	112	35.3	39.9
110	67	6 Carnauba	131.7	144.0	30	148	53.7	16
110	67	2 Carnauba	130.7	134.0	39	304	47.1	16
55	67	1 Carnauba	132.9	135.4	30	273	54.1	2
33	67	1 Carnauba	133.8	137.0	28	215	56.6	1
11	67	¾ Carnauba	135.1	138.6	15	90	56.1	½
	100	1 Carnauba	136.2	140.3	11	44	63.3	Very Slight
20		1 Carnauba	146.7	154.4	4.9	117	41.0	46
110	67	6 Carnauba	134.9	145.2	35	147	58.8	11
55	67	1 Carnauba	132 4	136.2	34	278	57.1	1
33	67	1 Carnauba	133.6	137.2	2.4	209	66.7	¾
22	67	1 Carnauba	133.8	138.4	20	155	55.6	½
11	67	1 Carnauba	135.1	139.9	13	91	58.8	⅓

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAXES AND COMPOSITIONS (*Continued*)

Paraffin Wax 128–130° F.	Paraffin Wax 133–135° F.	Added Wax	A.S.T.M. Ball and Ring Softening Point Regular	A.S.T.M. Ball and Ring Softening Point Sloping	Penetrometer Hardness 82° F.	Penetrometer Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
20		1 Carnauba	138.4	151.6	47	139	37.8	38
110	67	6 Carnauba	131.8	138.6	33	156	54.4	17
55	67	1 Carnauba	132.1	135.2	29	269	52.7	1–2
33	67	1 Carnauba	132.8	136.2	24	214	59.3	1
22	67	1 Carnauba	134.2	137.4	18	164	58.7	½
11	67	½ Carnauba	134.7	137.0	17	130	55.9	½
11	67	1 Carnauba	134.6	138.2	13	97	58.2	½
110	67	6 Carnauba	133.8	144.6	29	151	57.4	13
55	67	1 Ceresin 1 Carnauba	132.8	136.8	30	232	53.4	1
22	67	½ Ceresin ½ Carnauba	133.8	137.0	18	188	56.8	½
11	67	½ Ceresin ½ Carnauba	135.0	139.2	13	116	60.2	½
33	67	1 Palm Wax 1 Carnauba	134.0	137.2	22	234	58.0	½
33	67	1 Ceresin 2 Palm Wax	133.2	136.5	21	216	51.3	½
11	67	2 Palm Wax	134.4	138.4	13	129	69.4	½
33	67	1 Candelilla 1 Carnauba	134.8	138.5	21	189	49.1	½
88	22	2 Candelilla 2 Carnauba	131.9	136.8	39	210	47.8	16

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAXES AND COMPOSITIONS (*Continued*)

Paraffin Wax 128–130° F.	Paraffin Wax 133–135° F.	Paraffin Wax 138–140° F.	Added Wax	A.S.T.M. Ball and Ring Softening Point Regular	A.S.T.M. Ball and Ring Softening Point Sloping	Penetrometer Hardness 82° F.	Penetrometer Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
110	67		6 Carnauba	131.9	147.0	35	140	61.2	10
20			1 Carnauba						
22	134		1 Carnauba	134.8	137.7	17	163	64.5	½
22	134		1 Ceresin	135.1	136.7	16	139	50.6	½
	134		5 Carnauba + 1 Ceresin	153.1	157.6	10	40	93.9	½
11	67	67	1 Ceresin	137.8	140.2	12	41	52.4	¼
	134		1 Ceresin	136.3	138.8	13	55	56.0	¼

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF PARAFFIN WAX COMPOSITIONS

Paraffin Wax 128–130° F.	Paraffin Wax 133–135° F.	Added Wax	A.S.T.M. Ball and Ring Softening Points Regular	A.S.T.M. Ball and Ring Softening Points Sloping	Hardness 90° F.	Hardness 100° F.	Tensile Strength 90° F.	Stretch 90° F.
110	67	6 Ca.[1]	131.8	147.8	38	136	56.2	4
20		1 Ca.	147.1	152.5	45	138	42.5	3
10		1 Ca.	163.0	168.0	36	70	50.4	15
22	134	⅛ M.[3]	134.6	137.8	17	165	58.8	½
22	134	1 M.	135.5	138.8	12	144	62.9	½
11	134	1 M.	136.0	139.8	14	93	56.2	½
	134	⅛ M.	136.2	139.4	15	56	61.3	½
	134	1 M.	136.1	139.6	10	54	48.6	¼
	134	1 M. + 2 Ca.	137.4	141.8	11	43	67.4	½
	50	1 Ca. + 1 Ce.[2]	135.7	141.0	11	42	69.2	½
	134	5 Ca. + 1 Ce.	136.2	146.3	8	41	70.4	½
	134	7 Ca. + 1 Ce.	150.3	157.0	7	41	97.0	½
	14	1 Ca.	161.1	166.0	23	74	83.4	3
	10	1 Ca.	165.5	170.0	18	53	91.6	2

[1] Ca. = Carnauba Wax. [2] Ce. = Ceresin. [3] M. = Montan.

SOFTENING POINT AND HARDNESS OF ROSIN-PARAFFIN WAX COMPOSITIONS

Wax Mixture: Parts Paraffin Wax		Parts Rosin	Softening Point ° F.**	Penetrometer Hardness at: 70° F.	82° F.	95° F.	100° F.
	124–126° F. (Supplier A)						
100	"	0	122.4	37	158	Inf.*	Inf.
30	"	100	113.0	11	57	"	"
50	"	100	113.5	11	65	"	"
75	"	100	112.3	10	74	"	"
50	"	55	111.0	10	68	"	"
	(Supplier B)						
100	"	0	122.6	24	69	Inf.	Inf.
30	"	100	115.0	5	21	143	"
50	"	100	114.6	7	30	169	"
75	"	100	112.2	9	37	194	"
50	"	55	114.0	10	42	220	"
	128–130° F.						
100	"	0	129.2	17	32	145	Inf.
30	"	100	120.0	3	11	144	215
50	"	100	117.8	5	19	218	Inf.
75	"	100	117.9	7	23	129	"
50	"	55	119.2	7	24	124	"

* Infinite. Sinks through in 5 seconds. ** A.S.T.M. Ball & Ring (Regular).

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF MICROCRYSTALLINE AND PARAFFIN WAX COMPOSITIONS

% "Be Square" Wax	0	1%	5%	10%	25%	50%	75%	100%
Parts "Be Square" Wax	0	3.5	17.5	35.0	87.5	175.0	262.5	100
Domestic 133–135° F. Paraffin Wax	220	346.5	332.5	315.0	262.5	175.0	87.5	0
Softening Point—Regular	129.1	127.0	131.5	131.0	135.9	163.2	178.5	187.4
Softening Point—Sloping	136.0	134.8	137.4	136.6	146.8	173.6	184.2	192.0
Hardness at 90° F.	30	36	32	26	20	11	9	8
Hardness at 100° F.	3½ sec.	3 sec.	269	119	46	25	18	11
Tensile Strength at 90° F.	36.6	35.6	36.8	58.6	63.3	68.6	72.3	56.4
Stretch at 90° F.	–½	½	–½	¾	½	–½	½	¼

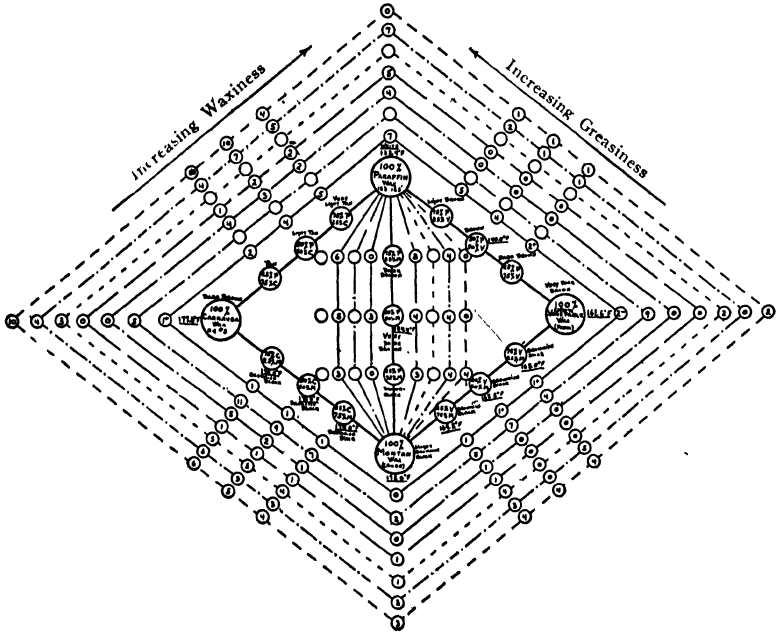
SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF MICROCRYSTALLINE AND PARAFFIN WAX COMPOSITIONS

Domestic 133–135° F. Paraffin Wax	150	150	350	347.4	347.4	347.4	347.4	347.4	347.4	347.4
Imported Ceresin	1	1	0	0	0	0	0	0	0	0
A.W.S. Crown Amber Wax	0	0	0	2.4	2.4	0	0	0	0	0
A.W.S. Gem Amber Wax	0	0	0	0	0	2.4	2.4	0	0	0
180–185° F. Barnsdall Wax	0	0	0	0	0	0	0	2.4	0	0
160–165° F. Barnsdall Wax	0	0	0	0	0	0	0	0	2.4	0
Utah Ceresin	0	0	0	0	0	0	0	0	0	2.4
% Amorphous or Microcrystalline Wax	0.66	0.66	0	0.69	0.69	0.69	0.69	0.69	0.69	0.69
Softening Point—Regular	127.0	127.0	127.4	126.2	127.0	127.1	126.9	127.1	129.4	126.3
Softening Point—Sloping	134.0	134.0	132.4	133.2	134.2	133.4	134.0	133.4	133.4	133.6
Hardness at 90° F.	34	34	36	38	37	34	33	32	33	37
Hardness at 100° F.	3½ sec.	3½ sec.	4 sec.	3½ sec.	2½ sec.	3 sec.	3 sec.	3 sec.	2½ sec.	2 sec.
Tensile Strength at 90° F.	37.9	37.9	32.3	34.6	30.1	27.3	26.1	36.7	38.1	36.2
Stretch at 90° F.	½	½	–½	½	¼	¼	–¼	½	–½	½

SOFTENING POINT, HARDNESS, TENSILE STRENGTH AND STRETCH OF MICROCRYSTALLINE AND PARAFFIN WAX COMPOSITIONS

Domestic 133–135° F. Paraffin Wax	75	75	346.5	346.5	339.5	332.5	325.5	346.5	339.5
Imported Ceresin	1	1	3.5	0	0	0	0	0	0
A.W.S. Amber Microcrystalline Wax	0	0	0	0	0	0	0	3.5	10.5
A.W.S. Black Microcrystalline Wax	0	0	0	3.5	10.5	17.5	24.5	0	0
% Amorphous Mineral Wax	.54	.54	1.0	1.0	3.0	5.0	7.0	1.0	3.0
Softening Point—Regular	131.7	131.7	129.3	130.3	131.7	132.9	131.5	127.9	131.3
Softening Point—Sloping	139.4	139.4	135.6	135.4	136.2	139.2	140.1	135.0	136.6
Hardness at 90° F.	–16	–16	–27	–28	29	28	–26	29	28
Hardness at 100° F.	118	118	3½ sec.	4 sec.	273	262	162	4 sec.	272
Tensile Strength at 90° F.	39.4	39.4	44.1	38.3	38.7	42.1	43.3	38.2	36.2
Stretch at 90° F.	¼	¼	½	½	½	½	½	½	–¾

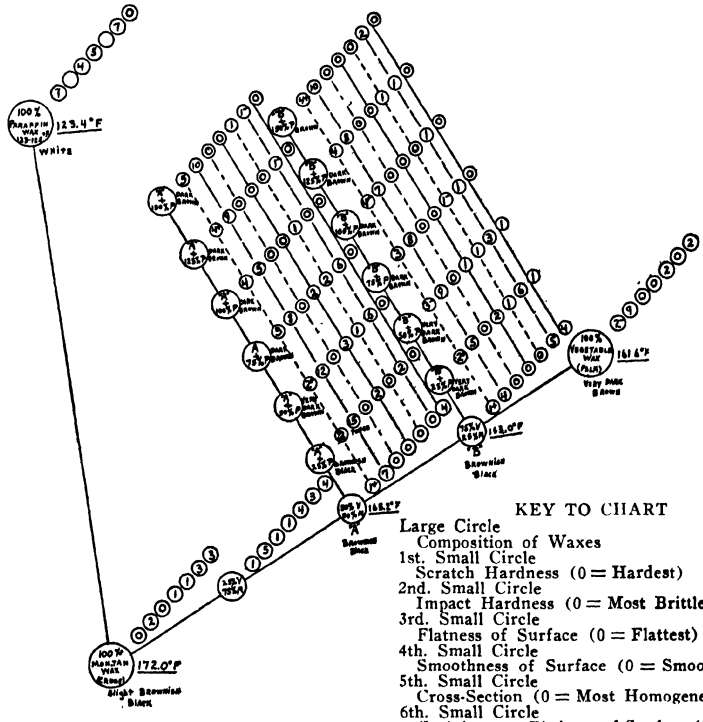
Physical Properties of Waxes



Line 1
Composition of Waxes
Line 2
Scratch Hardness (0 = Hardest)
Line 3
Impact Hardness (0 = Most Brittle)
Line 4
Flatness of Surface (0 = Flattest)

Line 5
Smoothness of Surface (0 = Smoothest)
Line 6
Cross-Section (0 = Most Homogeneous)
Line 7
Graininess or Pittiness of Surface (0 = Least)
Line 8
Contraction or Cracking (0 = Least)

EFFECT OF VARIOUS PERCENTAGES OF PARAFFIN
UPON VEGETABLE—MONTAN MIXTURES



KEY TO CHART

Large Circle
Composition of Waxes
1st. Small Circle
Scratch Hardness (0 = Hardest)
2nd. Small Circle
Impact Hardness (0 = Most Brittle)
3rd. Small Circle
Flatness of Surface (0 = Flattest)
4th. Small Circle
Smoothness of Surface (0 = Smoothest)
5th. Small Circle
Cross-Section (0 = Most Homogeneous)
6th. Small Circle
Graininess or Pittiness of Surface (0 = Least)
7th. Small Circle
Contraction or Cracking (0 = Least)

BENZENE INSOLUBLES, SPECIFIC GRAVITY AT 25° C. AND CAPILLARY TUBE MELTING POINTS OF WAXES AS RECEIVED AND AFTER BENZENE EXTRACTION

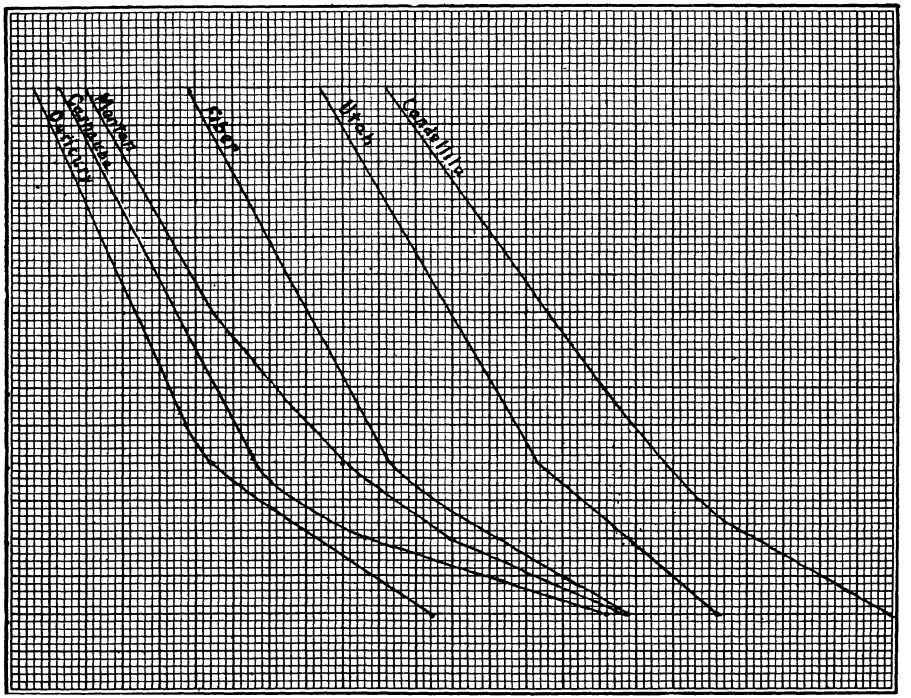
	% Benzene Insoluble	Sp.Gr. As Received	Sp.Gr. Extracted	M.P. ° F. As Received	M.P. ° F. Extracted
1. Carnauba Wax N.C. #3, Refined	0.18%	0.9912	0.9916	180.5	183.0
2. Carnauba Wax N.C. #3, Crude	1.60%	1.0097	0.9979	181.2	180.1
3. Ouricuri Wax, Refined	0.005%	1.0025	1.0040	181.0	179.5
4. Ouricuri Wax, Crude	4.54%	1.0321	1.0085	181.0	181.0

MELTING POINTS OF WAX-OIL COMBINATIONS

The following table gives the melting point of various percentages of wax when cut with oil. The oil, used in this case as being representative, is 1200/100 mineral oil.

% Wax	Carnauba M.P. ° C.	Ouricury M.P. ° C.	Fiber M.P. ° C.	Candelilla M.P. ° C.	Utah M.P. ° C.	Montan M.P. ° C.
100	78	79	72	63	66	77
90	76	78	70	60	64	75
80	74	76	69	59	62	73
70	72	75	66	57	60	71
60	71	73	64	52	58	68
50	69	71	63	50	56	65
40	64	69	58	46	52	60
30	53	61	52	40	48	52

This table is useful when a reduced or lowered melting point is desired. By using an oil a scale is established for the wax when a blend without reaction is achieved. Blends of waxes can be roughly estimated from this table and the melting points of the two waxes.



M.P. ° C. of Wax and Mineral Oil 1200/100 (S.A.E.) Mixtures

WAX-OIL COMPOSITIONS

	Mixed 50–50 With #752 Oil *	Mixed 50–50 With Sperm Oil	Mixed 50–50 With Half Sperm Oil Half 752 Oil
Bayberry Wax	Soft body similar to Philadelphia cream cheese, when worked up.	Smooth surface. Consistency and hardness of Roquefort cheese.	Softer than sperm, harder than 752 oil mix. Characteristics similar to 752 oil mix.
Candelilla Wax	Smooth surface. Takes oil up well. Hardness slightly greater than American cheese.	Smooth surface. Breaks with sharp fracture. Mixture harder than candelilla in 752 Oil. Not as hard as carnauba in sperm oil.	Softer than sperm, harder than 752 oil mix. Characteristics and appearance similar to sperm oil mix.
Carnauba Wax	Smooth surface. Oil absorption excellent. Hard mix. Breaks in sharp fracture.	Smooth surface. Oil is taken up well. Breaks with sharp fracture. Slightly harder than carnauba–752 oil mixture.	Harder than 752 oil, softer than sperm oil mixture. Characteristics and appearance similar to sperm oil mixture.
Esparto Wax	Smooth surface. Breaks in sharp fracture. Hardness not quite equal to carnauba in 752 oil. Forms homogeneous mixture.	Hardness practically equal to carnauba–sperm oil mixture. Breaks with sharp fracture.	Slightly softer and less brittle than 752 oil mix. Hardness about equal to sperm oil mixture.
Japan Wax	Quite soft. Consistency of amber petrolatum. Grainy appearance.	Smooth surface. Consistency of hard tallow. Oil is taken up well. Homogeneous mixture.	Harder than 752 oil, but softer than sperm oil mix. Characteristics and appearance similar to sperm oil mixture.
Japan Wax Substitute	Takes up more oil than natural Japan wax. Appearance soft, granular, and cheesy.	Surface smooth. Consistency of Roquefort cheese. Appearance, when worked up, like mashed potatoes.	Softer than sperm, but harder than 752 oil mixture. Characteristics similar to 752 oil mixture.
Ouricury Wax	Appearance and hardness of mixture is practically same as carnauba in 752 oil. Smooth surface. Breaks in sharp fracture (not quite as sharp as carnauba).	Smooth surface. Breaks with sharp fracture. Mixture harder than 752 oil-ouricury mixture. Takes up oil very well. Homogeneous mix.	Hardness and characteristics similar to sperm oil mixture.

* Mid Continent Mineral Oil (Gulf Co.) Saybolt Viscosity 100 sec. at 100° F.

WAX-OIL COMPOSITIONS—(*Continued*)

	Mixed 50–50 With #752 Oil *	Mixed 50–50 With Sperm Oil	Mixed 50–50 With Half Sperm Oil Half 752 Oil
French, Yellow Ozokerite	Homogeneous mixture. Hardness of candles.	Homogeneous mixture. Slightly harder than 752 oil mixture.	Softer than sperm, but harder than 752 oil mixture. Characteristics similar to 752 oil mixture.
Italian, Yellow Ozokerite	Surface semi-smooth. Consistency of dry, amber petrolatum. Homogeneous mixture.	Homogeneous mixture. About same hardness as French ozokerite with sperm oil.	Softer than sperm, but harder than 752 oil mixture. Characteristics similar to sperm oil mix.
Montan Wax (Natural)	Smooth top. This wax takes up all of the oil but a considerable amount can be forced out under pressure. Cheesy appearance. Hardness equal to overcooked fudge.	Smooth surface. Consistency and hardness of overcooked fudge.	Similar to both sperm-montan mixture and 752 oil-montan mixture. All three alike.
Utah Wax #1	Has crystalline appearance. Dark brown. Hard and cheesy. Excess oil may be squeezed out by pressure.	Smooth surface. Consistency slightly harder than American cheese. Oil may be forced out under pressure.	Softer than sperm oil mix. Slightly harder than 752 oil mixture.
I.G. Wax E	Smooth surface. Breaks in sharp fracture. Takes up oil well. Hardness almost equal to that of carnauba.	Smooth surface. Breaks with sharp fracture. Hardness not equal to that of carnauba wax. Homogeneous mixture.	All three about equal in hardness and characteristics.
I.G. Wax S	Smooth surface. Takes up oil well. Mixture is slightly more brittle and drier than I.G. Wax E. Breaks with sharp fracture.	Smooth surface. Forms hard mixture equal to that of carnauba. Breaks with sharp fracture.	All three about equal in hardness and characteristics.
I.G. Wax KP	Smooth surface. Hard, dry, cheesy appearance, when broken up. Does not break in sharp fracture. Much softer than I.G. Wax S.	Smooth surface. Hardness slightly greater than that of candelilla in same mixture. Breaks with sharp fracture. Homogeneous mixture.	Softer than sperm oil mixture. Harder than 752 oil mixture. Characteristics similar to sperm oil mixture.

* Mid Continent Mineral Oil (Gulf Co) Saybolt Viscosity 100 sec. at 100° F.

WAX-OIL COMPOSITIONS—(*Continued*)

	Mixed 50–50 With #752 Oil *	Mixed 50–50 With Sperm Oil	Mixed 50–50 With Half Sperm Oil Half 752 Oil
Mannitan Monostearate	Not miscible.	Not miscible.	Not very miscible. Characteristics similar to sperm oil mixture.
Normal Stearamide	Two layers. Top is soft and cheesy; the bottom somewhat harder.	Crystalline surface. Consistency dry, crystalline and semi-cheesy.	Harder than 752 oil, but softer than sperm oil mixture. Characteristics similar to sperm oil mixture.
Sorbitan Tetrastearate	Very soft, granular appearance. Consistency of cold, bacon grease.	Smooth surface. Consistency of mashed potatoes though slightly harder.	Softer than sperm, harder than 752 oil mixture. Characteristics of 752 oil mixture.
Beeswax	Smooth surface. Forms homogeneous mixture. Hardness equal to that of dark green petrolatum.	Smooth surface. Homogeneous mixture. Consistency and hardness of hard tallow.	Softer than sperm oil, harder than 752 oil mixture. Characteristics and appearance of sperm oil mixture.
Spermaceti	Quite sugary and crystalline. Oil may be squeezed out readily. Consistency about same as that of paraffin wax in 752 oil.	Crystalline surface. Appearance of mass quite granular and crystalline. Hardness about equal to paraffin wax in 752 oil.	Softer than sperm oil mixture. Harder than 752 oil mix. Characteristics and appearance similar to sperm oil mixture.
Paraffin Wax (125° F.)	Quite crystalline and sugary. Hardness not greater than that of Crisco.	Crystalline surface. Can be worked up into mixture which is equal in hardness to hot mashed potatoes. Oil may be readily squeezed out under pressure.	Softer than sperm oil mixture. Harder than 752 oil mix. Characteristics similar to sperm oil mixture.

* Mid Continent Mineral Oil (Gulf Co.) Saybolt Viscosity 100 sec. at 100° F.

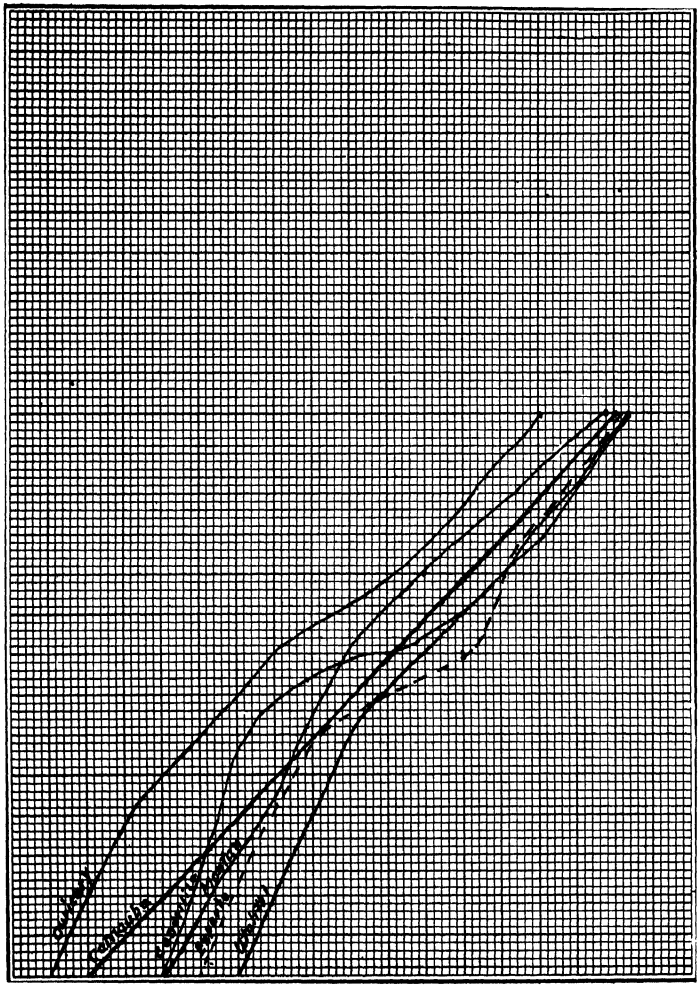
HARDNESS OF WAXES AND WAX COMPOSITIONS

Temperature of Material	25° C.
Instrument	Precision Penetrometer with Brass Cone
Weight Used	Brass Cone Plus 150 Grams
Time	60 Seconds
Values	Penetration in Centimeters $\times 10^{-2}$ (Average of 5 to 10 Readings)
Accuracy	About 5%.

	Wax Alone Hardness	50 Wax 50 Ink Oil Hardness	47.5 Wax 47.5 Ink Oil * 3.0 Aerosol OT Hardness
Carnauba Wax (N.C. #3)	0.5	23.2	21.2
Santowax M	0.3	> 45.0	
Code 200 (Werner G. Smith)	1.0	59.3	53.6
Special Wax "A" (Werner G. Smith)	1.3	23.9	
Dallawax (Black 190° F.) (Dallas Laboratories)	7.6	> 60	74
Texas Paraffin Wax (127° F.), Refined	18.3		
Socony Paraffin Wax (123–125° F.), Refined	18.7		

	Hardness
50 Carnauba Wax 50 Paraffin Wax (123–125° F.)	7.8
50 Texas Paraffin Wax 50 Stearic Acid	14.5
50 Paraffin Wax (123–125° F.) 50 Stearic Acid	14.7
50 Carnauba Wax 50 Dallawax (Black, 190° F.)	2.2
50 Santowax M 50 Dallawax (Black, 190° F.)	7.6
50 Code 200 50 Dallawax (Black, 190° F.)	6.5
50 Special Wax "A" 50 Dallawax (Black, 190° F.)	3.6
50 Paraffin Wax (123–125° F.) 50 Dallawax (Black, 190° F.)	23.9

HARDNESS OF WAX OIL COMPOSITIONS



HARDNESS OF WAX COMPOSITIONS

	86% Wax 14% Carbon Black Hardness	43% Wax 43% Ink Oil * 14% Carbon Black Hardness
Special Wax A	0.1	
Code 150 (Werner G. Smith)	0.15	
Code 200 (Werner G. Smith)	0.0	
Code 1000 (Werner G. Smith)	1.0	
Utah Wax	0.0	
Z-51 (Allied Asphalt)	0.1	
Z-52 (Allied Asphalt)	0.7	
NC Wax (Foster D. Snell)	0.25	
HC Wax (Foster D. Snell)	0.25	> 4.0
LOH Wax (Foster D. Snell)	0.1	
Dallawax (Black, 190° F.)	0.6	> 4.0
Carnauba Wax NC #3		1.3
Norcowax C-37 (Neatsfoot Oil Refineries)		> 4.0
Norcowax #55 (Neatsfoot Oil Refineries)		> 4.0

* Ink oil referred to in all cases is a Mid-Continent Mineral Oil—100 Saybolt sec. at 100° F.; 39 Saybolt sec. at 210° F.

VISCOSITIES AND DENSITIES AT 95° C. OF WAXES AND WAX-OIL COMPOSITIONS

(Accuracy 1–2%; viscosity with Ostwald viscosimeter)

	Wax Alone			Wax in Ink Oil 50–50		
	Centi-stokes	Density	Centi-poises	Centi-stokes	Density	Centi-poises
Carnauba Wax NC #3	33.80	0.845	28.60	13.40	0.846	11.30
Code 200 Wax	31.20	0.896	28.00	11.00	0.845	9.30
Dallawax (Black) 190° F.	32.20	0.842	27.10	11.60	0.833	9.70
Special Wax A	25.20	0.865	21.80	11.20	0.823	9.20
Santowax M	4.28	1.038	4.44	3.67	0.888	3.26
Texas Paraffin Wax–127° F.	5.71	0.762	4.35	....	....	....
Socony Paraffin Wax–123–125° F.	3.58	0.756	2.71	....	....	....

* Mid-Continent Mineral Oil, 100 Saybolt viscosity at 100° F.

WAX-OIL CONSISTENCY FOR INKS

Wax	Col	P.	Hardness * Compared With Carnauba Wax	Mineral Oil (1 Part Oil 1 Part Wax)	Pigment Wetting	Flow in Ink
Acrawax	Light	C.	Softer	Much softer than carnauba	Good	Poor
Albacer	White	C.	Softer	Slow-blending, softer than montan	Fair	Poor
Opal	White	98° C.	Softer	Similar to Albacer	Poor	Poor
Esparto	Brown	75° C.	Slightly Softer	Slightly softer than carnauba	Good	Good
Candelilla	Brown	68° C.	Slightly Softer	Slightly softer than carnauba	Good	Good
Fiber	Brown	70° C.	Slightly Softer	Slightly softer than carnauba	Good	Good
Ouricury	Brown	180° F.	Slightly Harder	Slightly harder than carnauba	Good	Good
Sugar Cane		80° C.	Slightly Softer (When Pure)	Slightly softer than carnauba	Good	Fair
Wax #703	Brown	180° F.	Similar	Harder than carnauba	Good	Good
Wax #648	Brown	180° F.	Similar	Hard as montan	Good	Good
Wax #688	Brown	143° F.	Similar	Soft	Good	Poor
			Mineral Waxes			
"B"	White	158° F.	Softer	Good-blending	Good	Good
"B"	Yellow	158° F.	Softer	Good-blending	Good	Good
Barnsdall Special		160–165° F.	Softer	Good-blending	Fair	Fair
Crown	Black	190° F.	Softer	Good-blending	Good	Good
Crown	Amber	200° F.	Softer	Good-blending	Good	Good
Gem		185° F.	Very Soft	Good-blending	Good	Good

* Hardness rating is based on pure wax.
The oil taken for comparison is mineral oil 200/100° F. viscosity.

DENSITIES OF WAXES AND WAX-OIL COMPOSITIONS

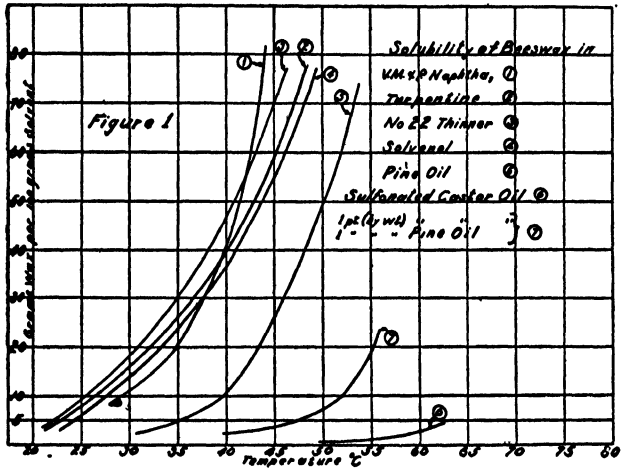
	Gravimetric Method At 95° C. ± 1.0	Hydrometer Method At 99° C.	At 100° C.
	g/cc	g/cc	g/cc
Carnauba Wax-NC#3	0.845	0.847	0.843
Ink Oil *	0.838	0.840	0.836
Socony Paraffin Wax-123-125° F.	0.756	....	0.754
Dallawax (Black) 190° F.	0.842	....	....
Santowax M	1.038	....	1.036
Special Wax A	0.865	....	0.861

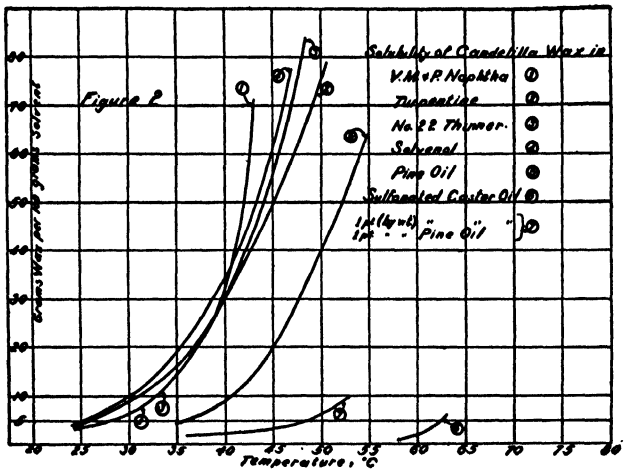
VISCOSITIES AND DENSITIES OF WAX AND WAX-OIL COMPOSITIONS

Grams	Wax Composition	Centistokes	Density	Centiposes
50	Carnauba Wax NC #3	13.6	0.778	10.6
50	Socony Paraffin Wax (123-250° F.)			
50	Special Wax A	26.8	0.848	22.7
50	Dallawax (Black, 190° F.)			
50	Carnauba Wax NC #3	31.5	0.776	24.4
50	Dallawax (Black, 190° F.)			
50	Santowax M	10.4	0.918	9.6
50	Dallawax (Black, 190° F.)			
50	Socony Paraffin Wax (123-250° F.)	9.1	0.783	7.1
50	Dallawax (Black, 190° F.)			
47.5	Carnauba Wax NC #3	13.8	0.828	11.4
47.5	Ink Oil			
3.0	Aerosol OT			
47.5	Code 200 Wax	11.4	0.863	9.84
47.5	Ink Oil			
3.0	Aerosol OT			
47.5	Dallawax (Black, 190° F.)	12.5	0.848	10.6
47.5	Ink Oil			
3.0	Aerosol OT			

WAX SOLUBILITIES[1]

Variations in data on wax solubilities maybe due to impurities, different grade or source, temperature or other factors.





[1] O. A. Pickett, *Ind. Eng. Chem.* **21**, 767 (1929).

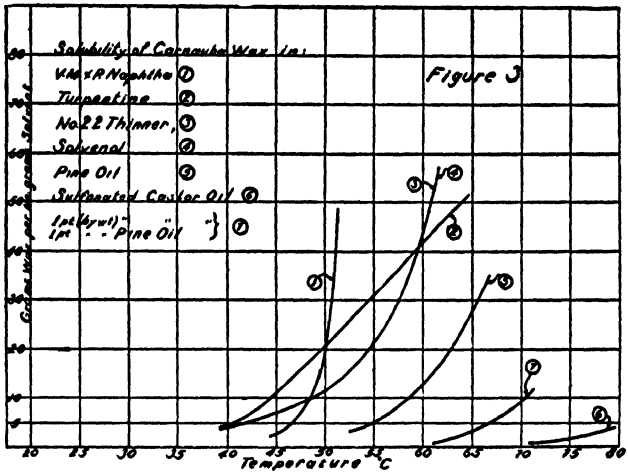


Figure 3

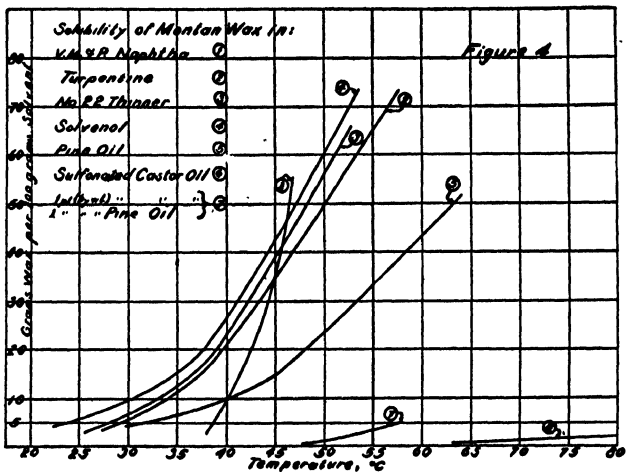


Figure 4

MATERIALS USED IN ABOVE EXPERIMENTS

Waxes

Beeswax. Commercial grade; yellow, unbleached; setting point 62° C.

Candelilla wax. Commercial grade; light yellow; setting point 66° C.

Carnauba wax. Commercial grade; light gray with slight greenish tint; setting point 82° C.

Montan wax. Commercial grade; dark brown; setting point 69° C.

Solvents

(1) V. M. & P. Naphtha. Standard grade petroleum hydrocarbons.
(2) Turpentine. Standard, steam-distilled, wood turpentine.
(3) No. 22 Thinner. Industrial solvent carrying approximately 55% terpene hydrocarbons and 45% gasoline.
(4) Solvenol. Industrial solvent, consisting of approximately 97% terpene hydrocarbons and 3% saturated hydrocarbons.
(5) Pine oil. Standard grade of Yarmor pine oil.
(6) Sulfonated castor oil. Industrial grade carrying 1.46% total sulfur equivalent to 3.65% SO_3.
(7) Equal parts, by weight, of pine oil (5) and sulfonated castor oil (6).

It is evident that solubility curves (1), (2), (3), and (4) all lie relatively close together, with (5) somewhat lower. At lower temperatures, Solvenol, No. 22 Thinner, and turpentine are all better solvents for the waxes tested than V. M. & P. naphtha, whereas at the higher temperatures, the latter is the best solvent.

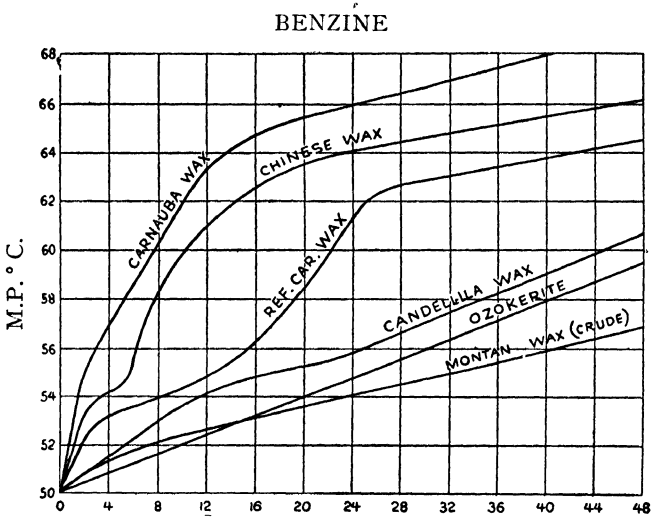
Curves marked (6) show that sulfonated castor oil is a relatively poor solvent for waxes. Yet, it is known to be a good emulsifying agent in the dewaxing of textile fibers. Mixtures of pine oil and sulfonated castor oil are extensively used for such purposes; curves marked (7) partly explain why such mixtures are increasing in favor. The addition of pine oil increases the solubility of the wax, without appreciably decreasing the emulsifying power of sulfonated castor oil, since pine oil itself is a good emulsifying agent.

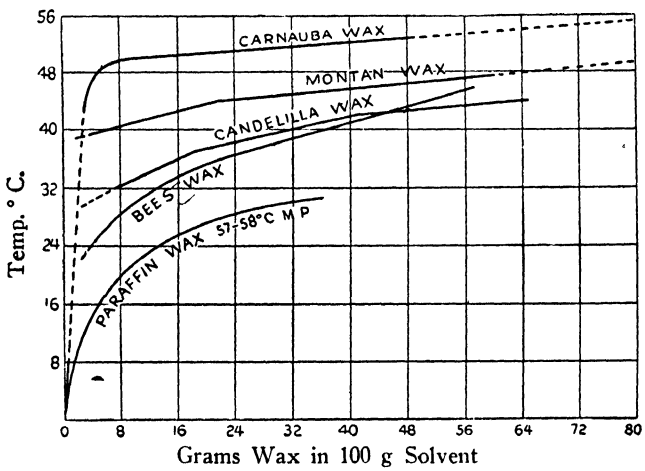
WAX SOLUBILITIES[1]

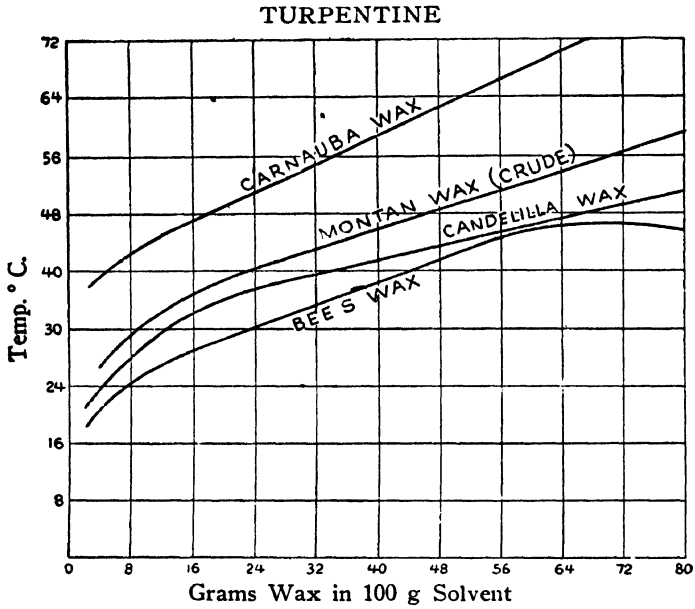
The behavior of candelilla, ozokerite and crude montan blended with paraffin wax suggests that these materials contain large amounts of long-chain hydrocarbons which, being similar in type to those of paraffin wax, dissolve mutually in a manner which approximates the laws of ideal solutions. The presence of no eutectic mixtures in this range shows how futile the past attempts have been to compound waxes in volatile solvents which after spreading would dry bright without rubbing.

[1] C. F. Mason, *Chem. Industries* **38**, 254 (1936).

A eutectic mixture, deposited from a solvent in a continuous film, without crystals or amorphous particles which would reflect the light at one angle, would be the answer.






TURPENTINE
Temp. °C.
72
64
56
48
40
30
24
16
8
CARNAUBA WAX
MONTAN WAX (CRUDE)
CANDELILLA WAX
BEES WAX
0
8
16
24
32
40
48
56
64
72
80
Grams Wax in 100 g Solvent

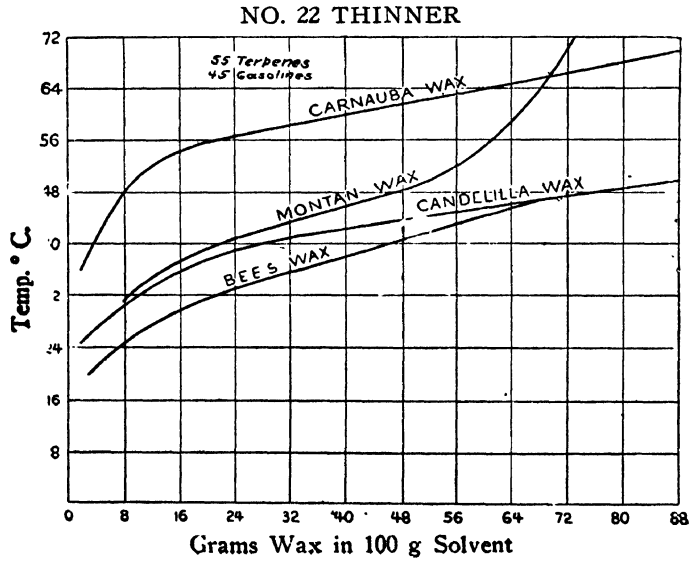

NO. 22 THINNER
55 Terpenes
45 Gasolines
Temp. °C.
72
64
56
48
0
2
24
16
8
CARNAUBA WAX
MONTAN WAX
CANDELILLA WAX
BEES WAX
0
8
16
24
32
40
48
56
64
72
80
88
Grams Wax in 100 g Solvent

TABLE I

CRYSTALLIZATION POINTS OF 10% WAX SOLUTIONS FROM RESPECTIVE SOLVENTS (SYNTHETIC WAXES)

Wax	Turpentine ° C.	Heavy Benzine ° C.
Rilan	58–59	68–69
I. G. Wax Z.	66–67	66–67
I. G. Wax C. R.	45–46	48–49
I. G. Wax B. J.	43–44	69–70
I. G. Wax S.	47–48	55–56
I. G. Wax E.	54–55	59–60
Shellac Wax	38–39	42–43

Comparing these values to those in the preceding graphs for 10% concentrations, Rilan, I. G. wax E. and Z. are superior to carnauba in respect to temperature of solution, and although they come out of solution at a higher temperature than carnauba, they do so in a finely divided colloidal or gelatinous condition which does not subside and, in addition, retards the settling of other natural waxes present. This is beneficial in making wax gels of low concentration.

Various, two-component wax blends, dissolved in benzine (25% wax content), and the percentage loss of the solvent measured after thirty days' exposure to the atmosphere, under conditions identical with those in Table I.

TABLE II

Paraffin Wax % / Added Wax %	100 / 0	99.5 / 0.5	98 / 2	95 / 5	90 / 10	80 / 20	50 / 50	25 / 75	0 / 100
Paraffin Wax M.P. 48 and 61° C.	34	..	35	..	40	..	50	..	66
Paraffin Wax 53° C. Ozokerite 77° C.	58	36	25	31	33	35	63	74	79
Paraffin Wax 53° C. Ozokerite 79° C.	58	..	..	..	20	30	..	..	83
Paraffin Wax 61° C. Ozokerite 79° C.	66	..	..	..	75	77	..	..	83
Paraffin Wax 53° C. Beeswax	58	..	..	..	25	..	10	..	88
Paraffin Wax 61° C. Beeswax	66	..	..	..	79	26	..	..	88
Paraffin Wax 48° C. Montan Wax A	34	..	..	..	50	..	38	..	49
Paraffin Wax 61° C. Montan Wax	66	..	..	..	64	..	54	..	48
Paraffin Wax 61° C. Carnauba Wax	58	..	46	..	..	..	50	..	87

The upper horizontal columns contain the percentage of paraffin wax and the percentage of the added wax respectively; and under each, the figures, opposite the names of the ingredients,

represent the percentage of benzine, lost by exposure, after thirty days. Some values are very striking, for instance, the low loss of 20% corresponding to 90% paraffin and 10% ozokerite, also the loss of 26%, corresponding to 80% paraffin and 20% beeswax. These experiments cannot be considered analogous to the behavior in a film, but they are indicative of how tenaciously certain mixtures retain the solvent.

SOLUBILITY OF WAXES AT 25° C.
(Grams per 100 grams of solvent)

Wax	Naphtha (Distillation Range 300–400° F.)	Toluene
Acrawax	0.55	—0.00
Acrawax B	0.10*	1.20
Acrawax C	0.21	0.42
Beeswax USP	3.50	4.50
B-Z Wax	4.50	4.95
Candelilla Wax	3.60	> 1.00*
Carnauba Wax #2	0.30	0.40
Durocer	0.20	0.20
Flexowax C	4.20	4.30
Flexowax C, Light	4.40	4.00
Glycowax A	0.90	> 5.00
Japan Wax	4.50	> 5.00
Montan Wax, Bleached	2.40	2.30
Nipocer	3.20	> 5.00
Ozokerite, Bleached	4.60	4.40
Ozowax	1.80	2.40
Paraffin Wax	> 5.00	> 5.25
Rezowax A	0.20*	1.20
Rezowax B	0.30*	1.10
Strobawax, New	0.40*	4.20
Wax S688	4.75	4.90

* Gels in 5% solution.

COMPATIBILITY OF PARAFFIN WAXES WITH OTHER MATERIALS

This subject is extremely complicated. However, there are certain generalities which can be mentioned.

Petroleum waxes are, generally speaking, miscible with fatty waxes such as carnauba wax and candelilla wax, if held in the

molten condition. The solubility of these vegetable waxes, particularly those of high melting point, is quite low if the molten wax is only slightly above its melting point. Long-time storage of such a mixture, at a temperature intermediate between the melting points of the two components, will cause crystallization of the higher-melting component, and its alternate deposition. In the solid state, a two-phase system exists, with crystals of the higher-melting wax interspersed throughout the mass of the petroleum wax. This is probably responsible for the pronounced effect on hardness which carnauba wax has when blended with paraffin wax. It will be found that if the higher-melting additive (wax) is entirely soluble in the lower-melting constituent, it will have much less effect on the properties of the blend than if it is only slightly soluble as is carnauba wax. For example, if a petroleum wax of high melting point is blended with a lower-melting paraffin wax, the blend will be changed relatively little from the original paraffin, unless, of course, large quantities of the higher-melting wax are used.

A great many resins, both natural and synthetic, have been studied as blending agents for petroleum waxes. It will be found that many of the natural resins, including rosin, burgundy pitch and other such materials are quite miscible with the wax. Such mixtures are somewhat unstable in that deposition of the resin will frequently occur as a result of crystallization or oxidation of the resin. In the case of rosin, this can be somewhat overcome by the utilization of hydrogenated rosins, ester gum, or Acrawax C. It will be found once again that if the additive is to have any appreciable effect upon the petroleum wax, its solubility must not be too good.

Synthetic resins present a far more complex problem in that their chemical composition is far more diversified than in the case of natural resins. It will be found, in general, that resins which contain appreciable amounts of oxygen in the molecule are soluble with difficulty or insoluble. Those, which are composed largely of hydrocarbons, will be found to be compatible. In the latter group are such products as polymerized terpenes, rubber-like polymers such as Vistanex, certain vinyl chloride

resins, and the like. The solution of resins in molten wax is very closely related to the solution of resins in conventional solvents, and the same general rules will hold. It should be remembered, however, that petroleum waxes are quite paraffinic in nature and hence have much poorer solvency than do ordinary solvents. Compatibility is, of course, related to the well established rule that materials of similar composition are miscible with one another.

The main purpose in adding a resin to a wax is to modify the characteristics of the wax in some manner. This modification might be an increase in melting point, improvements in ductility, greater adhesiveness, an increase in viscosity, or the like. Once again, if the resin is too soluble, its effect will be negligible unless abnormally large quantities are employed.

COMPATIBILITIES OF MIXED FATTY ACIDS

Arranged in order of compatibility with resins, rubbers, etc., the fatty acids would line up approximately as follows: linseed, soybean, oleic, corn, cotton and saturated fatty acids, waxes.

The fatty acids are compatible with most of the synthetic resins before polymerization, at which time, they are sometimes added as modifiers. After polymerization, the resins are apt to be oil-resistant, the resistance being as follows:

Excellent: Acrylate, methacrylate, phenol-formaldehyde, polyvinyl, urea-formaldehyde.

Good: Casein, cellulose esters.

Poor: Polystyrene, chlorinated rubber.

Resistance of the resins to fatty acids would be expected to be somewhat less good than to the neutral oils.

Although temperatures as high as 250° C. are sometimes required, all the natural resins except accroides and sandaric are completely compatible with the unsaturated oils and therefore would be compatible with the fatty acids.

The amount of fatty acids, milled into natural and synthetic rubbers, is usually not more than 5%; but higher quantities are compatible.

COMPATIBILITIES[1] OF WAXES WITH OTHER MATERIALS

Wax	Other Material	Proportions[2]
Acrawax	Acrawax B	1:1
	Albacer	1:1
	Beckacite #1100	9:1
	Beckacite, Super #2000	9:1
	Candelilla Wax	2:1
	Carnauba Wax	1:1;1:99
	Cetyl Alcohol	3:2; 1:1
	Congo Gum, Fused	9:1
	Diolin	4:1
	Ester Gum	1:1
	Ester Gum, Mannitan	1:1
	Ester Gum, Sorbitan	1:1
	Ethyl Cellulose	3:1
	Manila Loba A	9:1; 4:1
	Monostearin	1:1
	Pentalyn	1:1
	Rosin	1:1
	Santowax M	1:9; 1:1
	Shellac, Dewaxed	1:1; 9:1
	Stearic Acid	1:1
	Teglac Z152	9:1; 1:1
Acrawax B	Acrawax	1:1; 9:1
	Albacer	1:1
	Beckacite 1100	1:1; 9:1
	Beeswax	1:1
	Candelilla Wax	1:1
	Carnauba Wax	1:1; 99:1
	Congo Gum, Fused	1:1; 9:1
	Cumar	1:1; 9:1
	Dammar	9:1
	Ester Gum	1:1; 4:1
	Ester Gum, Mannitan	1:1
	Ester Gum, Sorbitan	1:1
	Ethyl Cellulose	3:1
	Flexo Wax C	1:1; 3:1
	Glyceryl Tristearate	1:1
	Manila Gum	1:1; 9:1

[1] The compatibilities in this section refer to wax compositions at normal temperatures. Certain materials may be compatible at higher temperatures, but separate on solidification of the wax.

[2] First figure in ratio to the proportion of wax and the second figure to the other material (which may also be a wax). The proportions given do not necessarily mean that other proportions are not compatible. They are only indicative that these proportions have been tried and found compatible.

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
	Manila Loba A	4:1
	Microcrystalline Wax	1:1; 1:3
	Monostearin	1:1
	Nypene Resin	3:1
	Paraffin Wax	1:1; 1:9; 2:1
	Paranol, Extra Hard	9:1
	Pentalyn	1:1
	Piccolyte S100	1:1
	Rezowax	1:1
	Rosin	1:1
	Shellac, Dewaxed Orange	1:1; 9:1
	Spermaceti	
	Teglac Z152	1:1
	Tristearin	1:1
Acrawax C	Aluminum Stearate	*
	Candelilla Wax	1:1
	Carnauba Wax	1:1
	Ester Gum, Mannitan	1:1
	Ester Gum, Sorbitan	1:1
	Halowax	
	Microcrystalline Wax	1:1
	Nypene Resin	3:1
	Paraffin Wax	1:9½; 1:2; 1:1; 2:1; 9:1
	Pentalyn	1:1
	Phenolformaldehyde Resins	All proportions
	Piccolyte Resin S100	1:1
	Polymer #34	1:1
	Polyvinyl Butyral	
	Rezowax	1:1
	Rosin	1:1
	Santowax P	3:1
	Scale Wax	1:9
	Teglac Z152	1:1
	Tristearin	1:1
	Vinylite	
Albacer	Acrawax	1:1; 4:1
	Acrawax B	1:1
	Beeswax	9:1; 7:3; 1:1
	Candelilla Wax	7:1; 4:1
	Carnauba Wax	9:1; 7:3; 1:1

* Where no proportion is given, compatibility in certain proportions does exist, but the exact amount has not been noted.

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
	Cetyl Alcohol	4:1; 5:1
	Congo, Fused	4:1
	Cumar	9:1; 7:3; 1:1
	Dammar	4:1
	Ester Gum	4:1
	Japan Wax	9:1; 7:3; 1:1
	Montan Wax	9:1; 7:3; 1:1
	Paraffin Wax	1:1; 1:3; 1:9
	Teglac Z102	9:1; 7:3; 1:1
Bayberry Wax	Beeswax	
	Cumarone Resins	
Beeswax	Acrawax B	1:1
	Bayberry Wax	
	Carnauba Wax	1:2; 1:3; 1:4; 1:6
	Ceresin	
	Chinese Insect Wax	
	Chlorinated Paraffin	All proportions
	Cumarone Resins	< 30%
	Dammar	
	Diglycol Stearate	
	Elemi	
	Ethyl Cellulose	< 50%
	Glyceryl Monostearate	
	Japan Wax	
	Methacrylate Polymers	
	Nipocer	
	Ozokerite	
	Ozowax	
	Paraffin Wax	1:1
	Petrolatum	3:97; 1:4
	R. H. Resin	< 10%
	Rezowax	1:1
	Rosin	
	Spermaceti	
	"Staybelite" Esters	
	Stearic Acid	
	Tallow	
	Wool Wax	
B-Z Wax A	Candelilla Wax	1:7
	Cocoa Butter	
	Ouricury Wax	1:1; 1:4; 1:7
	Paraffin Wax	3:1
	Santowax M	1:15
	Stearic Acid	
	Sugar Cane Wax	1:15

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
Candelilla Wax	Acrawax	1:2
	Acrawax B	1:1
	Albacer	1:9; 1:7; 1:4; 1:1
	B-Z Wax A	7:1
	Cumarone Resins	
	Ethyl Cellulose	1:13; 1:4
	Ouricury Wax	3:7; 2:3; 1:1; 1:2; 1:4
	Paraffin Wax	3:1; 4:1; 6:1; 8:1; 9:1
	Piccolyte Resin	4:1
	Rezowax	1:1
	Santowax M	1:9; 1:3
	"Staybelite" Resin	95:5
Carbowax	Bakelite XR-9392; BR3360	1:1; 1:5
	Nitrocellulose	1:5
	Vinylite Resin AYAF	9:1
Carnauba Wax	Abalyn	
	Acrawax	1:1; 99:1
	Acrawax B	
	Adhesowax	3:1
	Albacer	1:1; 3:7; 1:9
	Beeswax	2:1; 3:1; 4:1; 6:1
	B-Z Wax A	5:3; 3:1; 4:1; 5:1; 9:1; 10:1; 15:1
	Candelilla Wax	2:1; 1:4
	Cetyl Alcohol	All proportions
	Cumarone Resins	< 30%
	C. V. Wax	1:1
	Dammar	
	Durez Resin 409	
	Elemi	
	Esparto Wax	1:4; 2:1; 5:1
	Ethyl Cellulose	1:7; 1:13; 1:27; 2:1; 3:1
	Flexowax C	8:1; 15:1
	Glyceryl Monolaurate	2:3
	Glyceryl Tristearate	
	Glyco Wax	2:23
	Hercolyn	
	Hydrogenated Vegetable Oils	2:23
	Methacrylate Polymers	
	Montan Wax	3:1; 1:1; 1:2
	Nipocer	
	Nypene	
	Ouricury Wax	3:2; 4:1

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
	Ozokerite	2:1;3:1;15:1
	Ozowax	
	Paraffin Wax	1:1;1:5;4:1;5:1;6:1;15:1
	Petrolatum, Dark Green	4:1; 3:2; 2:3; 1:4
	Polymer #34	1:4
	Rezowax	1:1
	Santowax M	1:9; 1:1
	"Staybelite" Esters	1:1
	"Staybelite" Resin	97½:2½
	Stearic Acid	1:1;2:1
	Sugar Cane Wax	1:3
	Utah Wax #1	1:2
	Utah Wax #4, Yellow	4:3;7:2;5:2;3:2;2:1
Ceresin (See also Paraffin Wax)	Carnauba Wax	
	Cumarone Resins	< 30%
	Paraffin Wax	
	Rosin	
	Rubber	
	Rubber Resins	
	"Staybelite" Esters	
Cetyl Alcohol	Acrawax	2:3; 1:1
	Albacer	1:4; 1:5
	Carnauba Wax	All proportions
	Cumarone Resins	
	Ethyl Cellulose	
	Opal Wax	1:4; 1:6
	Ouricury Wax	1:1; 3:1
	Paraffin Wax	1:5
	Piccolyte Resin	
	Rubber Resins	
Chinese Insect Wax	Beeswax	
	Paraffin Wax	
	Rubber, Depolymerized	
Chlorinated Naphthalene	Acrawax C	
	Butyl Stearate	
	Chlorinated Diphenyl	
	Cumarone Resins	< 30%
	Gilsonite	
	Naphthalene	
	Polymerized Isobutylenes	
	Resins	
	Rosin	
	Rubber	
	Rubber, Depolymerized	
	Stearic Acid	

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
	Sulfur	
	Vinylite Resin AYAF	9:1
Dammar Wax	Paraffin Wax	1:3
Diglycol Stearate	Beeswax	
	Cocoa Butter	
	Paraffin Wax	
	Spermaceti	
Durocer	Arochlor	9:1
	Glyceryl Tristearate	19:1
	Hydrogenated Oils	
Fiber Wax	Carnauba Wax	1:4; 2:3; 3:2; 4:1
(Esparto Wax)	Ethyl Cellulose	1:99; 1:9
	Montan Wax	3:1; 1:1
	Ouricury Wax	1:2; 1:1; 3:1; 4:1; 9:1
	Paraffin Wax	1:1; 3:1; 1:3
	Petrolatum, Dark Green	4:1; 3:2; 2:3; 1:4
	Utah Wax #1	4:1
	Utah Wax #4	3:1
Flexo Wax C	Acrawax B	1:1; 1:3
	Carnauba Wax	1:8; 1:15
	Chlorinated Paraffin	All proportions
	Hercolyn	9:1
	Lanolin	
	Microcrystalline Wax	All proportions
	Nevillite Resin #1	1:1
	Nevindene Resin	4:1
	Paraffin Wax	All proportions
	Petrolatum	All proportions
	Piccolyte Resin S100	3:7; 7:3; 1:1
	Protowax	All proportions
	Record Wax, Light	1:1
	Rosin	4:1
	"Staybelite"	4:1
Glyceryl Mono-	Beeswax	
stearate	Cocoa Butter	
	Ethyl Cellulose	3:1
	Glyco Monostearat	
	Paraffin Wax	
Glyceryl Tristearate	Acrawax B	1:1
	Acrawax C	1:1
	Carnauba Wax	
	Durocer	1:19
	Ethyl Cellulose	

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
Glyco Wax	Acrawax B	
	Carnauba Wax	23:2
	Cocoa Butter	
	Ethyl Cellulose	3:1
	Japan Wax	5:4; 4:5
Halowax (See Chlorinated Naphthalene)		
Hydrogenated Oils (See also Opalwax)	Acrawax B	1:1
	Carnauba Wax	23:2
	Cumarone Resins	
	Durocer	1:19
	Ethyl Cellulose	
	Naphthalene Tetrachloride	
	Paraffin Wax	1:100
	Piccolyte Resin	
	Rosin	
	Stearone	
IG Wax OP	Paraffin Wax	1:1
IG Wax S	Paraffin Wax	
IG Wax Z	Paraffin Wax	
	Stearic Acid	
Japan Wax	Beeswax	
	Cocoa Butter	
	Cumarone Resins	
	Dammar	
	Elemi	
	Ethyl Cellulose	30%
	Glyco Wax	5:4; 4:5
	Nipocer	
	Rosin	
	Santowax M	1:9
	Tallow	
Microcrystalline Wax (See Paraffin Wax)		
Monostearin	Acrawax	1:1
Montan Wax	Carnauba Wax	1:3; 1:1; 2:1
	Cumarone Resins	30%
	Dammar	
	Elemi	

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
	Esparto Wax	1:3; 1:1
	Ethyl Cellulose	< 50%
	Nypene Resin	
	Paraffin Wax	3:97; 2:3; 3:1
	"Staybelite" Resin	17:3
	Stearic Acid	
	Tar	
Opal Wax (See also Hydrogenated Oils)	Behenone	5:1
	N-Butyl Methacrylate	
	Carnauba Wax	
	Ceresin	
	Cetyl Alcohol	4:1, 6:1
	Cumarone Resins	
	Diglycol Laurate	6:1
	Ester Gum	
	Ethyl Cellulose	
	Montan Wax	
	Naphthalene Tetrachloride	5:1
	Ozokerite	
	Paraffin Wax	1:1;4:1
	Rosin	
	Santowax M	1:9; 1:3
	"Staybelite" Esters	1:1
	"Staybelite" Resin	92½:7½
	Stearone	5:1
Ouricury Wax	B-Z Wax A	1:1;4:1;7:1
	Candelilla Wax	7:3;3:2;1:1;2:1;4:1;5:1 9:1
	Carnauba Wax	2:3; 1:4
	Cetyl Alcohol	1:1;1:3
	Esparto Wax	2:1;1:1;1:3;1:4;1:9
	Gelowax	4:3;2:1;4:1;
	Microcrystalline Wax	3:2;1:1;2:1
	Ozokerite	15:1
	Paraffin Wax	4:1;3:1;1:1
	Utah Wax #1	5:3;6:1;2:1;1:1
Ozokerite	Beeswax	
	Carnauba Wax	4:1; 1:2; 1:3; 1:15
	Cumarone Resins	< 30%
	Dammar	
	Elemi	
	Nipocer	
	Ouricury Wax	1:15
	Paraffin Wax	All proportions

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
	Rubber	
	"Staybelite" Esters	
	Rubber Resins	
Ozowax	Beeswax	
	Carnauba Wax	
	Ozokerite	
	Paraffin Wax	
	Rosin	
Palmitic Acid (See also Stearic Acid)	Piccolyte Resin	
Paraffin Wax	Abalyn	1:1
	Acrawax B	9:1;1:1;1:2
	Acrawax C	1:9½;1:2;2:1;9:1
	Albacer	1:1;3:1;9:1
	Aluminum Stearate	2½–4½%
	Arochlor	
	Asphalt, Blown	
	Balsam, Oregon	
	Beeswax	
	Bitumens	
	B-Z Wax A	1:3
	Candelilla Wax	97:3;3:2
	Carnauba Wax	1:1;6:4;97:3
	Cetyl Alcohol	5:1
	Chinese (Insect) Wax	97:3;3:2
	Chlorinated Paraffin	All proportions
	Cumarone Resins	< 30%
	Dammar Resin	
	Dammar Wax	3:1
	Dammar Wax Residue	9:1;3:1
	Diglycol Stearate	
	Durez Resin #409	
	Esparto Wax	1:1:1:3;3:1
	Ester Gum	9:1
	Glyceryl Monostearate	
	Hercolyn	50% or more
	Hycar OR	< 2%
	Hydrogenated Oils	100:1
	I G Wax OP, S, Z	1:1
	Jelutong	
	Kavri Resin	
	Lanolin	
	Lard	

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS (*Continued*)

Wax	Other Material	Proportions
	Lead Stearate	3%
	Limed Resin	1:8.9
	Methacrylate Polymers	
	Microcrystalline Wax	All proportions
	Montan Wax	97:3;3:2;1:3
	Nevtex Resin #10	9:1;3:1;1:1
	Nipocer	
	Nuba (Resinous Pitch)	
	Nypene Resin	
	Opal Wax	1:1;1:4;5:1
	Ouricury Wax	2:3; 1:1; 1:2
	Ozokerite	All proportions
	Ozowax	
	Petrolatum, Dark Green	2:3; 1:4
	Piccolyte Resin	1:1;3:7;19:1
	Pliolite	
	Polybutenes	
	R. H. #4	1:3; 3:1
	R. H. Resin	3–4%; 3:1
	Rezowax	1:1
	Rubber	
	Rubber, Chlorinated	
	Rubber, Depolymerized	
	Rubber Resins	
	Santowax M	1:1;3:1;19:1
	Shellac Wax	5:1
	"Staybelite" Esters	
	"Staybelite" Resin	1:1;19:1;97½:2½
	Stearic Acid	
	Stearone	1:9
	Velsicol Resins	All proportions
	Vistanex	19:1
Protowax (See Paraffin Wax)		
Rezowax A	Acrawax B	1:1
	Acrawax C	1:1
	Beeswax	1:1
	Candelilla Wax	1:1
	Carnauba Wax	1:1
	Microcrystalline Wax	1:1
	Paraffin Wax	1:1
	Pine Fatty Acid Pitch	4:1
	Rosin	

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
Santowax M	Acrawax	1:9; 1:1
	B-Z Wax A	15:1
	Candelilla Wax	1:9; 1:3
	Carnauba Wax	1:9; 1:1
	Ester Gum	1:9; 1:3
	Japan Wax	1:9
	Manila Resin	1:9
	Opal Wax	1:9, 1:3
	Paraffin Wax	< 2%
	Piccolyte	1:9
	Rosin	1:9; 1:3
	Shellac	1:9
Santowax O	Beeswax	1:9; 1:3; 1:1
	Opal Wax	1:9
	Paraffin Wax	All proportions
	Rosin	1:9; 1:3
Santowax P	Acrawax C	1:3
	Paradene #1	1:19
Scale Wax (See Paraffin Wax)		
Spermaceti	Beeswax	
	Cumarone Resins	
	Ethyl Cellulose	< 50%
	Stearic Acid	
Stearic Acid	Acrawax	1:1
	Aluminum Stearate	
	Beeswax	
	Carnauba Wax	1:1; 1:2
	Cumarone Resins	
	Ethyl Cellulose	1:1; <50%
	Gum Elemi	
	Halowax	
	Hycar OR	< 2%
	Montan Wax	
	Paraffin Wax	
	Piccolyte Resin	
	R. H. Resin	< 10%
	Spermaceti	
Stearyl Alcohol	Cumarone Resins	
	Ethyl Cellulose	
	Piccolyte Resin	
Sugar Cane Wax	B-Z Wax A	15:1
	Carnauba Wax	1:1; 1:2; 3:1

COMPATIBILITIES OF WAXES WITH OTHER MATERIALS
(*Continued*)

Wax	Other Material	Proportions
Tristearin (See Glyceryl Tristearate)		
Utah Wax	B-Z Wax A	20:1
	Carnauba Wax	2:1; 1:2
	Esparto Wax	1:4
	Montan Wax	
	Ouricury Wax	3:5; 1:6; 1:2; 1:1
	Ozokerite	
	Paraffin Wax	
	Rosin	

COMPOUNDED WAXES

Wax compositions, containing different waxes and/or other substances, are often employed to obtain special effects, not obtainable otherwise. For example, in making paper milk bottle caps or hoods, a composition of paraffin wax, carnauba wax, and rosin is used.

Paraffin wax is extremely slow-setting, when employed alone, and is rather greasy, and exhibits a considerable degree of adhesion to glass. Rosin, on the other hand, sets fairly rapidly and is notably adhesive and sticky. Carnauba wax sets quickly and is substantially non-adhesive. It is surprising to find that the sticky qualities of rosin and the slow setting properties of paraffin wax are so considerably modified by their action one on the other and that carnauba or another high-melting wax, even in the small proportion of 10% or thereabouts, introduced into the mixture of rosin and paraffin, causes mild adhesion, substantial absence of greasiness, quick setting, strong binding effects, and excellent water resistance.[1]

[1] Ellis, U. S. Patent 1,987,288 (1935).

DATA ON PARAFFIN WAX–CERESIN–RESIN MIXTURES

Resin	0	20% WW Rosin	20% Staybelite	20% Resin P–88	20% Ester Gum	20% Ester Gum, Hard
Paraffin Wax (Imported 133–135° F.)	140.0	140.0	140.0	140.0	140.0	140.0
Ceresin Wax	1.0	1.0	1.0	1.0	1.0	1.0
Softening Point (° F.), Regular †	138.0	129.4	131.0	133.6	133.6	132.8
Softening Point (° F.), Sloping †	138.6	136.1	136.6	137.0	136.6	136.8
Wax Hardness (70° F.)‡	10	6	7	6	6	6
Wax Hardness (90° F.)‡	15	15	18	14	17	18
Wax Hardness (100° F.)‡	50	48	89	58	56	51
Tensile Strength (90° F.) (in lb/¼ sq in.)	45.6	56.5	75.6	49.8	69.2	74.3
Stretch (90° F.) (in mm)	–½	½	1	½	¾	¾
The following data were obtained from commercially impregnated milk bottle caps or hoods, using sulfite or kraft paper of about 0.025 in. thickness.						
% Wax in Caps	83.8	88.6	87.6	86.6	83.3	86.6
Immersion in Water						
16 hr 32° F. then 2 hr 70° F.						
% Absorbed Water	18.4	14.9	18.4	18.2	21.6	20.5
Flare 18 hr (mm)*	1.2	1.2	1.8	1.7	1.8	2.0
Cap Hardness Test D	21.2	28.1	26.1	23.7	25.2	25.0
Cap Hardness Test B	10.4	17.9	15.7	14.0	12.9	12.5
Cap Hardness Test C	37.9	50.3	49.4	41.6	46.2	43.9
Cap Hardness Test DB	15.8	23.0	20.9	18.9	19.1	18.8

† A.S.T.M., Ball and Ring method.
‡ Penetrometer.
* Flare refers to linear expansion of cap after immersion test.

DATA ON PARAFFIN WAX-CERESIN-RESIN MIXTURES
(*Continued*)

Resin	0	20% WW Rosin	20% Staybelite	20% Resin P–88	20% Ester Gum	20% Ester Gum, Hard
16 hr 32° F. then 2 hr 90° F.						
% Absorbed Water	21.8	21.2	27.4	23.5	23.8	23.5
Flare 16 hr (mm)	1.1	0.5	1.0	1.0	1.0	1.0
Flare 18 hr (mm)	2.1	2.0	3.0	2.9	2.8	3.0
Cap Hardness Test A	24.0	23.0	13.8	23.2	19.0	18.0
Cap Hardness Test B	9.0	8.6	5.8	8.5	6.8	6.4
Cap Hardness Test C	34.2	37.9	20.9	36.3	30.3	27.8
Cap Hardness Test AB	16.5	15.8	9.8	15.9	12.9	12.2

WAX-ROSIN COMPOSITIONS

According to concentration and temperature, rosin-wax mixtures may be fluid, solid solutions, or mixtures in which there is a balance between solid solution and pure wax. Up to 25% wax, solid solutions are formed, and these may be supersaturated with wax by quick chilling. The wax molecules gradually diffuse through the solid rosin, forming a turbidity which may be estimated photometrically; the ductility is thereby decreased. The "life" of the supersaturated solution increases with time of heating, mixing, and thickness of the preparation, but decreases with the concentration.[1]

COMPATIBILITY OF WAXES WITH STAYBELITE RESIN

Wax	Solubility as Evidenced by Transparency	Insolubility as Shown by Hazy to Opaque Wax	Compatibility Waxy Character Predominant	Incompatibility Cracks and Checks Develop
Paraffin Wax	2.5%	2.5 to 20%	20 to 40%	40 to 95%
Opalwax	7.5%	7.5 to 50%	.....	50 to 95%
Carnauba Wax	2.5%	2.5 to 15%	15 to 60%	60 to 95%
Candelilla Wax	5.0%	5 to 70%	70 to 95%	.....
Montan Wax (Crude)	15%	15 to 40%	40 to 70%	70 to 95%

[1] G. Jahn, *Kolloid. Beihefte* 13, 213 (1921).

CUMAR (CUMARONE-INDENE RESINS) AND WAX COMPOSITIONS

Many useful combinations of Cumar with waxes both natural and synthetic have found application in the electrical industry, rubber manufacture, textile proofing, printing ink and other arts. Cumar has been used, for example, to (1) impart quick setting to wax compounds; (2) increase the melting point of certain waxes; (3) improve the adhesion of wax mixtures to paper or textile fibers; (4) impart gloss; (5) improve alkali resistance; (6) contribute desired electrical properties.

In very few instances are blends of Cumar with waxes transparent and the homogeneity or stability of a blend must be determined by observing the physical characteristics of the mix. Homogeneous blends of Cumar and waxes depend very often on the use of optimum proportions which will vary with the nature of the wax used. In instances, where difficulty is experienced in blending certain waxes with Cumar, the mixture is often stabilized by the introduction of a suitable third component.

Noticeable separation of Cumar-wax mixtures from molten blends is more likely to occur in large masses, which cool slowly, than in small quantities, which can be chilled quickly. Stirring during cooling, while the mixture is still mobile, promotes the formation of a homogeneous mixture.

Blends of the (V or W) grades of Cumar were made with the following waxes and homogeneous blends were observed:

Bayberry Wax
Beeswax
*Carnauba Wax
Candelilla Wax
Ceresin Wax
Cetyl Alcohol
Halowax
Fatty Alcohols
Hydrofol (Hydrogenated Oil)
Japan Wax
Lanette Wax
Lanolin (Anhydrous)
Montan Wax
Opal Wax
Ozokerite (Refined)
**Paraffin Wax
Rilan Wax
Spermaceti
Stearic Acid
Stearyl Alcohol

* Small percentages of carnauba wax may be blended with Cumar.

** Blends of Cumar and paraffin can be made in the proportion of 70 (or more) parts of Cumar with 30 (or less) parts of paraffin. To stabilize blends of Cumar with paraffin, agents such as rosin, beeswax, metallic resinates, chlorinated diphenyl, or other mutual solvents may be used.

COMPATIBILITY OF VARNISH RESINS WITH WAXES

A number of the normal phenol-modified resins, as well as ester gum and a fused congo, have been tested with various waxes and have been found to be compatible. However, when this mixture is subjected to continuous heating, as is done in practical applications, there is a separation. It is believed that this is due to oxidation of the resin as the oxidized products are no longer soluble in the wax, causing precipitation. Because of this, resins are now produced in which the oxidizable portions have been brought down to the very minimum either by hydrogenating or polymerizing rosin before later modification or esterification. This type of resin has been found to have much greater compatibility and will blend readily with paraffin, carnauba, candelilla, beeswax, montan, ozokerite and other waxy substances.

COMPATIBILITY OF NATURAL RESINS WITH WAXES[1]
(Ratio of Resin to Wax, 1:1)

Resin	Beeswax	Carnauba	Japan	Montan	Ozokerite	Paraffin	Petrolatum Wax and Paraffin*	Stearic Acid
Batavia and Singapore Dammar	C-1	C-1	C-1	C-1	C-1	C-2	C-4	C-1,2
Batu	C-2	C-3	C-3	C-3	C-3	C-3	C-4	C-2
Black East India	C-2	C-2	C-2	C-2	C-2	C-2	C-4	C-2
Congo	C-5	C-5	P.C.	C-5	P.C.	P.C.	P.C.	C-3
Elemi	C-1	C-1	C-1	C-1	C-1	C-1	C-1	C-1
Kauri	C-5	C-5	C-5	C-5	P.C.	C-5	C-5	C-2
Pale East India	C-2	C-2	C-2	C-2	C-2	C-3	C-4	C-2
Manila WS	C-5	C-5	P.C.	C-5	P.C.	P.C.	P.C.	C-2
Manila Loba	C-5	C-5	C-5	C-5	P.C.	P.C.	P.C.	C-2

C-1 Compatible at temperatures in the range of 90–120° C.
C-2 Compatible at temperatures in the range of 120–150° C.
C-3 Compatible at temperatures in the range of 150–200° C.
C-4 Compatible at temperatures in the range of 200–225° C.
C-5 Compatible at temperatures in the range of 275–325° C.
P.C. Partially compatible.
* 45% Petrolatum wax, 10% paraffin, balance resin.

[1] Booklet; Amer. Gum Importers' Ass'n.

NATURAL RESIN PARAFFIN WAX COMPOSITIONS

Resin	Compatibility	M.P. of Mixture, ° C.
Batavia Dammar	Good	49.0
Pale East India	Good	64.0
Black Scraped East India	Good	62.0
Batu	Good	69.5
Run Boea Medium Dark	Not Complete	...
Run Congo	Not Complete *	...
Run Brown Kauri	Good	54.0

* Completely compatible if run to a "fine-melt."

RESIN WAX COMBINATIONS

It may be seen from the data below that, except in the case of elemi-wax mixtures, addition of resin to the wax usually raises its melting point. Elemi, while lowering the melting point, acts as a plasticizer.[1]

DATA ON (1:1) RESIN-WAX MIXTURES

Mixture	Combining Temperature, ° C.	Loss in Weight, Per Cent	Melting Point, ° C.
Batavia Dammar B and Beeswax	90–100	0.4	59.5
Batavia Dammar B and Carnauba	90–100	1.0	66
Batavia Dammar B and Japan	90–100	0.0	47
Batavia Dammar B and Montan	90–100	0.4	76
Batavia Dammar B and Ozokerite	90–100	0.0	64
Batavia Dammar B and Paraffin	140–150	0.5	49
Bold Black Scraped E. I. and Beeswax	130–140	0.6	65
Bold Black Scraped E. I. and Carnauba	130–140	2.0	82.5
Bold Black Scraped E. I. and Japan	130–140	1.2	75
Bold Black Scraped E. I. and Montan	130–140	0.4	99
Bold Black Scraped E. I. and Ozokerite	130–140	0.0	73
Bold Black Scraped E. I. and Paraffin	130–140	..	62
Pale E. I. Macassar Bold and Beeswax	120–130	0.4	62.5
Pale E. I. Macassar Bold and Carnauba	120–130	1.4	75

[1] R. W. Allan, *Chem. Industries* **42**, 508 (1938).

DATA ON (1:1) RESIN-WAX MIXTURES (*Continued*)

Mixture	Combining Temperature, ° C.	Loss in Weight, Per Cent	Melting Point, ° C.
Pale E. I. Macassar Bold and Japan	120–130	1.0	65.5
Pale E. I. Macassar Bold and Montan	120–130	0.8	83
Pale E. I. Macassar Bold and Ozokerite	120–130	0.2	77
Pale E. I. Macassar Bold and Paraffin	150–200	..	55
Pale E. I. Singapore Bold and Beeswax	120–130	1.2	62
Pale E. I. Singapore Bold and Carnauba	120–130	1.8	76
Pale E. I. Singapore Bold and Japan	120–130	0.2	80
Pale E. I. Singapore Bold and Montan	120–130	0.6	95
Pale E. I. Singapore Bold and Ozokerite	120–130	0.0	86
Pale E. I. Singapore Bold and Paraffin	150–200	..	64
Elemi and Beeswax	98–100	..	56.5
Elemi and Carnauba	100	1.0	57
Elemi and Japan	98–100	1.0	45.5
Elemi and Montan	100	1.2	60.5
Elemi and Ozokerite	100	1.0	70
Batu Bold Scraped and Beeswax	130–140	0.0	65
Batu Bold Scraped and Carnauba	150–200	2.2	85
Batu Bold Scraped and Japan	150–200	2.6	75
Batu Bold Scraped and Montan	150–200	2.0	127
Batu Bold Scraped and Ozokerite	150–200	2.8	74
Batu Bold Scraped and Paraffin	150–200	..	69.5
Singapore Dammar #2 and Beeswax	100–110	2.6	60
Singapore Dammar #2 and Carnauba	110–120	0.8	79.5
Singapore Dammar #2 and Japan	90–100	0.0	42
Singapore Dammar #2 and Montan	90–100	0.0	75
Singapore Dammar #2 and Ozokerite	130–140	0.0	67
Singapore Dammar #2 and Paraffin	140–150	0.5	50
Manila WS and Beeswax	275–325	18.2	69
Manila WS and Carnauba	275–325	16.4	80
Manila Loba C and Beeswax	300–325	26.3	68

DATA ON (1:1) RESIN-WAX MIXTURES (*Continued*)

Mixture	Combining Temperature, ° C.	Loss in Weight, Per Cent	Melting Point, ° C.
Manila Loba C and Carnauba	300–325	17.0	79
Congo #4 and Beeswax	300–325	18.5	66
Congo #11 and Beeswax	300–325	17.6	68
Congo #11 and Carnauba	300–325	21.8	75.5
Kauri Pale #1 and Beeswax	300–325	14.3	67
Kauri Pale #1 and Carnauba	300–325	10.0	81.5
Run Brown Kauri #2 and Paraffin	300–325	..	54

Natural resins dissolve in waxes with varying degrees of ease. The dammars (in which class are included Batavia and Singapore dammars, the black and pale East Indies, and Batu), and also elemi, a miscellaneous type, are the only ones that dissolve in the waxes, without being run or at least partially run. The loss of weight is an indication of the relative ease with which solution takes place. Manila resin—Congo—and kauri-wax mixtures lose much more weight in the process of combination than do the above dammar resins.

A resin, soluble with difficulty in wax, may be combined by use of a common solvent without marked loss in weight. For instance, elemi is easily soluble in all the waxes tested, whereas loba C is not. Loba C is easily soluble in elemi. Elemi may, therefore, be considered a common solvent for the waxes and the resin and become a medium to effect their combination. Taking carnauba wax as an example, the Manila (loba C) may be dissolved in the melted elemi and carnauba added to form a ternary mixture in which both resin and wax are stable.

If it is necessary to have liquid resin-wax mixtures, they may be used, for the most part, in the form of aqueous emulsions. When the melting point is sufficiently low, they can be readily emulsified by ordinary methods, using commercially available emulsifying agents. Triethanolamine soaps are effective agents. The melting point of the mixture may be such, however, that the addition of water, even at the boiling point, will cause the melted compound to solidify, making dispersion impossible. In the case of Manila resins, such a compound may be emulsified by a somewhat different method. The compound is powdered

and added slowly to a solution of sodium hydroxide under stirring and heat. Part of the Manila is saponified. The resulting soap acts as the emulsifying agent. Stirring is continued after all the mixture has been added and heat removed, to insure uniform and complete dispersion.

The natural resins dissolve in various synthetic waxes with different degrees of ease. The dammar and elemi (one of the miscellaneous class of resins) are the more readily compatible. Resins soluble with difficulty may be more easily combined by forming a ternary mixture with elemi as a common solvent for resin and wax.

METHACRYLATE RESIN HOT-MELT BLENDS

The methacrylate polymers do not fuse to a liquid state, when heated above their thermal yield points, but maintain a rubbery consistency over a wide temperature range. For this reason, the pure polymethacrylates cannot be used readily as hot melts for coating and adhesive purposes unless dissolved or dispersed. The rubbery consistency can be reduced and the fluidity greatly increased at temperatures between 150 and 200° C., by blending with resinous fluxing agents of lower molecular weight, such as rosin, ester gum, dammar, and the coumarone-indene resins. By variation of the methacrylate polymer and the nature and concentration of the added fluxing agent, a series of resin blends can be obtained which differ widely in fluidity in the molten state but closely resemble the methacrylate polymers in other properties. The melt viscosity of the methacrylate polymers, with a given percentage of fluxing agent, decreases as the molecular weight of the alcohol, esterified with methacrylic acid, is increased. When the blends are used as adhesives, their bond strengths, at elevated temperatures, vary with the nature of the methacrylate polymer and the nature and proportion of the fluxing agent. These blends are heat-stable, and no appreciable change takes place on heating for prolonged periods at 150 to 200° C.

The higher methacrylate polymers, such as butyl or isobutyl, can be dissolved readily in molten waxes, such as paraffin, beeswax, and carnauba wax, to produce solutions which, on cooling, form toughened, rigid, or flexible masses. The higher-softening

methacrylate polymers tend to form harder, more rigid wax blends; the softer, more pliable methacrylates, in general, produce more pliable, elastic blends. Solution temperatures of the wax blends (temperature at which a clear methacrylate-wax solution is obtained) vary with the methacrylic ester used and with the nature and concentration of the wax. In paraffin wax, for example, the solution temperature decreases as the molecular weight of the alcohol, esterified with methacrylic acid, is increased; and with a given polyester, the solution temperature increases as the percentage of paraffin is increased. Solution temperatures also vary directly with the melting point of the paraffin wax and the molecular weight of the methacrylate polymer. Blending agents of various types can be added to these compositions to reduce solution temperatures and modify the physical properties of the blends at lower temperature. Methacrylate-paraffin blends, with solution temperatures as low as 100° C., can be obtained readily.

Such toughened melts are extremely fluid in the molten state and are suitable for coating purposes by roller coating, immersion, and spreading methods. Paper, coated from these melts, is superior to paraffin-coated paper in water and oil resistance, especially after it is folded, and gives much stronger bonds on heat sealing.

Compositions and properties of some melts, which appear attractive for adhesive purposes, are listed below. All are fluid enough for application at temperatures below 200° C.

Composition	Description at Room Temperature
1) 67% n-Butyl MA * Polymer 33% Cumar V½	Clear, hard, light brown.
2) 60% n-Butyl MA Polymer 40% Dammar	Slightly opaque, light color, flexible, slightly tacky.
3) 60% n-Butyl MA Polymer 40% Rosin	Clear, light brown, pliable, slightly tacky.
4) 42% n-Butyl MA Polymer 28% Dammar 30% Paraffin Wax	Light yellow, not tacky. Good adhesive for moistureproof "Cellophane," waxed paper, etc.
5) 20% Ethyl MA Polymer 80% Rosin or Ester Gum	Clear, slightly brown.

* MA = Methacrylate.

Composition	Description at Room Temperature
6) 20% Ethyl MA Polymer 80% Dammar	Light, opaque.

Some products, giving good preliminary results in paper coating tests, which can be applied at about 100°C., are:

7) 37.5% n-Butyl MA Polymer 37.5% Opalwax 25.0% Paraffin Wax(135° F.)	White, fairly tough, not tacky.
8) 34% n-Butyl MA Polymer 34% Opalwax 23% Paraffin Wax (135° F.) 9% Santicizer B-16	Tough, not tacky, does not block.
9) 40% n-Butyl MA Polymer 20% Opalwax 20% Paraffin Wax (135° F.) 20% Rosin	Tan, tough, slightly tacky.

Countless modifications can be made along the above lines. In general, increasing the methacrylate content produces tougher, stronger blends with higher viscosities in the molten state. The use of softer resinous modifying agents, soft waxes, and plasticizers gives greater softness and pliability. Some interesting blending agents, not included in the above illustrations, include asphalt, spermaceti, carnauba wax, beeswax, Japan wax, stearic acid and butyl stearate.

Blends such as 1, 2 and 3 listed before (no wax) have considerable viscosity at elevated temperatures. They are not fluid enough for general dip coating operations and would require roller coating, spreading, or the like. The blends are most readily prepared by the use of an internal mixer of the Werner-Pfleiderer or Banbury type, at an appropriate temperature of 150 to 220° C.

Blends, such as 4 to 9, are much more fluid in character since they employ, in general, smaller quantities of methacrylate resin. Also, the opalwax and paraffin wax, used in many of them, have quite low viscosities at high temperatures. Melts of this class are readily prepared by heating all of the ingredients but the methacrylate to an appropriate solution temperature of 140 to 180° C. and adding the methacrylate polymer with stirring. The solution temperature and stirring should be maintained

until a smooth dispersion is obtained. This generally requires less than one hour. A mechanically driven "T" type stirrer, run at a sufficient rate to prevent the settling of polymer lumps, is satisfactory.

If melt applications are employed in connection with products which must be odor-free, two points must be kept in mind. Polymers, essentially free from odor, must be employed and direct heating and high temperatures must be avoided to prevent the development of odor. If the nature of the composition will permit, temperatures should not be allowed to exceed 150 to 160° C. for best results.

COMPATIBILITY OF N-TYPE ETHYL CELLULOSE WITH WAXES, TARS, AND SIMILAR COMPOUNDS

Purified Montan Wax	C	Stearin Pitch	C
Crude Montan Wax	C	Gilsonite	C
Beeswax	C	Coal Tar	C
Candelilla Wax	C	Carnauba Wax	LC
Japan Wax	C	Ceresin	I
Spermaceti Wax	C	Ozokerite	I
Stearic Acid	C	Paraffin	I
Oleic Acid	C	Trinidad Asphalt	I
Lauryl Alcohol	C	Chinese Insect Wax	I
Cetyl Alcohol	C	Superla Waxes	I
Stearyl Alcohol	C	Syncera Waxes	I
Opalwax	C	Circasol Waxes	I
Tallow	C		

C—Compatible. LC—Limited Compatibility. I—Incompatible.

The best waxes for blending with ethyl cellulose are the aliphatic acids and alcohols. Outstanding toughening action occurs when ethyl cellulose is compounded in binary mixtures with beeswax, Japan wax, and coal tar. Although certain waxy materials in the above table are noted as incompatible, appreciable quantities can be added to a solution of ethyl cellulose, dissolved in a compatible wax, before any evidence of incompatibility is encountered.

Ethyl cellulose and waxes may be blended in solution in a volatile solvent, such as a mixture of toluene and alcohol, or they may be blended together by dissolving the ethyl cellulose directly in the molten wax heated to a temperature of 150 to 200° C.

The addition of ethyl cellulose to waxes, in which it is soluble,

raises the melting point of the wax, improves its toughness, diminishes surface tackiness, and decreases the tendency of the wax to crystallize. Some data are given below on the effect of ethyl cellulose addition on the melting point of waxes. Besides improving waxes alone, ethyl cellulose often improves mixtures of waxes, resins, or plasticizers from the standpoint of gloss, flexibility, and toughness. These mixtures have a wide variety of uses as coatings for paper and cardboard, adhesives, and plastics. Some of the coal tars are greatly hardened and toughened by ethyl cellulose.

EFFECT OF ETHYL CELLULOSE ADDITION ON MELTING POINT OF WAXES

Composition %		Drop Melting Point ° C.				
Wax	Ethyl Cellulose	Glyco Wax A	Gelo-wax	Purified Montan Wax	Bleached Beeswax	Stearic Acid
100	..	....	...	69.5	62.5	55.0
90	10	....	...	86.5	103.5	56.0
75	25	142.5	128	115.0	144.0	71.0
66.7	33.3	....	...	117.5	....	87.0
50	50	....	...	134.5	182.0	114.0

Composition %		Drop Melting Point ° C.				
Wax	Ethyl Cellulose	Refined Coal Tar	Glyceryl Mono-stearate	Diglycol Stearate	Acrawax	Acrawax B
100	..	27.5	...	....	....	....
90	10	88.0	...	....	....	....
75	25	118.0	125	110	134.7	120.5
66.7	33.3	132.0	...	....	....	....
50	50	171.0	...	....	....	....

ETHYL CELLULOSE AND WAX MIXTURES

It is to be noted that a small amount of high-viscosity ethyl cellulose (325 cps. in 5% solution) raises the softening point of stearin pitch 20°. It appears that smaller amounts of high-viscosity material will produce the same general effects as larger amounts of lower-viscosity material, but the solubility is sometimes impaired.[1]

[1] Hercules Powder Co., Wilmington, Del.

	Ethyl Cellulose	Fused At ° C.	Solubility	Softening Point ° C.	Melting Point ° C.	Cast
Aroclor, Solid						
100	0	...	...	126.0	129.0	Fair
90	10	150	Slow	128.0	137.0	Fair
75	25	170	Slow	125.5	128.0	Fair
66⅔	33⅓	200 Viscous	Slow	127.0	132.0	Fair
Asphalt (Genasco)—Not miscible.						
Beeswax						
100	0	...	...	61.0	62.5	Good
90	10	150 10M (Jells a little)	Good	99.5	103.5	Good
75	25	150 10M	Good	141.5	144.0	Good
66⅔	33⅓	170 10M	Good	131.0	139.0	Good
50	50	200 Darkens	Good	178.0	182.0	Good
Candelilla						
100	0	...	...	66.0	68.0	Poor
90	10	175	Fair	69.0	75.0	Poor
75	25	175	Fair	111.0	130.0	Poor
66⅔	33⅓	175	Fair	127.0	132.0	Good
50	50	200 Darkens	Fair	135.0	142.0	Good
Carnauba						
100	0	...	...	81.0	82.0	Poor
90	10	170 1 hr Signs of Separation	Fair	92.0	100.5	Quite Poor
75	25	200 10M	Good	119.5	122.0	Better but still poor
66⅔	33⅓	200 Viscous	Good	130.5	135.0	

	Ethyl Cellulose	Fused At ° C.	Solubility	Softening Point ° C.	Melting Point ° C.	Cast
Ceresin—Not miscible.						
Coal Tar						
100	0	...	...	22.5	27.5	Too Soft
90	10	170	Good	67.5	88.0	Too Soft
75	25	170	Good	95.0	118.0	Excellent
66⅔	33⅓	170	Good	119.0	132.0	Excellent
50	50	200	Good	143.0	171.0	Excellent
Gilsonite						
100	0	...	...	142.0	158.5	Good
95	5	200	Good	167.0	174.5	Good
90	10	200	Good	166.0	172.5	Good
75	25	240	Good	176.5	195.5	Good
66⅔	33⅓	240	Good	198.5	208.5	Good
50	50	240	Good	206.0	218.0	Too Viscous
Halowax—(Similar to Aroclor)						
Japan Wax						
100	0	...	...	40.0	41.0	Excellent
90	10	150 Darkens	Slow	60.0	69.0	Excellent
75	25	150 Darkens	Slow	75.0	121.0	Excellent
66⅔	33⅓	170 Darkens	Slow	127.0	151.0	Excellent
50	50	200 Darkens	Slow	138.0	182.0	Excellent
Linseed Oil Fatty Acid						
100	0	Liquid	...	...	...	...
90	10	Viscous	Liquid	Good Solution	...	...
75	25	150	Good	51.0	64.0	Semi-Solid
66⅔	33⅓	150	Good	72.0	83.0	Semi-Solid
50	50	160	Good	80.0	110.0	Solid

Montan, Crude	Ethyl Cellulose	Fused At ° C.	Solubility	Softening Point ° C.	Melting Point ° C.	Cast
					83.0	Good
100	0	...	...	82.0	87.5	Good
90	10	200 15M	Good	85.0	112.5	Good
75	25	200 15M	Good	104.0	125.0	Good
66⅔	33⅓	200 15M	Good	122.0		
50	50	200 15M	Good	143.5	145.0	Good
Montan, Pure						
100	0	...	...	68.5	69.5	Fair
90	10	150 5M	Good	73.0	86.5	Excellent
75	25	150–170 10M	Good	110.5	115.0	Excellent
66⅔	33⅓	180 15M	Good	114.5	117.5	Excellent
50	50	200 15M Darkens	Good	129.0	134.5	Excellent
Oleic Acid						
100	0	Liquid				
90	10	Liquid	Excellent Solution			
75	25	150	Excellent	48.0	61.0	Semi-Solid
66⅔	33⅓	170	Excellent	55.0	75.0	Semi-Solid
50	50	200	Excellent	105.0	106.0	Solid

Ozokerite—Not miscible.

Paraffin—Not miscible.

Spermaceti	Ethyl Cellulose	Fused At ° C.	Solubility	Softening Point ° C.	Melting Point ° C.	Cast
100	0	...	...	44.0	45.5	Good
90	10	150 10M	Good	78.5	91.5	Good
75	25	150 10M	Good	120.0	127.5	Good
66⅔	33⅓	170 10M	Good	116.5	120.0	Good
50	50	200 10M	Good	129.0	131.5	Good
Stearic Acid						
100	0	...	...	54.0	55.0	Wouldn't Cast
90	10	100	Excellent	55.0	56.0	Fair
75	25	125	Excellent	64.0	71.0	Good
66⅔	33⅓	140	Excellent	75.0	87.0	Good
50	50	170 Darkens	Excellent	91.0	114.0	Good
Stearin Pitch						
100	0	...	...	75.0	85.0	Too Soft
99	1 High Visc.	200	Fair	95.0	106.0	Too Soft
90	10 Medium Visc.	200	Fair	100.0	120.0	Too Soft
75	25 Medium Visc.	200	Fair	133.0	> 250.0	Sticky
66⅔	33⅓ Medium Visc.	215	Fair	148.0	163.0	Good
50	50 Medium Visc.	250	Fair	172.0	182.0	Brittle
Tallow						
100	0	...	...	34.0	35.0	Excellent
90	10	150	Slow	38.0	62.0	Excellent
75	25	150	Slow	106.0	151.0	Excellent
66⅔	33⅓	170 Darkens	Slow	107.0	117.5	Excellent
50	50	200 Darkens	Slow	112.0	165.0	Excellent

In some cases, the insoluble waxes may be put into ternary solutions by the use of a mutually miscible material; for example, paraffin wax 10, montan wax 10, ethyl cellulose 2 give a homogeneous product:

Ethyl Cellulose	10
Stearic Acid (54° C. M.P.)	45
Paraffin (44° C. M.P.)	45

The above mixture, fuses at 200° C., gives good solution, and has a drop melting point of 64° C. As noted above, ethyl cellulose is immiscible in paraffin waxes, but it is soluble in the aromatic hydrocarbon waxes such as naphthalene and anthracene.

The solubility of ethyl cellulose in fatty alcohols, such as cetyl alcohol, myristyl alcohol and stearyl alcohol, is excellent. In all cases, the melting point of the solid alcohols is much increased by the addition of the ethyl cellulose. The hardness and toughness are likewise improved.

MELTING POINTS OF COMPOUNDED WAXES

Components and Individual Melting Point					M.P. of Composition
	° F.		° F.	Ratio	° F.
Paraffin Wax	150	Opalwax	208	1:1	145
"	150	Montan	169	1;3	138
"	150	I.G. Wax OP	221	1:1	145
"	150	Carnauba	185	1:1	153
"	125	Albacer	202	1:1	Very thick, no flow.
"	150	"	202	1:1	Very thick, no flow.
"	150	"	202	3:1	Does not melt; slow cooling.
Ozokerite	130	Carnauba	185	4:1	171
Carnauba Wax	174	Acrawax	201–8	99:1	179

SETTING POINTS OF MIXTURES OF VARIOUS KINDS OF WAXES WITH A DOUBLE-REFINED PARAFFIN WAX HAVING A SETTING POINT OF 50° C.
(LUDECKE)

Percentage of Waxes Added to Paraffin Wax Setting Point, 50° C.	Carnauba Wax, Crude Setting Point, 75° C.	Refined Carnauba Wax Setting Point, 70° C.	Chinese Insect Wax Setting Point, 76° C.	Candelilla Wax Setting Point, 67° C.	Ozokerite Natural Yellow Setting Point, 70° C.	Crude Montan Wax Setting Point, 74° C.	Refined Montan Wax Setting Point, 70° C.
3	56.0	52.5	53.4	51.4	50.45	52.0	51.0
5	57.0	53.2	54.4	51.8	51.00	53.0	51.5
8	60.2	53.6	58.0	53.4	51.70	53.0	52.2
10	62.0	54.0	60.0	53.6	52.00	53.2	52.4
15	64.0	56.0	61.4	54.4	53.00	54.0	53.2
20	65.0	59.0	63.6	55.0	54.00	54.0	54.0
25	65.6	62.0	64.0	56.0	54.80	55.0	54.0
30	66.6	62.6	64.4	57.0	55.70	56.0	55.0
35	67.0	63.0	65.0	58.0	57.00	56 4	55.4
40	67.6	63.2	65.4	59.0	58.00	56.4	56.0

MELTING POINTS OF BINARY AND TRINARY WAX MIXTURES [1]

Melting point curves of the binary wax mixtures are to be found in the three narrow graphs (pp. 232 and 233) surrounding each of the triangular graphs. The triangular graphs represent all possible trinary mixtures of the waxes indicated. Since only compositions can be plotted, a single curve connects all mixtures melting at one specific temperature. The melting point, in ° C., for each curve, is indicated thereon. In general, a curve is drawn for every 2.5° rise in melting point, and the curves then may be compared to the altitude lines on a contour map. Each apex of the triangle represents 100% of the wax indicated, and also 100% of the wax indicated for the binary graph adjoining.

Each side of the triangle represents all binary mixtures of the two waxes indicated at the ends of the line. From the binary melting point data we may select binary mixtures melting at, let us say, 62.5, 65, 67.5, 70, and 72.5° C. By drawing a line on the triangular graph, between two sets of binaries that have the same melting point, we obtain suggested compositions of trinary mixtures for that melting point. Compositions are chosen at uniform intervals over the length of the line and the melting points of the trinary mixtures determined. For a very short line one trinary mixture is sufficient, while for a long line 4 or 5 trinary mixtures are used.

Knowing the qualitative composition of a trinary mixture of waxes, the melting point of this mixture will enable one, by use of these graphs, to determine the approximate quantitative composition of the mixture with a minimum of other data. Likewise, by use of the graphs, mixtures of waxes of any desired melting point can readily be prepared.

It will perhaps seem striking, at first sight, that the isothermals actually are straight lines within the limits of experimental error. This substantiates the idea that wax mixtures are true

[1] J. R. Koch, G. J. Hable, L. Wrangell, *Ind. Eng. Chem., Anal. Ed.*, **10**, 167 (1938).

mixtures and that new chemical compounds are not formed. Because of the comparative chemical inertness of the esters and hydrocarbons, making up most waxes, this is to be expected. Small amounts of carnauba are effective in raising the melting points of individual or mixed waxes. The only other wax, approaching carnauba in its effectiveness in quick melting point rise, is Chinese insect wax.

The fact that the isothermal lines are not parallel in any instance quickly leads to the conclusion that the effect of any individual wax on the melting points of two other waxes is never proportionally the same, but is specific. This is also shown by the dissimilarity in the shape of the various binary mixture curves. A striking example of the effectiveness of each of two waxes in altering the melting point of the other when present in small quantities is shown in the case of beeswax and candelilla. A diametrically opposite effect is shown in the case of candelilla and Chinese insect wax on the same graph.

CANADA balsam 1.530
CANADA balsam 1.530
CANADA balsam 1.530
CANADA balsam 1.530
CANADA balsam 1.530
CANADA balsam 1.530

PARAFFIN
BEESWAX
MONTAN
OZOKERITE
CHINESE INSECT
CANDELILLA

CHAPTER IV

WAX TECHNOLOGY

ADULTERATIONS

Waxes, especially when bought at lower than market prices or from unreliable sources, are often adulterated. Flagrant adulterations can sometimes be detected by comparison with a sample of a genuine wax. Other more subtle sophistications require physical, chemical or use tests of varying complexities.

QUALITY VARIATIONS

Natural waxes, like all other natural products (e.g., flour, starch, fossil resins, etc.), vary within certain limits because of place of origin, climatic conditions, time and method of gathering, method of handling, storage and shipping, age, exposure and other factors. Slight variations may not be serious for certain uses. Pronounced variations may make changes in formulation necessary or even rule out a certain lot as unsuitable for a particular use.

SIMPLE TESTS

The following tests are quick and rough in nature. Their purpose is to enable the non-chemist to check on variations in properties and composition of waxes and allied products. Samples for testing should be taken from top, bottom, and center of each lot, to avoid results that are not average or uniform.

Melting Point

A little wax is melted in a dish. Into this, dip the bulb of a laboratory thermometer, drawing it out at once and spinning it so that the wax on the bulb forms a fairly uniform layer. Next, work a cork, with a hole of the same size as the thermometer stem, down the top of the thermometer stem to about four inches from the bulb. Then insert the cork into a dry, clean

test tube which is placed in a beaker of water over a gas burner. Warm the water and watch the wax on the thermometer bulb. When the wax on the bulb becomes transparent or when a small drop of melted wax appears, read the temperature. This temperature may be considered as the melting point.

Specific Gravity

A. For waxes lighter than water: Fill a 100 cc graduate (measuring cylinder) to the 50 cc mark with a mixture of equal volumes of water and alcohol (take the specific gravity of this, with hydrometer). To this add 20 g of the wax in pieces smaller than the cross section of the graduate so that they will not touch the sides thereof. Read the increase in volume of the water-alcohol mixture. For example, if the increase in volume is 21 cc and the specific gravity of the water-alcohol mixture 0.935, then $\frac{20}{21} \times 0.935 = 0.89$ is the approximate specific gravity.

B. For waxes heavier than water: Use the above method except that plain water, instead of a water-alcohol mixture, is utilized. For example, if the 20 g of wax raises the volume of the water by 18 cc, then $\frac{20}{18} \times 1.11$ is the approximate specific gravity. No factor is needed in this calculation, the specific gravity of water being 1.

Moisture (Water) and Insoluble Matter

Put a little wax in a test tube standing in a beaker of boiling water and keep the water boiling until the wax has melted. Then turn off flame and pour benzol into the test tube until it is about half full. Let it warm up and stir or shake until the wax is dissolved. If the solution is turbid, water is present. Then allow to settle. The water will form a layer at the bottom, along with the insoluble impurities present.

SPECIFIC GRAVITY (ACCURATE DETERMINATION) [1]

The accuracy of some of the specific gravity values given in the literature for natural waxes, such as carnauba and candelilla,

[1] Cartwright, Foster D. Snell Inc.

especially some of the very low values reported, is questionable. The temperatures at which these values were determined are often not given. It is possible that they were determined on the molten waxes above their melting points, in which case they would be substantially lower than for the solid waxes, since these waxes shrink markedly on setting. Experience indicates that the lower values are probably in error, due either to their having been determined on massive pieces of wax, containing internal voids caused by shrinkage on cooling, to the buoyant effect of adhering air bubbles in cases of determination by liquid displacement, or to some other errors in the determinations.

A method for determining the specific gravity which appears to give reasonably accurate and reproducible results has been developed.

It is accurate to ± 0.001 for the samples examined, and variations of more than 0.01 between the specific gravity values for different samples of the same kinds of natural wax at the same temperature are rather improbable.

The following are average values for the specific gravities, at 25/25° C., of various natural waxes, as determined by the method given below:

Carnauba Wax, Yellow	1.000
Candelilla Wax, Refined	0.990
Ouricury Wax, Refined	1.060
Beeswax, Yellow, Refined	0.960

Preparation of Sample

Take a representative sample of the wax to be examined. In the case of natural waxes such as carnauba, candelilla, or ouricury, this may require crushing a substantial amount of wax and quartering down until a representative sample of 10 or 20 g is obtained, or any suitable method of obtaining a representative sample may be used. Melt this sample, allow any dirt or sand to settle to the bottom, remove any foam or air bubbles from the surface, and pour into a clean, smooth, flat-bottomed mold, such as a small glass or procelain dish, a depth of 2 or 3 mm of the melted wax sample. Allow this to cool, and leave at 25° C. for at least 2 or 3 hours to permit full shrinkage to occur. Then cut a piece of the wax slab approximately 2 cm $\times$ 4 cm, weighing approximately 2 g. Scrape the edges smooth and slightly round all corners. This method of preparation yields a repre-

sentative specimen of the wax, substantially free from foreign particles, internal voids due to shrinkage on cooling, and air bubbles, and suitable in size and shape for determination of its specific gravity by the method described below.

Determination of Specific Gravity at 25/25° C.

Use a Hubbard type specific gravity bottle, approximately 70 mm high and 22 mm inside diameter, having a ground-in glass stopper with concave bottom and small hole in the center. Make all weighings accurately to 0.0001 g at 25° C. Weigh the wax specimen. Weigh the bottle, filled with water at 25° C., stoppered carefully and wiped dry, then submerge the wax specimen in the water in the bottle, slowly and carefully so that no air bubbles cling to the surface of the wax, replace the stopper carefully, wipe dry, and weigh again. In order to facilitate wetting the surface of the wax specimen, it is desirable to add a very small amount of wetting agent to the water used in the bottle. Addition of 0.1% of Carbowax 4000 is quite effective, has little tendency to cause the water to foam excessively, and does not alter the density of the water sufficiently to require consideration within the limits of accuracy of the method.

The most probable sources of error in the method lie in failure to wet the wax specimen perfectly and avoid all air bubbles, failure to seat the ground glass stopper with the same force each time, and failure to maintain accurate temperature control. However, reasonably careful manipulation permits reproducibility of results to within ±0.001 g in the weight of the bottle filled with water or filled with the wax specimen and water, in successive determinations.

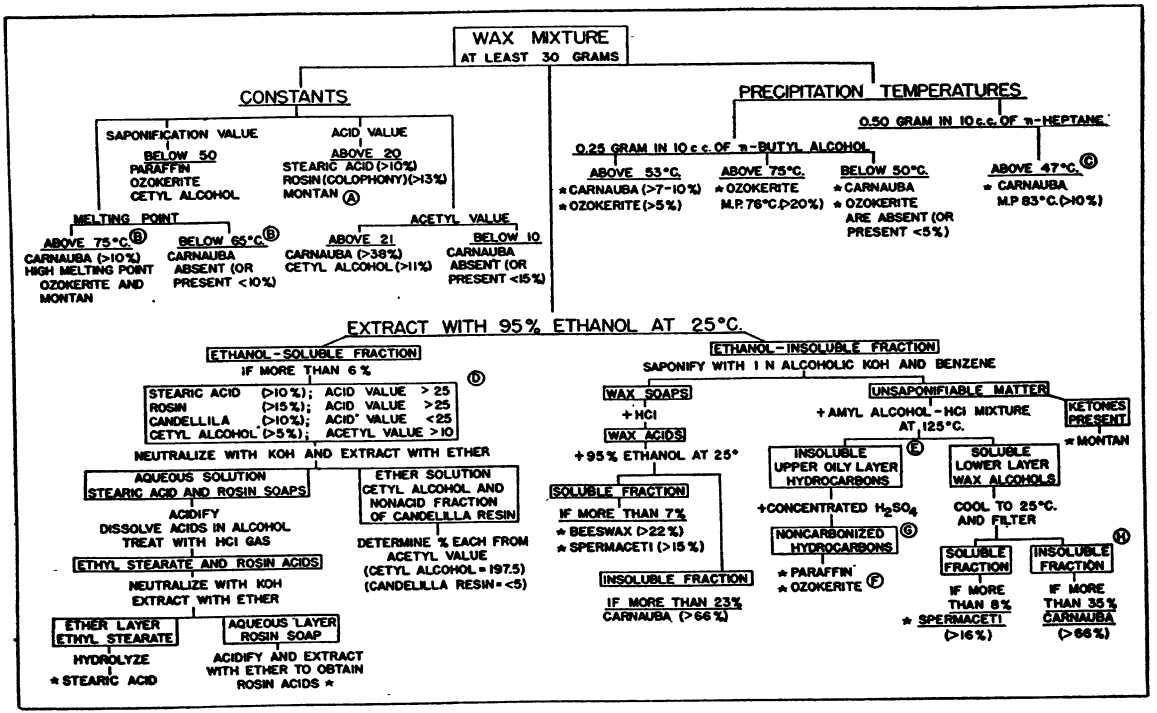
The specific gravity, at 25/25° C., of the wax specimen is calculated as follows:

$$\text{Specific gravity} = \frac{\text{Weight of Wax}}{\text{A} - \text{B} + \text{Weight of Wax}}$$

Where A = weight of bottle filled with water; B = weight of bottle filled with wax and water.

For example, if the wax sample weighs 2.0000 g, the bottle filled with water weighs 50.0000 g, and the bottle filled with wax and water weighs 49.9800 g, then the specific gravity = 2.0000/2.0200 = 0.990. An error of ±0.001 g in either A or B would result in an error of ±0.0005 in the specific gravity.

IDENTIFICATION OF MIXED WAXES[1]



[1] Zweig and Taub, *Ind. Eng. Chem., Anal. Ed.* 12, 10 (1940).

SCHEMATIC OUTLINE FOR IDENTIFICATION

(All per cent figures are based on weight of original sample of wax mixture.)

A. Variations in composition of montan make definite statement concerning quantity impossible.
B. Based on data from Koch *et al.*[2] and Lewkowitsch.[3]
C. Candelilla forms a cloudy solution in *n*-heptane and, therefore, interferes with determination of precipitation temperatures in this solvent.
D. Rosin and candelilla resin form cloudy solutions in *n*-heptane.
E. Absence of a hydrocarbon fraction (solid at 25° C.) indicates the absence of not only paraffin wax and ozokerite but also of candelilla (> 5%), beeswax (> 10%), and montan.
F. 20 to 30% of raw ozokerite is attacked by concentrated sulfuric acid.
G. Hydrocarbons from candelilla, beeswax, and montan are carbonized.
H. Since alcohols of other waxes are also found in this fraction and are closely related to carnauba wax alcohols, this fraction is of value only when a high percentage of carnauba is present (over 60%).

The per cent figure in parentheses indicates the quantity that will always be detected by the determination; when preceded by ">" it indicates that the presence of the quantity stated, or more, will be detected. A smaller quantity may or may not be detected, depending upon a knowledge of the presence or absence of certain other waxes. For example, more than 8% of wax alcohols, soluble in amyl alcohol-hydrochloric acid at 25° C., indicates spermaceti (16%). When the spermaceti, present in the wax mixture, exceeds 16%, the fraction soluble in cold amyl alcohol-hydrochloric acid mixture will always be more than 8 per cent, and spermaceti will always be detected by this determination. However, if the spermaceti in the wax mixture is less than 16%, wax alcohols, soluble in amyl alcohol-hydrochloric acid, may or may not exceed 8%, depending upon the nature and quantity of other waxes present in the mixture.

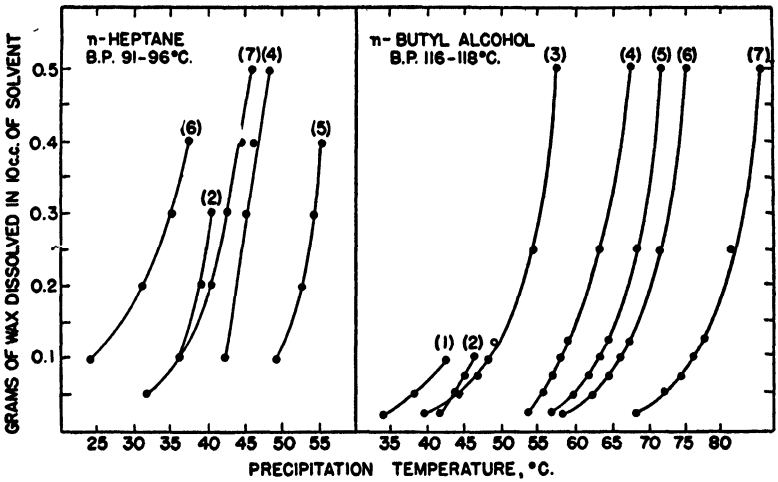
Table I indicates that the per cent of the fraction, soluble in amyl alcohol-hydrochloric acid, for all the waxes determined is: spermaceti, 48%; candelilla, 8%; beeswax, 5%; carnauba, 3%. As candelilla contains as much as 8% of substances soluble in amyl alcohol-hydrochloric acid, spermaceti cannot be determined with certainty unless this fraction is over 8% of the total wax mixture (16% of spermaceti). However, if the approximate quantity of candelilla and/or beeswax is first ascertained, less than 16% of spermaceti can be detected.

Where the name of a substance is starred, that particular determination is of greatest analytical significance for the identification of the substance.

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[2] Koch, Hable, and Wrangell, *Ind. Eng. Chem., Anal. Ed.* 10, 166 (1938).
[3] Lewkowitsch, *Chemical Technology and Analysis of Oils, Fats, and Waxes* (London, Macmillan Co., 1922), Vol. II, p. 889.

PRECIPITATION TEMPERATURES



1 Beeswax, M.P. 60–62° C.
2 Montan, Bleached, M.P. 68° C.
3 Candelilla, M.P. 70.5° C.
4 Carnauba, Refined, M.P. 81.5° C.
5 Carnauba No. 1 Yellow, M.P. 83° C.
6 Ozokerite, M.P. 65–67° C.
7 Ozokerite, M.P. 76–78° C.

Procedure

The finely grated wax is weighed and added to 10 cc of solvent contained in a jacketed test tube (the inner tube is 1.5 × 13.75 cm; the outer, 2.5 × 15 cm), and then placed in a thermostatically controlled bath which has been previously heated to a temperature at which the wax will dissolve. The temperature of the bath is then allowed to decrease gradually, not more than 1° per minute. The temperature is recorded at the point at which crystals just begin to form. In most instances, this point is fairly sharp. In others, however, because of the gradual precipitation the exact temperature cannot be determined. The limit of observational error is ± 1° C.

Results

The precipitation temperatures in *n*-heptane and *n*-butyl alcohol are plotted in Figure 1. It is evident that the precipi-

tation temperatures of carnauba and ozokerite are much higher than those of other waxes. It may, therefore, be said that if, for example, 0.125 g of a wax in 10 cc of *n*-butyl alcohol has a precipitation temperature above 50° C., it probably contains ozokerite or carnauba. When the precipitation temperature of 0.100 g of wax in 10 cc of *n*-butyl alcohol is above 64° C., a quantity of high-melting ozokerite is present in the wax mixture. In such a case, the presence of carnauba, admixed with ozokerite, cannot be detected. However, if the wax mixture is then dissolved in *n*-heptane, the order of solubility of the two waxes is reversed and carnauba precipitates at a higher temperature than ozokerite. A determination of the precipitation temperatures of definite concentrations of wax in both *n*-butyl alcohol and *n*-heptane, therefore, will permit the detection of both ozokerite and carnauba. Their presence is further verified by a quantitative separation of the wax components and by the other constants determined.

Beeswax was omitted from the *n*-heptane determinations because it remains dissolved in concentrations specified, even at room temperature. Candelilla and rosin (colophony) form cloudy solutions in boiling *n*-heptane; their presence would, therefore, interfere with the determination of the precipitation temperatures in this solvent. However, the precipitation temperatures in *n*-butyl alcohol are not influenced by their presence.

Separation and Comparison of Properties of Wax Components

Alcohol-Soluble Fraction

Alcohol extraction is an established method for the determination of stearic acid and rosin in beeswax. In order to extend this procedure to the estimation of these substances in other waxes, it is necessary to have a knowledge of the quantity as well as the properties of the alcohol-soluble fractions of all the waxes.

Procedure

Fifty grams of wax are melted in a 400 cc beaker and extracted by treating with four 150 cc volumes of boiling 95 per

cent alcohol. The alcohol solution is decanted while hot and allowed to cool to 25° C. The precipitate is then collected on a Büchner funnel, washed twice with 50 cc of cold alcohol, and combined with the residue that remains from the original hot extraction. The filtrate is evaporated and the residue weighed.

The alcohol-soluble extract of candelilla consists of a clear resinous material with characteristic aromatic odor. It is completely soluble in cold acetone, alcohol, benzene, ether, terpineol, and ethylene chlorohydrin, and partially soluble in hot acetic anhydride and in boiling *n*-heptane and cyclohexane. In 30 parts of *n*-heptane 15% of the resin-like material remains undissolved. A reddish purple color which changes to dark purple on standing is obtained in the Liebermann-Storch test.

The alcohol-soluble material from carnauba consists of a greenish, gummy, and resin-like material with a pungent, aromatic odor. It shows approximately the same solubilities as the candelilla resin, and in 30 parts of cold *n*-heptane 16.5% remains undissolved. The result of the Liebermann-Storch color reaction is similar to that for candelilla resin.

The alcoholic extracts from beeswax, spermaceti, and bleached montan have a soft wax-like consistency, and are completely soluble in *n*-heptane and cyclohexane (the corresponding candelilla and carnauba fractions produce cloudy solutions when dissolved in these solvents).

Alcohol-Insoluble Fraction

Ten grams of the fraction insoluble in 95 per cent alcohol at 25° C. are saponified by boiling for 2 hours with a mixture of 50 cc of benzene and 25 cc of alcoholic potassium hydroxide (45 g of potassium hydroxide in 1000 cc of absolute alcohol). Fifty cubic centimeters of hot water are added and the aqueous layer is drawn off and washed with three successive volumes of 50, 30, and 30 cc of benzene. The combined benzene solution is washed with an alkaline aqueous alcohol mixture (2 to 1). The benzene is evaporated, and the unsaponifiable matter dried at 110° C. To the soap solution, 15 cc of concentrated hydrochloric acid are added and the separated acids are shaken out with hot benzene. The benzene layer, separated from the acid

aqueous layer, is washed twice with equal volumes of water, and evaporated. The acids are then dried at 110° C.

By this method, the alcohol-insoluble fraction is divided into: (1) substances soluble in aqueous alkali after saponification (chiefly wax acids); and (2) substances insoluble in aqueous alkali, but soluble in benzene (chiefly alcohols and hydrocarbons, known collectively as the "unsaponifiable matter").

Acids

The acids are dissolved in twenty parts of hot 95% alcohol, and the solution is allowed to cool to 25° C. and filtered. Two fractions result: (1) acids soluble in cold alcohol and (2) acids insoluble in cold alcohol.

Unsaponifiable Matter

The unsaponifiable matter (from 10 g of wax) is dissolved in 100 cc of hot amyl alcohol and 100 cc of concentrated hydrochloric acid (36%) are added. The mixture is stirred and boiled over an asbestos plate for about 5 minutes. The presence of hydrocarbons is evidenced by an oily layer on the surface of the liquid. Upon cooling, a disk of solidified hydrocarbons can be lifted from the lower amyl alcohol–hydrochloric acid layer. The residual liquid is filtered through a Büchner funnel and the precipitate washed twice with 25 cc of amyl alcohol–hydrochloric acid mixture. The filter paper with the precipitate is placed in a large evaporating dish, and boiling water is added. The oily layer of wax alcohols rises to the top and solidifies on cooling. The filtrate containing the soluble alcohols is washed in a separatory funnel with hot water until free from hydrochloric acid. The amyl alcohol is then evaporated or vacuum-distilled, and the alcohols are dried and weighed.

This divides the unsaponifiable matter into three fractions: (1) substances insoluble in hot amyl alcohol–hydrochloric acid mixture (chiefly hydrocarbons); (2) substances soluble in hot amyl alcohol–hydrochloric acid mixture but insoluble in cold amyl alcohol–hydrochloric acid mixture (mainly alcohols of high molecular weight, such as ceryl or myricyl); (3) substances soluble in cold amyl alcohol–hydrochloric acid mixture

(mainly wax alcohols of low molecular weight, such as cetyl alcohol).

PROPERTIES OF FRACTIONS SEPARATED FROM WAX

Fraction	% of Entire Wax	M.P. ° C.	n_D, 90° C.	Neut. or Acid Value
Spermaceti				
Entire Wax	..	43.5–44.0	1.4252	...
Soluble in Cold Alcohol	5	32.5–33.0	1.4295	10
Insoluble in Cold Alcohol	95	43.5–44.0	1.4252	...
Total Acids	45	37.8	1.4199	218
Soluble in Cold Alcohol	45	37.8	1.4199	218
Insoluble in Cold Alcohol	None	....	....	...
Unsaponifiable Matter	48	46–50.0	1.4204	...
Hydrocarbons	None	....	....	...
Alcohols (Plus Other Unsaponifiable Matter)				
Insoluble in Cold Amyl Alcohol–HCl	None	....	....	...
Soluble in Cold Amyl Alcohol–HCl	48	44–47.0	1.4200	...
Acetyl Value of Entire Wax	..	2.6	....	...
Saponification Value of Entire Wax	..	128–130	....	...
Beeswax				
Entire Wax	..	60–62.0	1.4327	19
Soluble in Cold Alcohol	5	60.0	1.4391	88.5
Insoluble in Cold Alcohol	95	62–62.5	1.4326	...
Total Acids	40	56–59.0	1.4308	170
Soluble in Cold Alcohol	30	46.6–48.0	....	187
Insoluble in Cold Alcohol	9.5	75–78.0	....	105
Unsaponifiable Matter	55	71–72.0	1.4298	...
Hydrocarbons	20	51.7–52.0	1.4264	...
Alcohols (Plus Other Unsaponifiable Matter)				
Insoluble in Cold Amyl Alcohol–HCl	30	79–80.0	1.4310	...
Soluble in Cold Amyl Alcohol–HCl	5	....	....	...
Acetyl Value of Entire Wax	..	15	....	...
Saponification Value of Entire Wax	..	93	....	..

PROPERTIES OF FRACTIONS SEPARATED FROM WAX
(*Continued*)

Fraction	Carnauba: % of Entire Wax	M.P. ° C.	n_D, 90° C.	Neut. or Acid Value
Entire Wax	..	83.0	1.4496	7
Soluble in Cold Alcohol	3	....	1.4916	19
Insoluble in Cold Alcohol	97	83.3	1.4493	...
Total Acids	40	78.0	1.4441	...
Soluble in Cold Alcohol	5	73.8	....	193.5
Insoluble in Cold Alcohol	35	81.6	....	108.5
Unsaponifiable Matter	55	88.3–89.0	1.4375	...
Hydrocarbons	None	....	....	...
Alcohols (Plus Other Unsaponifiable Matter)				
Insoluble in Cold Amyl Alcohol–HCl	52	86–87.0	1.4358	...
Soluble in Cold Amyl Alcohol–HCl	3	....	....	...
Acetyl Value of Entire Wax	..	51–60	....	...
Saponification Value of Entire Wax	..	79–88	....	...

Fraction	Candelilla: % of Entire Wax	M.P. ° C.	n_D, 90° C.	Neut. or Acid Value
Entire Wax	..	70–70.5	1.4600	22
Soluble in Cold Alcohol	19	....	1.5115	24
Insoluble in Cold Alcohol	81	72–73.0	1.4503	...
Total Acids	29–30	80–80.5	1.4496	115
Soluble in Cold Alcohol	7.5	50–50.3	1.4734	177
Insoluble in Cold Alcohol	22.5	82.5	1.4428	91
Unsaponifiable Matter	50	67–68.0	1.4476	...
Hydrocarbons	30	66.8	1.4325	...
Alcohols (Plus Other Unsaponifiable Matter)				
Insoluble in Cold Amyl Alcohol–HCl	11	78.2	1.4417	...
Soluble in Cold Amyl Alcohol–HCl	8	....	1.5136	...
Acetyl Value of Entire Wax	..	9–21	....	...
Saponification Value of Entire Wax	..	57	.. .	...

PROPERTIES OF FRACTIONS SEPARATED FROM WAX
(*Continued*)

Fraction	Montan (Bleached) % of Entire Wax	M.P. ° C.	n_D, 90° C.	Neut. or Acid Value
Entire Wax	..	67.5–68.5	1.4270	45
Soluble in Cold Alcohol	3	52.0	1.4386	29.5
Insoluble in Cold Alcohol	97	68.5–68.7	1.4270	...
Total Acids	38	77–79.0	1.4325	109
Soluble in Cold Alcohol	2.6	....	....	93.3
Insoluble in Cold Alcohol	35.2	78–79.0	....	118
Unsaponifiable Matter	58.2	51.5–51.7	1.4246	...
Hydrocarbons	52.6	52.4	1.4236	...
Alcohols (Plus Other Unsaponifiable Matter)				
Insoluble in Cold Amyl Alcohol-HCl	5	....	....	...
Soluble in Cold Amyl Alcohol-HCl	Trace	....	....	...
Acetyl Value of Entire Wax	..	11.2	....	...
Saponification Value of Entire Wax	..	77	....	...

The properties of the various fractions, separated from each wax by the procedure outlined, are listed in the preceding table.

The results of the preceding determinations are interpreted below. Allied substances such as stearic acid, cetyl alcohol, and rosin are included, since they are often found admixed with waxes, and their presence may affect the interpretation of the results.

From a knowledge of the constants, certain generalities may be inferred—for example, a low saponification value (below 50) indicates the presence of paraffin or ozokerite; a very low acid value (below 3 or 4) excludes the presence of more than 10 per cent of beeswax, montan, or candelilla, and indicates the absence of rosin or stearic acid. Similarly, a low acetyl value (below 10) excludes appreciable quantities of carnauba or free cetyl alcohol; a low melting point (below 65° C.) shows the absence of more than 10% of carnauba.

The precipitation temperatures indicate the presence or absence of ozokerite and carnauba.

An examination of the alcohol-soluble fraction yields valuable

information concerning a wax mixture—for example, when the quantity of alcohol extract is below 5%, the absence of candelilla, rosin, stearic acid, and cetyl alcohol may be definitely inferred. Candelilla contains 20% of an alcohol-soluble, resinous substance, with a low acid value. Consequently, the presence of more than 5% of an alcohol-soluble material, with a high acid value (above 25), indicates the presence of acid substances such as stearic acid or rosin.

The separation of the constituents of the alcohol-insoluble fraction and the determination of their properties yield more specific information concerning the wax mixture. The wax acids are divisible into two groups, on the basis of solubility. The acids, soluble in cold alcohol, are compounds of low molecular weight, chiefly myristic, palmitic, and adjacent homologous acids, with melting point below 51° C. Those insoluble are compounds of high molecular weight, with content from 24 to 34 carbon atoms and melting point above 75° C. The entire acid fraction of spermaceti and 75% of the acids of beeswax are composed of the lower melting point compounds. Therefore, if the alcohol-soluble acid fraction is absent, or present in small quantities (less than 7.5% of the entire wax), spermaceti and beeswax are either absent or present in small quantities. A further verification can be obtained by an examination of the wax alcohols.

The wax alcohols have similarly been divided into a fraction soluble in cold amyl alcohol–hydrochloric acid mixture and a fraction insoluble in this solvent. The entire unsaponifiable fraction from spermaceti is composed of alcohols soluble in cold amyl alcohol–hydrochloric acid, whereas all the other waxes, including beeswax, yield comparatively small percentages of material soluble in this solvent at 25° C. Therefore, the presence or absence of spermaceti would be indicated by the determination of the quantity of material soluble in cold amyl alcohol–hydrochloric acid mixture. Since spermaceti is essentially the cetyl ester of myristic and lauric acids, the ratio of soluble acids to soluble alcohols is approximately 1 to 1. A higher ratio, such as 1.5 or more of soluble acids to one part of soluble alcohols, would therefore indicate the presence of beeswax.

The hydrocarbon fraction offers a means for detecting the

presence of ozokerite or paraffin. The wax hydrocarbons are carbonized when heated to 110° C. with concentrated sulfuric acid,[1, 2] while the paraffin hydrocarbons are unattacked and can be extracted from the diluted acid mixture with a volatile solvent such as ether or petroleum ether. The quantitative determination of ozokerite and paraffin, when both are present, is difficult. Graefe's method,[3] often employed for this purpose, is based upon the fact that 50 to 60% of ceresin hydrocarbons are precipitated from their solution in carbon disulfide by the addition of a mixture of ether and alcohol (1 to 1), whereas paraffins remain in solution. Other methods, based on differences in solubility, melting points, and refractive index, are described by Holde.[4]

The following compilation of the important distinguishing characteristics of each wax is presented as a supplement to this discussion.

Spermaceti

The unsaponifiable matter, totaling 48%, is found in the fraction soluble in cold amyl alcohol–hydrochloric acid. All the acids are soluble in cold ethyl alcohol. When added to other waxes, spermaceti causes a lowering of the acid value, melting point, and acetyl value. The ethanol-soluble fraction is small, and hydrocarbons are absent.

Beeswax

Seventy-five per cent of the acids are soluble in cold alcohol. (If spermaceti is present, as indicated by the quantity of cold amyl alcohol–hydrochloric acid fraction, the amount of acids in excess of the combining ratio of alcohols and acids, 1 to 1, which form the ester of spermaceti permits the calculation of the approximate quantity of beeswax.)

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[1] Better and Davidsohn, *Taschenbuch für die Wachsindustrie* (Stuttgart, Wissenschaftliche Verlagsgesellschaft, 1932).

[2] Lüdecke, *Die Wachse und Wachskörper* (Stuttgart, Wissenschaftliche Verlagsgesellschaft, 1926).

[3] Graefe, *Chem. Z.* 27, 248 (1903); *Analyst*, 28, 190 (1903).

[4] Holde, *Examination of Hydrocarbon Oils and of Saponifiable Fats and Waxes* (New York, John Wiley & Sons, 1922).

Carnauba

The precipitation temperatures in *n*-butyl alcohol and in *n*-heptane are much higher than those of other waxes (ozokerite excepted). Hydrocarbons are present in but very small amounts (about 1%). The acetyl value is much higher than that of any other wax studied. The melting point of a wax mixture is considerably increased by the addition of small quantities of carnauba.[1, 2] The acids and alcohols are mostly of high molecular weight; consequently, both the cold alcohol-soluble acid fraction and the fraction soluble in cold amyl alcohol–hydrochloric acid are very small.

Candelilla

The alcohol-soluble fraction consists of a resinous material and constitutes approximately 20% of the wax. This fraction has a low acid value, in contradistinction to rosin (colophony) which has an acid value of about 160. The resinous material may be separated from rosin and stearic acid by neutralizing the alcohol-soluble fraction with potassium hydroxide, adding water, and extracting with ether or benzene.

The acid fraction of candelilla is dark brown in color and more than 75% is insoluble in cold alcohol. The hydrocarbon fraction is relatively large. The hydrocarbons differ from paraffin or refined ozokerite hydrocarbons in being readily carbonized by concentrated sulfuric acid.

Montan

Considerable differences are found in the composition of the three varieties of montan, but all invariably contain montanic acid ($C_{28}H_{56}O_2$), free or combined as an ester. The proportion of hydrocarbons is large, and ketones have been found in the raw and the distilled products. The presence of resinous substances and sulfur-containing compounds differentiates the raw montan from the distilled and bleached products.

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[1] Koch, Hable, and Wrangell, *Ind. Eng. Chem., Anal. Ed.*, 10, 166 (1938).

[2] Lewkowitsch, *Chemical Technology and Analysis of Oils, Fats, and Waxes* (London, Macmillan Co., 1922), Vol. II, p. 889.

Because of the absence of alcohols, the acetyl value of the unsaponifiable matter of distilled wax is for all practical purposes zero, whereas the raw and refined wax contain varying amounts of alcohols of high molecular weight, such as ceryl or myricyl. The presence of ketones in the unsaponifiable matter is an important clue to the identification of montan. Ketones are estimated by reducing with sodium in alcohol to secondary alcohols and determining the difference in hydroxyl value before and after reduction. They may also be estimated by the method of Mangouri,[1] which is based on the insolubility in boiling methyl alcohol of the barium salt of a hydrazone formed when the ketones are treated with *p*-hydrazinebenzoic acid.

Paraffin

The hydrocarbons are not attacked by concentrated sulfuric acid, whereas wax hydrocarbons are carbonized by this acid. The addition of paraffin to a wax mixture appreciably lowers the saponification value.

Ozokerite

The precipitation temperatures in *n*-butyl alcohol and *n*-heptane are much higher than those of all the other waxes (carnauba excluded). The hydrocarbons of the refined ozokerite are not attacked by concentrated sulfuric acid.

The precipitation temperatures of the unattacked hydrocarbons can be used to differentiate paraffin qualitatively from ozokerite. Graefe's method[3] may be applied to determine whether both are present.

Rosin (Colophony)

Rosin, which is found in the cold alcohol-soluble fraction, has a very high acid value (about 160), and can be differentiated from stearic acid in that rosin acids are not converted into ethyl esters when treated in alcohol solution with hydrogen chloride gas.[2] Addition of rosin to a wax mixture raises the acid value

[1] Mangouri, *Biochem. J.*, **31**, 1978 (1937).

[2] Lewkowitsch, *Chemical Technology and Analysis of Oils, Fats, and Waxes* (London, Macmillan Co., 1921), Vol. I, p. 639.

considerably (10 per cent of rosin increases the acid value by 16). Color reactions for rosin, such as the Libermann-Storch reaction, are not very reliable since candelilla and montan produce similar colors.

Stearic Acid

This acid, like rosin, is found in the alcohol-soluble fraction, and is differentiated from rosin as indicated above. The acid value of a wax mixture is increased by 20 when 10% of stearic acid is added.

Cetyl Alcohol

This alcohol is identified by the high acetyl value of the alcohol-soluble fraction. The acetyl value of the entire wax mixture is increased by 20 for each 10% of added cetyl alcohol.

RATIO NUMBERS OF WAXES

The ratio number often serves as a good guide in detecting adulteration of beeswax.[1]

$$\text{Ratio Number} = \frac{\text{Saponification No.—Acid No.}}{\text{Acid No.}}$$

Ratio Numbers	
Ceresin	0
Paraffin Wax	0
Ozokerite	0
Stearic Acid	0
Japan Wax	11
Insect Wax	29
Carnauba Wax	39
Tallow	48
Myrtle Wax	68

ODOR AND TASTE

To detect odorous or flavoring components, a thin layer of the wax under test is brought into contact with diluted 50 and/or 10% alcohol for about twenty-four hours. The alcohol must

[1] Fryer and Weston, *Technical Handbook of Oils, Fats and Waxes* (New York, University Press, 1917).

not taste and smell differently from alcohol of the same strength after having been in contact with the wax.

An odor which is not noticeable or only faint may develop on aging, heating or interaction with other components. Samples of the wax should be put into clean jars and stoppered or closed to be air tight. Two jars should be kept in a dark place, one at room temperature and the other near a radiator or on a hot water line (not hot enough to melt the wax). Another jar should be placed in direct sunlight. After a few days, each jar should be opened and smelled. Time and temperature develop and intensify most odors.

MELTING OF WAXES

Commercial waxes are sold as slabs, cakes, lumps, flakes or powders. They are best melted in steam jacketed kettles, double boilers (water baths) or electrically heated kettles whose temperatures can be readily controlled. Direct-flame heating is to be avoided because local overheating leads to discoloration and decomposition and the fire hazard is very great.

In the case of waxes that are not sensitive to oxidation, open kettles may be used. For those waxes that are sensitive to oxidation, closed kettles, with or without a blanketing gas (nitrogen or carbon dioxide), are required. Since many natural waxes are contaminated with foreign matter such as insects, leaves, dirt, fibres, etc., it is customary to separate these from the molten waxes by settling or filtration. Where the circumstances permit it, this step may be postponed until the wax is dissolved or emulsified.

Waxes should not be heated any higher than it is necessary. The heating process, at any given temperature, should be of the shortest duration. These precautions are necessary to minimize discoloration and chemical or physical changes. Good stirring, by a mechanical mixer, helps to melt waxes quickly and uniformly. Care should be taken to avoid beating in too much air which may oxidize the wax. Regulating the speed of the mixer and using suitable propellers or arms on the mixing shaft tends to minimize the amount of air that is beaten in. The num-

ber, size, shape, pitch and location of the propellers or arms are influential in this connection.

Certain waxes contain varying amounts of water. When they are melted the water tends to volatilize and then boil off. This results in foam formation which may cause the batch to boil over. To avoid this, heat must be applied judiciously and, in some cases, a whipping stirrer must be used to break up foam at the surface of the molten wax. Wax melting kettles should never be filled so high that the expansion of the wax (caused by heat) and the foam produced will come too near the top of the kettle. Carnauba wax, containing 5% of water will expand 5 times as much as the dry wax does when heated.

Pigments, lakes, clays, abrasives and other materials, that are mixed with waxes, often contain appreciable amounts of water. They should be dried before addition to a wax that is to be melted.

Foam is especially troublesome in the hot emulsification of waxes. Here large quantities of foam are produced when soap or other foam producing emulsifying agents are used. In some cases, it is even necessary to use small amounts of defoaming agents such as oils, higher alcohols, or Foamex.

To avoid discoloration, chemical reaction or contamination, it is usual to melt waxes in glass-lined, aluminum, stainless steel, Inconel or other special alloy kettles. Iron or copper are not recommended as they are attacked by the fatty acids present or liberated in molten waxes.

When melting together waxes and other fusible ingredients, it is best to first melt that material which has the highest melting point. To this is then added the next highest melting component and any other materials are then added one at a time in the descending order of their melting points. Slow stirring should be resorted to at the start and the rate of stirring can be gradually increased as the harder components are melted. This routine saves time and heat and also prevents overheating, discoloration and decomposition. Of course, these conditions may be changed after a number of batches of a special composition have been made and their characteristics learned.

COMMERCIAL WAX SOLUTIONS

SOLVENTS FOR WAXES OR WAX-LIKE MATERIALS

The physical properties of solvents are an important consideration in the formulation of wax or wax-like mixtures. The properties of most importance to be considered are:

Solubility and compatibility
Dry time and evaporation rate (distillation range)
Flash point
Odor
Toxicity
Clean final dry
Possible tarnishing or corrosive effects on metals

A solvent may be defined as a substance by means of which a solid can be brought into a fluid state. This definition, although defective and inadequate, expresses the general idea underlying the use of solvents. The prime purpose of wax solvents is to dissolve or disperse the wax, so as to obtain suitable application properties.

In many processes the object of employing a solvent is merely to provide a means of transferring a solid from one place to another in a convenient and desirable manner; when the transference has been accomplished the solvent is of no further use and has to be removed as rapidly and as completely as possible, but in a manner compatible with concomitant factors. These factors make it desirable that certain characteristics of a solvent should be known and that a solvent suitable for the purpose should be used.

Liquid wax mixtures generally require moderately fast drying solvents. For this purpose petroleum solvents are widely used. These are available in various grades to suit regular and special requirements.

Paste wax mixtures require a solvent drying moderately slowly. For this purpose, a petroleum solvent like No. 10 Mineral Spirits or Apco 125 is often used. Apco 125 is preferred

where it is desirable to improve aging qualities and reduce shrinkage. It gives easier application, particularly under unusual conditions such as outdoor application, hot weather, rough surfaces.

Troluoil, Apcothinner, No. 10 Mineral Spirits, and Apco 125 are petroleum solvents. These products are considered to be non-toxic.

SOLVENT-WAX COMPOSITIONS

Since most waxes do not dissolve in the usual commercial solvents, in large amounts, it is necessary to formulate in such a way that a uniform stable paste or gel will result. To attain this end, while still retaining the necessary properties that make the finished product useful, it is necessary to carefully balance the waxes and solvents both as to kind and quantity. Thus, although ozokerite will give a stable gel with naphtha, it is not used alone in polishes, because of insufficient luster and because of its relatively high price. The addition of carnauba wax improves its hardness and luster and the addition of paraffin wax reduces the unit cost while improving luster.

Carnauba and paraffin waxes are crystalline and only small amounts thereof dissolve in solvents. They do not have good binding or gelling properties with solvents. Ozokerite and other amorphous waxes have excellent binding or gelling properties with many solvents and can carry along and prevent the crystallization of certain amounts of crystalline waxes. Consistency regulation of waxes in solvents is usually made with paraffin wax. Such compositions usually contain 2 to 6% ozokerite (in addition to the other waxes) to get the best consistency and stability.

In solvent-wax compositions, the high-melting wax content is usually not higher than the hydrocarbon wax content (ceresin, ozokerite and paraffin). Only for wax pastes that are subjected to higher temperatures, e.g., tropical goods, should the amount of high-melting waxes be increased.

When adding a solvent to a melted wax composition, the former should be warmed to a temperature above the setting point of the latter, to avoid crystallization. It should be run in

slowly, while mixing thoroughly by a mixing arrangement that does not splash the contents or beat in air.

Solvent Retention of Waxes [1]

A solution of 22 parts of 75° C. paraffin-free, Russian, refined ozokerite and 78 parts of oil of turpentine (sp. gr. 0.9800) is used as a standard for determining the amount of solvent necessary to produce pastes of like consistencies from various waxes. The parts of solvent per 100 parts of wax that will give the same consistencies are: 75° C. ozokerite, 354, 65° C. petrolatum, 233, beeswax, 294, 52–54° C. (solidification point) paraffin wax, 426, crude carnauba wax, 900, crude montan wax, 525.

In general, solvent retention decreases with increase in the setting point of waxes. This is the case with common varieties of ozokerite and paraffin wax. Beeswax possesses a markedly lower, and bleached montan wax a markedly higher retention than would be expected merely from their setting points. As a measure of retention, the *"retention number"* (Rn) is used.

$$Rn = 100\,\frac{S - Sv}{S}$$

where S = original solvent content and Sv = loss of weight of paste. For the power of a wax (ozokerite) to increase the retention of another wax, the term *Retention effect* or *Re* is used. The retention effect of an ozokerite is the greater, the smaller its own retention and the higher its setting point. The same applies to paraffin waxes. As a first approximation, the retention effect can be calculated by means of the equation $Re = R_{max} / C_{Rmax}$, where R_{max} is the highest value of the retention that can be imparted to a given wax, having originally a retention of R_O, by the addition of another wax (ozokerite). C_{Rmax} is the amount of such added wax expressed as a percentage of the mixture (ozokerite and paraffin wax).[2]

Ozokerite, in the form of a solvent paste, is transparent and exhibits uniform contraction of the entire mass, upon evapora-

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[1] H. Lux, *Allgem. Oel-u. Fett-Ztg.* **32,** 153 (1935).
[2] L. Ivanovszky, *Oil Colour Trades J.* **96,** 365 (1939).

tion of the solvent; paraffin wax is opaque and gives off solvent only at the surface.

It is impossible to pass from dilute solutions to pastes by solvent evaporation even though the threshold concentration for paste formation is reached.[2]

FAULTY SOLVENT-WAX COMPOSITIONS (SHOE CREAMS AND POLISHING WAXES) [1]

Trials, on a small scale, from the commencement of the process to the storage of the filled shoe cream, are very important, and even indispensable in avoiding the following expensive faults:

Folds or wrinkles with matt (dull) and often patchy surfaces owing to harsh cooling with cold air currents, especially with a high content in montan wax.

Bad mirror surface owing to unsuitable filling temperature, overcooling, overheating of the wax melt, too high content in hard wax, too much heavy benzine or too easily volatile benzine.

Veiled bloom on the surface, with black creams, owing to too little or too much nigrosine base, vapory filling room, too much hard wax.

Incrustation on the surface caused by too much vegetable wax, too volatile turpentine substitute, poor binding, whereby the uniform internal crystallization process of the cream has been disturbed, so that after the cream has set, a further crystallization takes place on the surface, and the wax components dissolved in the solvent remain behind, after evaporation, as a mouldy incrustation. It may also be caused by absorption of the easily soluble particles of the cream, by sweat, to the point of saturation so that, on evaporation, the same process takes place.

Sweating in the tin owing to putting highly chilled cream into too warm a store, insufficient internal binding, too much paraffin, too short storage of the fresh cream, too warm storage. The highly dispersed wax molecules absorb more thinning agent at cooler external temperatures, which, by increasing the

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[1] J. & A. Davidsohn, *Shoe Creams and Polishing Waxes* (New York, Chemical Publishing Co., 1940).

[2] L. Ivanovszky, *Petroleum* **4**, 100 (1941).

warming effect, are partly set free and separate in the form of drops on the edges and surface of the tin.

Granular condition may be caused by lack of homogeneity through too rapid or too cold addition of the solvent, too much montan wax, too much paraffin, too high melting or thinning temperature, too prolonged setting process. Sometimes granulation can be avoided by including ¼–2% Aerosol OT (100%).

Rattling in the tin; shrinkage of the cream owing to too much hard wax, use of paraffins of too high a melting point, bringing still warm cream, which has not yet fully bound itself with the solvent, into too cold a store room, too hot filling, badly fitting tin lids, too warm storage.

FILLING CONTAINERS WITH WAX COMPOSITIONS

When filling containers with wax compositions care must be taken to avoid bubbles, which mar the surface and cause excessive shrinkage or collapse on cooling. One method of avoiding this is to allow the melted wax to stand until most of the air, which may have been introduced by mixing, pumping or flowing, is dissipated. The filling should be through a funnel or tube that reaches as far down as possible into the container. Sometimes, especially in the case of large containers, the latter are filled nearly to the top and allowed to "set." Then the rest of the space is carefully filled. During the process of setting or congealing, the containers should not be disturbed. The lids should only be applied after complete setting and cooling. Even after this, the wax composition should be allowed to age for a few days.

Where the appearance of the surface layer of a wax compound is of importance, certain techniques in formulation and handling are necessary. The characteristic surface rings developed in some carnauba wax-solvent compositions are due to fractional crystallization of one or more components. This ring formation and high gloss are enhanced by rapid evaporation or cooling. Artificially chilled air is used by some who lead it over the open containers or pass the latter through a compart-

ment, on a moving belt. Too rapid cooling must be avoided as it may produce non-homogeneous products and separation.

The filling operation is best done in a room having an exhaust system to remove fumes and with air that has been passed through a filter and drier to remove dust and excessive moisture. A temperature of 55 to 65° F. is best for most purposes. For every wax composition, there are optimum filling conditions of temperature, speed, etc. These can only be determined by experiment. Where air conditioning equipment is not available or is out of order temperature of the wax and speed of filling must be adjusted to meet the changes in temperature and humidity of the room.

Solvent-containing wax compositions are usually packed in tins or jars rather than in tubes or bottles, because, if the solvent separates, leaving a wax mass beneath, it is difficult to remove or to stir together. Water-containing (emulsified) waxes, when properly made, do not harden and so are usually packed in tubes or bottles.

SOLVENT-BINDING AND LUSTER-PRODUCING PROPERTIES OF WAXES

Wax	Solvent Binding Power	Luster Value
Acrawax	Good	Good
Adhesowax	Good	Medium
Albacer	Slight	Good
Bayberry Wax	Good	Medium
Beeswax	Good	Slight
B. Z. Wax A	Medium	Medium
Carnauba Wax (Bleached)	Medium	Medium
Carnauba Wax (Crude)	Medium to Slight	Good
Carnauba Wax Residues	Medium	Medium
Candelilla Wax	Medium	Good
Ceraflux	Medium	Good
Ceresin	Good	Good
Cetyl Alcohol	Good	Medium
Chinese Insect Wax	Medium	Good
Cotton Wax	Medium	Good
Durocer	Excellent	Good
Fiber Wax	Medium	Good

SOLVENT-BINDING AND LUSTER-PRODUCING PROPERTIES OF WAXES (*Continued*)

Wax	Solvent Binding Power	Luster Value
I-G Waxes	Except I-G Wax E, which is suitable for saponified products, Good. I-G Wax E, Medium	Except I-G Wax BJ, bleached and unbleached, which only shows a slight polish effect, Good
Japan Wax	Good	Good
Lanette Wax	Good	Medium
Microcrystalline Paraffin Wax	Good	Medium
Montan Wax	Good	Good
Nipocer	Good	Good
Opalwax	Slight	Medium
Ouricury Wax	Medium to Slight	Good
Ozokerite	Excellent	Good
Ozowax	Good	Good
Paraffin Wax	Medium	Medium
Petrolatum Wax (Protowax)	Excellent	Medium
Rezowax	Good	Good
Rilan Wax	Good	Good
Shellac Wax	Good	Good
Spermaceti	Good	Good
Sugar Cane Wax	Medium	Good

U. S. GOVERNMENT SPECIFICATIONS FOR SOLVENT-WAX COMPOSITIONS

P-W-134. Wax, Floor; Solvent-Type, Liquid (With Resins). October 29, 1942. Intended for use on all floors except those containing asphalt or rubber. Shall consist of waxes and resins dispersed in turpentine or petroleum distillate. The flash point of the solvent shall be not less than 28° C. The wax shall dry in not over 45 minutes. There shall be not less than 11% of *non-volatile matter* having the following properties; *softening point* not less than 72° C.; *acid value* not over 18; *saponification value* 40 to 85; *Wijs iodine value* 15 to 22; *ash* not over 0.5%.

P-W-158. Wax, General-Purpose; Solvent-Type, Liquid and Paste (For Floors, Furniture, Etc.), Sept. 17, 1942, super-

seding PW-141, February 12, 1936. Shall consist of waxes dispersed in turpentine or petroleum distillate. The flash point of the solvent shall be not less than 28° C. The wax shall contain no rosin. The wax shall *dry* in not over 45 minutes. Type I (liquid) shall contain not less than 11%; Type II (paste) not less than 20% *non-volatile matter.* In both types the non-volatile matter must have a *softening point* of not less than 71° C.; *acid value* of not over 8; *saponification value* from 20 to 70; *ash* not over 0.5%.

COLORING WAXES

The color of waxes and wax compositions may be altered by means of dyes, pigments, bleaching or other chemical treatment. A temporary (until the wax is melted) lightening in color is often produced by beating air, or varying amounts of water, into a melted wax.

When dyes are used for coloring waxes, as in shoe polishes, a stock solution of the dye is usually made with oleic acid (red oil), montan wax or stearic acid. For example, heat 100 lb of oleic or stearic acid in a kettle (half full) to 90 to 95° C. Then stir in slowly, a little at a time, the dye (e.g., nigrosine base) to the extent of 30 to 50 lb and, while stirring, raise the temperature to 101 to 105° C. Continue stirring until all the dye is dissolved. If it is desired to dilute the dye solution, more oleic or stearic acid may be mixed in or a solvent, such as turpentine or naphtha, may be used. Where it is not desired to introduce oleic or stearic acid or solvents in making up the dye solution, certain waxes like montan, beeswax, Japan wax or carnauba wax may be used instead. They are not as good solvents for basic dyes and thus only permit the making of solutions less concentrated than those made with oleic or stearic acid.

Since dyes are often affected by heat, it is best to dissolve them at the lowest possible temperature in the shortest period of time. Thus, where they are to be dissolved in melted wax, they should be added only after all the components have been introduced and melted and at the lowest possible temperature before completing the batch.

Proper mixing is necessary to avoid undissolved dye, which

is not only an economic loss of a high-priced ingredient, but which mars the appearance because of specks or lumps and also produces different shades of color in different parts of the composition.

Dyes are standardized by their makers or distributors with salt, Glauber's salt, dextrin or other fillers. These are not soluble in fatty acids, waxes or wax solvents and sometimes may be harmful. If such is the case, their solution, in the wax or solvent, should be filtered before use. Where dyes are used to color wax emulsions, salt, Glauber's salt or other electrolyte present may disturb the emulsion or induce corrosion of the metallic container. Accordingly, only dyes standardized with dextrin or other harmless fillers should be used.

The type of dye used should be tested for permanence, or the supplier should warrant the quality. Thus, if it is to be used in an alkaline, acid, oxidizing, or reducing medium, it should not be affected. Suitable dyes are now available for all specific uses.

Wax compositions or solutions are usually colored with oil-soluble dyes with or without insoluble pigments. Wax emulsions can be colored either with oil-soluble dyes, dissolved in the wax or solvent that may be present, or with water-soluble dyes, dissolved in the water.

EMULSIONS

An emulsion may be considered as a homogeneous suspension of tiny droplets of oil in water or water in oil. The oil-in-water type may be represented by the usual furniture polish (milky) and the water-in-oil type by butter. The term "oil" is used here in a broader sense to include oils (mineral, vegetable, animal or essential), fats, greases, waxes, hydrocarbons (benzol, naphtha, turpentine, etc.), synthetics (ethylene dichloride, nitrobenzol, etc.), that is, something which does not mix with water.

Emulsification formulae and methods have been evolved chiefly through practice, by actually making innumerable emulsions. Because of the vagaries and eccentricities of emulsions, practical workers have made greater technical advances in this field than the research chemists. Too often, the trained chemist

does not achieve as good emulsions as the lay worker, because the former rebels instinctively against empirical formulae and does not follow instructions as implicitly as the man "who knows he doesn't know." Moreover each new emulsion represents a new problem having numerous variable factors. These should not be underestimated if a good stable emulsion is desired. The technique and preparation of any particular formula should first be mastered before any variations are attempted.

Formulation

The first factor in formulation is the ratio of the wax to the water phase. Usually, an increase in amount of the water phase will result in a lowered viscosity of the emulsion. Often, the decreasing of the amount of the water phase may cause inversion. Low percentages of water, in many emulsions, produce pasty or even solid emulsions. Since increased viscosity usually increases stability, viscous (concentrated) emulsions are frequently made so that aging and mechanical shock will not break them. These are diluted as required before use.

The amount of the emulsifier used is dependent on many factors, viz., stability, viscosity, type, color, costs, and so forth. It is usual to start out with an amount equal to that used in similar emulsions and work up or down, depending on desired results. It is best to work with parts by weight for all ingredients in order to avoid errors due to differences in densities.

Since a test of stability may require "shelf-testing" for some length of time, it is best to make up a number of experimental emulsions, varying the components (within certain limits) and allowing them to age.

Methods

Just as one man's food may be another's poison, so one method, which will give a perfect emulsion in one case, may produce a perfect failure in another. Thus no one method or emulsifying agent will serve universally.

When an emulsion of a solid, melting above 100° C., is desired, it should first be melted with sufficient solvent or oil to reduce the combined melting point below 100° C. For example,

naphthalene with naphtha or other hydrocarbons; synthetic resins with hydrocarbons or vegetable oils.

Summary

It must be borne in mind that perfect results cannot be gotten until a few experimental emulsions are made in order to become familiar with working conditions. That is why experience shows that one of the given formulae should be mastered before attempting any variations.

Variations in raw materials, procedure, errors in proportions, etc., produce poor results. The formulae given have been repeated many times and will work if they are strictly adhered to.

Of course these formulae cannot fill every individual requirement. Variations are therefore necessary. In order to work out successful formulae, patience is essential. That which is worth while getting is worth while striving for. It is suggested that only one ingredient or proportion is varied at a time. This enables one to know exactly what produces the change in the finished product.

Emulsifying with ammonium linoleate

This is an excellent agent for emulsifying vegetable and fish oils, waxes, fat, resins, hydrocarbons and many other water-insoluble products. When emulsifying a water-insoluble product, having a melting point of over 100° C., it should be first dissolved in naphtha, ethylene dichloride, turpentine, or similar solvent. Alcohol, as a rule, should not be used as it breaks down most emulsions. Similarly, acids, esters, and salts must be avoided.

Procedure

Using proportions given in the following table, first dissolve the indicated amount of water in the ammonium linoleate. This is done by covering the ammonium linoleate with the required amount of water and allowing it to soak over night. Work in slowly the next day until dissolved completely. Do not attempt to dissolve in any other way or lumps will result. To this add

slowly, with vigorous agitation, the indicated amount of oil and continue stirring until homogeneous.

When a wax is to be emulsified, the wax is melted and considered as an oil. In this case, the water must be heated above the melting point of the wax. Most trouble is encountered in making wax emulsions when the solution of ammonium linoleate in water and the melted wax are not heated sufficiently. To play safe, keep each of these solutions between 95 and 100° C., not allowing the temperature to drop below the melting point of the wax while adding one to the other. These formulae have been repeated numerous times with uniformly good results. If your emulsion is grainy or forms a film of wax on the surface, then the fault is in manipulation. Good wax emulsions cannot be made by hand or with a slow moving paddle. The vigorous agitation of a fast electric stirrer is essential.

Emulsions of the various, inflammable hydrocarbons give products of high cleansing power and of a much higher flash-point.

Material Emulsified	Parts	Water Parts	Ammonium Linoleate Parts
Kerosene	90	90	8
Naphtha	90	100	7
Benzol	90	100	7
Gasoline	90	100	7
Pine Oil	90	90	10
Carnauba Wax	90	620	12
Beeswax	90	500	12
Ozokerite	90	400	14
Turpentine	90	100	8
Nitrobenzol	90	100	8
Orthodichlorbenzol	90	100	8
Methyl Salicylate	90	100	8

The above formulae can be lessened in cost by reducing the amount of emulsifier used. The minimum can be determined by experiment. Increasing the amount of water will give thin emulsions. Certain emulsions are improved by the addition of 1% or so of ammonia dissolved in water when making the emulsion.

Some emulsions, particularly those containing saponified

candelilla, carnauba or Japan wax or stearic acid, may become thicker on standing.[1] New emulsions, therefore, should be observed for about a week to note any physical changes.

In certain wax emulsions, particularly for shoe creams, emulsification is brought about by partially saponifying one or more of the saponifiable waxes present. It is not necessary to effect complete saponification, but only to an extent that will produce a good emulsion with the water that is added. Most manufacturers of wax emulsions of this type use solutions of alkali carbonates in place of caustic alkalies. The former release carbon dioxide gas during the saponification process. The turbulence, produced by the gas, seems to aid in the dispersal of the wax and yields a better emulsion. In order to avoid boiling over of the batch, the wax mixture should be kept below 70° C., and the hot alkali solution added, a little at a time, with slow stirring.[1] Sodium soaps give firmer creams than potassium soaps, but the latter are preferred because the finished cream does not shrink as much. Saponification of waxes proceeds with increasing difficulty in the following order: Japan wax, beeswax, montan, carnauba, candelilla, fiber and shellac waxes. Paraffin, ozokerite, ceresin, petrolatum, micro-crystalline, and other hydrocarbon waxes are not saponifiable and thus require an added emulsifier.

In making emulsions of this type, it is usual to melt the waxes as described under Melting of Waxes. If a solvent is to be incorporated, it is warmed to a temperature a little above the melting point of the wax composition, and then run in slowly, while mixing. If the emulsifier is soluble in the melted wax, it is dissolved therein before the water is introduced. The latter is warmed to a temperature above the melting point of the wax composition and run in slowly, with good mixing. In some cases, it is desirable to add just enough water to form a gel of the wax and emulsifier and then mix thoroughly until all of the water added has been absorbed. Then the balance of the water is added slowly, while mixing well. If a sample is put on a glass

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[1] Bennett, *Practical Emulsions,* (New York, Chemical Publishing Co., 1943).

plate, it should not slide easily or show any water separation when pressed with a finger.

Wax emulsions corrode tins and, therefore, require that the inside of the latter be lacquered, enameled or otherwise coated.

Chapter V

WAXES IN INDUSTRY

DENTAL WAXES

Frederick Gruenwald

Dentists and dental laboratories use quantities of various wax compounds as: base-plate wax, inlay-casting wax, impression compound, set-up-wax, bite wax, sticky wax and carving wax. In the hands of the dentist and of the technician, the dental waxes have to work and serve as ideal plastic materials. They must have high plasticity at normal temperatures, tensile strength, fusibility, hardness, adhesiveness and non-crystallinity. For instance, the requirements for base-plate wax include plasticity, fusibility, hardness and light color. Inlay-casting wax must soften without becoming flaky. It must not show appreciable chipping or flaking when trimmed to a fine margin, at room temperature. It should become very plastic when heated and harden very quickly when cooled. The melted wax, when vaporized at 500° C., must leave no solid residue other than carbon. It must have a certain thermal expansion and flow.

Carving wax should be hard, of very fine grain, and easy to carve. Sticky wax must have good adhesion but should not stick to the fingers.

The following formulas are representative of these compounds:

Base-Plate Wax

Formula No. 1		No. 2	
Paraffin Wax	70	Paraffin Wax	80
Beeswax	20	Acrawax C	5
Carnauba Wax **	4	Rosin	5
Gum Dammar	6		

	Inlay Wax		
Paraffin Wax	18.0	Candelilla Wax	1.0
Carnauba Wax **	3.5	Resin *	2.5
	Sticky Wax		
Flexowax C	11	Ozokerite	13
Beeswax	11	Venice Turpentine	2
	Carving Wax		
Paraffin Wax	30	Montan Wax	20
Ozokerite	30	Carnauba Wax **	20

* The resin may be a phenol modified resin or a petroleum resin.
** Carnauba wax can be replaced by the synthetic wax Acrawax C.

In all these formulas the resins and waxes are being replaced more and more by synthetic products, because the synthetic materials are free from impurities, well-defined, and often cheaper than the natural products.

Method of Producing Base-Plate Wax

The resin, which must be very light, is melted; then the waxes are added and heated till homogeneous. The hot waxes are filtered through a fabric and again heated. An oil-soluble dyestuff, previously dissolved in a part of the paraffin wax, is added, for coloration and the mixture stirred till completely uniform, filtered again, and poured in flat pans. After a few days, the cakes are heated in warm water and milled on a two-roll mill, the rolls having the same speed and being made of granite or stainless steel. After cooling in cold water, the milled sheets of wax are stamped.

LIPSTICKS [1]

The outstandingly important property of lipstick waxes is their melting point, which means that synthetic substitutes must always be selected with this factor well in mind. Melting points of the more common waxes, normally used in lipsticks, are approximately as follows:

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[1] S. P. Jannaway, *Soap, Perfumery, Cosmetics* (1942).

	° C.
Beeswax	63–65
Ceresin	74–80
Carnauba Wax	84–86
Ozokerite, Bleached	70–82
Montan Wax, Bleached	70–85
Japan Wax	52–56
Paraffin Waxes	42–65

Hydrogenated fats and synthetic waxes cover this range quite effectively. Mixtures of different waxes do not possess exactly the melting point that one might expect from the individual melting points and ratio of the constituent waxes.

In addition to these waxes and their synthetic counterparts, including hardened oils and diglycol stearate, etc., other materials, commonly used in lipstick manufacture, include mineral oil, castor oil; sesame, peanut and other vegetable oils; petroleum jelly (short fiber), lanolin absorption base, deodorized cocoa butter, cetyl and stearyl alcohols, wool wax, spermaceti, stearic acid, benzoinated lard; perfume, color, antioxidants, and preservatives.

Beeswax is the most frequently found substance in a lipstick base. It gives a good consistency to the base and, together with the lanolin, aids in binding the castor oil, for beeswax is almost as soluble in a lanolin-castor mixture as it is in a hydrocarbon combination, such as paraffin oil. Beeswax also, because of its shrinkage properties, makes the expelling of the finished stick from the mold a much simpler process. Chemically, the wax stabilizes the eosin (color) in the stick by the presence of the free melissic and cerotic acids contained in the beeswax itself. On the other hand, to produce a shiny, brilliant lipstick a low beeswax content is necessary. Ten per cent of beeswax should never be exceeded for ordinary glossy sticks.

Ceresin resembles beeswax in many of its properties and may be used along with beeswax. This earth wax is a fair binder, with about the same consistency as beeswax, but it does not have the shrinkage property of the latter. The crystalline structure of ceresin does not tend to change with time, for once this ingredient has crystallized out in the mixture, no further change will be noted. Beeswax and ceresin can be used together in order to

secure a fine-grained mixture; as each product furnishes a complement of properties to the other.

Bleached ozokerite, including genuine ceresin, of course, is especially valuable because of its property of retaining oils uniformly and permanently throughout the wax structure of the lipstick. Carnauba wax, when present in about 2 to 8 per cent of the total mass, helps to promote rigidity and good finish.

Cetyl alcohol is a good solvent for the eosin in the stick and helps in the permanence of the stain. However, one must use this product with discretion, never exceeding 5 per cent of the total base, or else, the desired "cetyl effect" will be replaced by a tendency to dryness.

Paraffin wax and mineral and vegetable oils are also important constituents of many lipstick bases.

The lipstick must be of high melting point (about 55–65° C.) so that it will not soften unduly in the summer; it must be hard enough to withstand pressure applied to it without breaking. It must spread easily and smoothly, but not leave too thick and greasy a deposit. These properties are by no means easy to balance up together, especially when utilizing a more or less "scratch" lot of ingredients.

Although the pigments used do not have a great tendency to settle, heating should not be unduly prolonged. The melt is poured into molds which are then rapidly cooled. Slow cooling is not only a less satisfactory production job but it also tends to promote the growth of wax crystals, with consequent weakening of the stick. Sticks are removed from the mold, inserted in the case and then "flamed" to remove finger marks. "Flaming" consists of rapidly turning the lipstick through a small Bunsen flame in order to melt the surface of the stick. This must be done uniformly and rapidly.

PHARMACEUTICAL PREPARATIONS

Frederick R. Greenbaum

Ointments, in pharmacy and medicine, serve the purpose of bringing the medication in intimate contact with the skin. They serve to treat various skin conditions, burns, wounds and in-

juries with specific medications. Each particular medication offers an individual problem as to the compounding of the ointment.

There was a time in pharmacy and medicine, when almost every medication was placed in a grease base such as lanolin, petrolatum, ceresin, or combinations of these.

This type of ointment, lotion, etc., prepared from benzoinated lard, petrolatum, lanolin, or combinations of such vehicles is distasteful to the patient.

In addition to this, physicians, particularly dermatologists, have pointed out that a grease-base ointment will greatly delay the action of the drug, particularly if the drug is soluble in water, and should be made available in a form, which allows the drug to go into solution in the excretion of the skin or the exudates of the wounds, whatever the case may be. It is for this reason that greaseless bases have recently come to the foreground, and more and more ointments, salves, and lotions are put up in a greaseless-base formula.

A greaseless base is one in which stearic acid is used as a wax. Some of the stearic acid is combined with potassium hydroxide, or better with triethanolamine, which forms a soap with the equivalent portions of the stearic acid. This soap acts as an emulsifying agent for the excess stearic acid, forming a white ointment of the vanishing-cream type. The medication, if soluble in hot or cold water, is dissolved in water and added to the molten stearic acid, with the triethanolamine in the water phase. A uniform and smooth emulsification occurs, producing a greaseless-base ointment, which is very effective clinically.

Instead of stearic acid, Glycostearin, or a mono or a di-stearate may be used. Of course, very frequently, depending on conditions, other waxes are added, for instance, cranauba wax to impart hardness, or beeswax. Very often, in order to avoid the crystallization of stearic acid, a small amount of lanum, or an absorption base of the type of Aquaphor or Parachol is added.

Recently, sulfanilamide, sulfathiazole, and sulfadiazine have been recommended for topical application in wounds, war injuries, burns, etc., and these substances have been put up in an ointment base. Usually this ointment is a combination of a

greaseless base made from stearic acid, with another base made from lanolin or a hydrogenated vegetable oil.

Usually, ointments, made from stearic acid as a base, cannot be milled, and of course it is very desirable to mill a sulfanilamide or a sulfathiazole ointment, in order to break down the crystals of the sulfoneamides. With this object in view other waxes are added which make it possible to mill these ointments.

It must also be kept in mind that a greaseless base offers greater efficacy and, very often, the concentration of the drug must be lowered if it is used in a greaseless base. This is the case with ammoniated mercury. The 10% ammoniated mercury ointment, U. S. P. XII has wool fat and white ointment as a base. If ammoniated mercury ointment were made with a stearic acid, greaseless base, a 10% ammoniated mercury would produce severe burns. In a greaseless base, the highest concentration of ammoniated mercury ointment that can be used with safety, is 5 per cent. This is an example to show that each drug represents a specific and individual problem and no generalized rules can be laid down.

According to work done by the American Pharmaceutical Association,[1] the requirements of an ideal ointment base are as follows:

1) It should wash off with water
2) It should be stable
3) Therapeutically efficient, penetrating to the pathological site
4) Non-greasy
5) Free from objectionable odors
6) Non-irritating
7) Non-dehydrating
8) Neutral in reaction
9) Easily compounded by a pharmacist
10) Non-degreasing in action
11) Non-hygroscopic
12) Compatible with all medications
13) Non-staining

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[1] *J. Am. Pharm. Assoc.* **2**, 467 (1941).

14) Efficient on dry, oily, or moist skin
15) Capable of serving as a medium for oil-soluble as well as water-soluble medicaments.
16) Capable of holding at least 50% of water.

A number of washable ointments have been made, but all have been found to fall short of the ideal. Some bases are incompatible with many of the medicaments commonly prescribed by dermatologists. Others are apparently reversed by certain medicaments and become non-washable. Still others are unnecessarily involved or call for the use of substances which are very difficult to obtain.

Modifications of suggested bases have been studied and an attempt has been made to develop new bases, which would more closely approach the ideal. The base, which we shall discuss in the following, is the result of these studies and, although complete evidence, as to the incompatibility, is not as yet available, it appears to be more satisfactory than any other base thus far suggested in the literature. It is apparently compatible with every medicinal substance, with which it has been tested and until a better formula is developed it is suggested for use by the pharmacist and pharmaceutical manufacturer.

This formula uses cetyl alcohol and Wetanol (sodium lauryl sulfate) as a base.

Cetyl alcohol is a white, wax-like solid, melting at 49° C., insoluble in water, soluble in mineral oil and vegetable oils, fats, alcohols, ether, carbon disulfide, glycol, and glycol ethers. It is stable in the presence of acids, alkalies, light and air. It is used as a hardening agent, emulsion stabilizer, and emollient for creams. It may be used as additive in 1–5% concentration or 5–20% as the principal wax base.

Cetyl alcohol is greaseless, a good emollient, and renders the skin velvety. Its penetrating power in combination with a wetting agent, such as sodium lauryl sulfate (Wetanol), causes medicaments to be readily transferred through the skin and, in some cases, they may be used in lower concentrations than in older types of bases such as petrolatum and lanolin.

Wetanol and similar wetting agents are obtained from alkyl

derivatives of aryl sulfonates, esters of higher fatty alcohols and dibasic acids, such as sulfosuccinates and many others which are of value in preparing more efficient and finer ointment bases. Their effectiveness is based on the power of reducing surface tension and lowering interfacial tension between solid and solvent, thus permitting rapid penetration and dispersion of the solid. By this property, they are useful as detergents and penetrants and some of these agents are also efficient emulsifiers.

An important factor, in determining the desirability of an ointment base, is its pH value. The pH value of an ointment is difficult to determine and the pH value of skin is as yet not known. The pH of this new ointment base lies within 7–9, decidedly on the alkaline side.

Temperature changes between 0 and 50° C. do not affect the consistency or promote separation of this ointment base, so that extreme temperatures encountered in transporting this preparation will have little effect on its value as a washable ointment base.

No apparent incompatibilities have been found for this base, as far, at least, as the experimental work has progressed.

As an illustration of an ointment, using some of the newer wax bases, the following examples may be given:

Wetanol	0.5	White Petrolatum	20
Cetyl Alcohol	8.0	Water, To Make	100
Cocoa Butter	6.5		

This base is compatible with the following medications: phenol 2%, Whitfield combination, Ichthammol 10%, ammoniated mercury 1%, rectified oil of birch tar, sulfur 10%, Burrows solution 5%.

Another formula is as follows:

Cetyl Alcohol	6.4	White Petrolatum	14.3
Octadecyl Alcohol (Stenol)	6.4	Liquid Petrolatum	21.4
Wetanol	1.5	Water, To Make	100

Modifications of these formulae are obtained by adding various waxes, like beeswax, paraffin wax, spermaceti, or one of the

newer synthetic waxes such as Carbowax. Another base, suggested as a possibility for a greaseless base, is made in accordance with the following formula by N. Sorg and J. W. Jones.[1]

Glyceryl Monostearate	15	Glycerin	35
Cetyl Alcohol	15	Diethyleneglycol	35

In the treatment of athletes' foot, a very frequent fungus infection, various ointments are used such as Whitfield Ointment, N. F. VII, diluted to ¼ to ½ strength with petrolatum or Ung. Aquae Rosae. Frequently, 0.25 to 1% thymol is added.

Another ointment for this purpose is Ung. Hydrarg. Ammoniati, U. S. P. XII, Ung. Acidi Borici and Ung. Aquae Rosae mixed in equal portions.

One of the more modern treatments of athletes' foot is with a phenyl mercuric nitrate 1:1500 ointment incorporated in a greaseless base, usually, of the stearic acid triethanolamine type.

Whitfield ointment, also known as compound ointment of benzoic acid, N. F. VII, consists of

Benzoic Acid	12	Wool Fat	5
Salicylic Acid	6	Petrolatum, To Make	100

In recent work, Francis J. O'Brien [2] found that the addition of thymol and the use of a cold-cream base increases the fungistatic action of this popular ointment. The following formula is proposed:

Benzoic Acid	6	Mineral Oil	2.5
Salicylic Acid	3	Cold Cream, To Make	100
Thymol	2.5		

The cold cream, which is used for this purpose, has the following formula:

White Wax	13	Borax	0.6
Ceresin	6.4	Water, To Make	100
Mineral Oil	55.0		

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[1] *J. Am. Pharm. Assoc. Practical Pharm. Ed.* **2**, 400 (1941).
[2] *Ibid.* **2**, 376 (1941).

In the treatment of psoriasis, a common skin condition, a number of ointments are used, some supposedly specific for this condition, for example:

Salicylic Acid	1	Petrolatum, To Make	30
Anthralin Ointment	½–6		

A formula containing chrysarobin ointment may also be used, for example:

Salicylic Acid	1	Petrolatum, To Make	30
Chrysarobin	0.6		

Coal tar ointment may be used, if desired:

Crude Coal Tar	4	Corn Starch	15
Zinc Oxide	2	Petrolatum	15

A sulfur ointment for this purpose is as follows:

Precipitated Sulfur	1–2	Petrolatum	30
Salicylic Acid	1–2		

The function of beeswax, in ointment bases, is not only stiffening, but also to increase the water number or water value of the ointment to a considerable extent. Other waxes have been found to have properties similar to beeswax, one of these being ceresin. This substance has the ability to stiffen ointment bases and at the same time serves to minimize or eliminate oil leakage, or separation of oils from the ointment when water is incorporated.

Recently, sulfated, hydrogenated castor oil and an emulsified base consisting of Diglycol stearate 10%, sulfated hydrogenated castor oil 20%, petrolatum 30%, and water 40% were substituted for the official ointment bases in several antiseptic ointments. Bacteriological tests indicated that the antiseptic value of these ointments is equal or superior to that of the official ointments.

Stearic acid and cetyl alcohol are also used as waxes for a base of very satisfactory hand lotions, which may or may not be medicated. The addition of certain substances, such as pectin, tragacanth, sodium alginate, Methocel, etc, may be desirable.

The use of pectin as addition to an ointment base has recently been recommended. The following formula will serve as an illustration:

Boric Acid	5	Wool Fat	7
Glycerin	8	White Petrolatum	25
Pectin	3	Ringer's Solution, To Make	100 ,

This formula was recommended by Goldner.[1] Tannic acid, salicylic acid, and alkalies cannot be incorporated in an ointment containing pectin.

Suppositories are made of waxes or wax combinations. Cocoa butter is one of the old materials used for this purpose. Very often, other waxes or wax combinations are used, but, of course, it must be remembered that in suppositories the wax combinations must melt at body temperature, so that the medicaments will get into intimate contact with the mucous membrane and exert their beneficial action.

Another interesting use of waxes in medicine is in connection with silver nitrate solution, which is placed, as a routine measure, in the eyes of new born babies. This silver nitrate solution is put up in ampules made of wax. A special paraffin wax mixture is poured into molds and the silver nitrate is added to it and then the ampules are sealed. Upon cooling the silver nitrate solution is enclosed in the wax ampules. Before use, the doctor or nurse snips the ampule open and drops the silver nitrate solution into the eye.

Another use of waxes, in pharmacy and medicine, is in the coating of pills and tablets.

Tablets and pills, containing various medicaments, are sugar coated in special rotary drums. Several layers of sugar coating are applied, often color is added and then, in order to impart a nice shiny appearance, a very fine layer or coating of carnauba wax or other waxes is applied. This is carried out by tumbling the carnauba wax or other wax combinations, inside the rotary drum, with the sugar-coated pills. A very fine layer of wax is taken up by the pills and they assume the shiny appearance with which we are all familiar.

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[1] *J. Am. Pharm. Assoc. Practical Pharm.* Ed., **3**, 24 (1942).

EMBALMING PREPARATIONS

Hilton Ira Jones

The chief uses of waxes in embalming are in the production of wound fillers, feature modeling waxes and lip wax, and in making the corpse appear more natural.

Wound Fillers

No. 1

A	Yellow Beeswax	25	B	Soap Flakes	10
	Paraffin Wax	50		Water	25
	White Petrolatum	50			

Heat each separately to a clear solution, then add A to B, with stirring and color to suit.

No. 2

Protowax #33448	50
Ceresin	50
Color	To suit

No. 3

A	Paraffin Wax	25	B	Stiff Paste of Bentonite in
	White Petrolatum	50		Water
	Yellow Beeswax	25		

Melt A and add to B, with stirring and color to suit.

No. 4

Protowax	20	Starch	40
White Petrolatum	10		

Melt waxes together, but the melt should not be hot, and beat in starch. Add color to suit.

No. 5

Protowax	40	Oil Red Solution (10% in	
White Petrolatum	20	Kerosene)	2
Starch	80	Oil Brown Y (10% in Kerosene)	1

The above two waxes are widely used as modeling waxes for making noses, ears, etc., in reconstruction of accident cases. If this formula is to be used as a wound filler, it is better to have it softer as:

No. 6

Protowax	20	Starch	40
White Petrolatum	20		

Lip Wax

No. 1

Wound Filler	75	White Petrolatum	100
White Beeswax	75		

Add color to suit with Oil Red.

No. 2

White Lead Paint	100	Solution Oil Red (10%)	1

PYROTECHNICS

George W. Weingart

The different colors of the flames of burning pyrotechnic compounds are due to the fact that certain colored lines predominate in the spectra of the elements used in their production. For instance, yellow lines predominate in the spectrum of sodium, hence sodium salts are used to produce yellow fire. The strontium spectrum shows the predominance of red lines, therefore, strontium gives a very decided red light.

To produce these color effects, it is necessary to volatilize a portion of the element. This is accomplished by combining an oxidizing agent with a source of carbon, which, when ignited, develops a high temperature, sufficient to vaporize a portion of the color-producing element.

The oxidizing agent is usually potassium chlorate and many substances have been utilized for supplying the required carbon. Among these are the waxes which have been found to work very satisfactorily with potassium chlorate and, in some instances, e.g., the production of blue fire, stearin and paraffin wax give a smooth burning fire of deep color unobtainable with any other carbon source. Kauri and carnauba waxes are more suitable for red, green and yellow fires. The following mixtures will serve to illustrate the use of waxes:

		Blue	
Potassium Chlorate	7	Stearin	1
Copper Oxalate	2	Calomel	3
		Red	
Strontium Nitrate	16	Kauri Wax	3
Potassium Chlorate	8		
		Green	
Barium Nitrate	60	Carnauba Wax	10
Barium Chlorate	25	Paraffin Wax	1
Potassium Chlorate	5		
		Yellow	
Potassium Chlorate	7	Barium Nitrate	1
Sodium Oxalate	2	Kauri Wax	1

CANDLES

Most candles are made entirely of paraffin wax. For religious purposes beeswax candles are preferred. Where price is not of paramount importance, stearic acid and various blends of waxes are utilized.

Stearic acid is a good hardening agent for paraffin wax candles. It raises the melting point and can be used in any quantity, without impairing the burning quality of the candle. The hydrogenated oils and fats also serve as hardening agents for paraffin wax and are used chiefly for candles which are consumed in glasses. Synthetic or natural resins can be applied in the form of coatings only and are used chiefly for decorative candles.

Paraffin wax, added to stearic acid, for candle manufacture, in amounts of 5% or more, prevents crystallization and facilitates removal from molds.

2% Santowax M, added to paraffin candles, gives an opacity equal to that produced by using 40% stearic acid.

Opaque Paraffin Candles*

Hertolan (Beta Naphthol Benzoate)

Hertolan is added to the molten paraffin wax, by which it is at once completely absorbed, as its melting point is but a trifle higher than that of paraffin. In order to ensure thorough mixing, the mass should be well stirred.

Even when adding Hertolan to paraffin previously melted in boiling water, it is readily absorbed, being absolutely insoluble in water.

If ½ per cent Hertolan is added to the molten paraffin, the mass becomes clouded, i.e., the paraffin takes on the milk-white appearance of stearin. By a 1 per cent addition of Hertolan, the result is the same as if at least 40 per cent stearin had been added, and the candles produced by the admixture of Hertolan are of a still whiter and more opaque appearance than if additions of stearin had been made.

The quantity of Hertolan to be added depends on the requirements and on the material employed. Generally an addition of 1 per cent Hertolan should suffice.

The full effect does not show in the freshly made candles until after some time.

The effect of Hertolan is satisfactory as long as paraffin of good quality is used. Should the material assume a faint red coloration, it is attributable to the iron content of the paraffin employed.

Beta Naphthol

Beta naphthol is used in small proportions and is added to the paraffin to make the pure paraffin candles look like composition candles. The paraffin candle looks more or less transparent whereas the stearin candle or the composition candle looks opaque. The opaque candle is valued more and is also priced higher than the paraffin candle. To deceive the market, there-

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* N. N. Godbole, *Candle Manufacturer* (New York, Chemical Publishing Co., 1935).

fore, beta naphthol is added in small percentages to the paraffin mass so that, without any appreciable change in the melting point or in the cost, the candle looks better from the dealer's point of view. The same effect is also obtained by adding methylated spirit in small quantities.

Colored Candles

To prepare colored candles, a special class of oil colors is supplied by the color manufacturers. These are meant to withstand the action of both heat and light and are unaffected by the acidic nature of stearic acid. The colored candles are used mostly as pencil candles and for other decorative and ceremonial purposes and, therefore, have a limited sale. The following is a list of some of the colors recommended for the purpose:

Red: Sudan IV, Flexin, Rose-Bengal, Rhodamine 6G and B Fuchsin.

Yellow: Chinolin Yellow, Auramine "Lederin."

Green: Acid Green, Victoria Green, Brilliant Green, a mixture of Victoria Blue and Chinolin Yellow.

Blue: Induline, Victoria Blue, Methyl Violet.

The colors used are mostly organic colors belonging to the phenyl-methane and phthalic series. The proportion of colors used varies from 0.05 to 0.01% on the weight of the stearic acid used, depending upon the depth of the color desired. In this connection, it should be noted that stearic acid used in the colored candles should not contain large proportions of olein and the mass should not be heated to a high temperature, otherwise the colors may decompose. These colors are more soluble in stearic acid than in paraffin and the solubility of the color is increased by the addition of a little alcohol.

Melting Point

It is advisable to understand something about the properties of the mixed products obtained either by adding stearic acid to paraffin or paraffin to stearic acid. The disadvantage of using paraffin only (even if it is of high melting point) for candle manufacture is its great drawback of having a softening point below its melting point. Due to this, such candles either get

stuck up or get bent or both and cause annoyance to the consumer. It should be noted, in this connection, that instead of one paraffin wax with, say, a melting point of 52° C., it is possible to get a paraffin of the same melting point by mixing two paraffins, one of 36° C. and another of 60° C. The melting point and the proportion of the mixtures can be worked out by the following formula

$$\frac{fa + f'b}{a + b}$$

where f and f' stand for the melting points of the two varieties and a and b for the quantities used: as, for example, four parts of paraffin of melting point 55° C. and two parts of paraffin of 49° C. will give according to the formula

$$\frac{4 \times 55 + 2 \times 49}{4 + 2} = \frac{220 + 98}{6} = 53° \text{ C.}$$

Even in the case of two separate paraffins (not mixtures), having the same melting points, it should be remembered that the paraffin obtained from brown coal has much less of bending action than the paraffin obtained from mineral oil, in, what is known as, the bending test. Candles of different materials and of the same lengths and diameters are suspended horizontally with their one end fixed, in rooms heated to definite temperatures, for at least three hours. In this test, in the case of mixtures of paraffins, the effect of softening point on the low-melting paraffins is to produce a greater bending than in the case of unmixed paraffins of the same melting point. In this latter case again, the candles made out of brown-coal paraffins are less liable to bend than those of paraffins obtained from mineral oils.

The initiative for fixing the proportion will, therefore, be left to the individual cases. It should be borne in mind that, so far as light-giving properties are concerned, the paraffin candles, because they are composed of merely hydrocarbons (carbon and hydrogen only), emit more light per unit than either pure stearic acid candles or composition candles which are mixtures of the two. Stearic acid, it should be remembered, is already an oxidized product, that is to say, it is made up of carbon, hydrogen and oxygen, and it will naturally emit less light and

heat, but this difference, in the burning of candle is hardly of any disadvantage, although it may be of interest from an academic point of view.

Congealing Points

When molten candle material is allowed to cool, it begins to congeal at a point much lower than the softening or melting point. This is known as the congealing point and is a characteristic property of oils and fats. This property is of special importance in candle manufacture, because the candle material, when it is poured into the machine, must congeal and solidify before it can be pushed out of the mold. Even when the melting point of the candle material is over 50° C., the congealing point is as low as 30° C., consequently, the water, used in the candle-machine must be at least of about 20° C., so that the candles will be cooled quickly in the machine.

The chilling time of paraffin wax is a better indication of value for candle making than the melting point.

Under specified conditions the chilling time is as follows:

M.P. ° C.	Chilling Time Minutes
54–56	50–60
52–54	60–70
50–52	70–80

MELTING POINTS OF CANDLE COMPOSITIONS

Mixed Ceresin and Paraffin Wax

Ceresin Per Cent	Paraffin Wax Per Cent	Melting Point ° C.	Solidifying Point ° C.
100	0	70–73	69.5
95	5	69–73	68.5
90	10	68–72	66.5
80	20	66–71.5	65.0
70	30	64.5–70	63.0
60	40	62–69	62.0
50	50	58.5–67	60.0
40	60	56.5–65	59.0
30	70	54.5–62	57.0
20	80	52.5–58.5	54.0
10	90	49.5–54.5	49.0
0	100	47–52	47.0

Mixed Paraffin Wax and Stearic Acid

Paraffin Wax		Stearic Acid		Mixture Melting Point ° C.
Per Cent	Melting Point ° C.	Per Cent	Melting Point ° C.	
90	38.9	10	49.3	37.7
80	38.9	20	49.3	37.0
70	38.9	30	49.3	37.7
60	38.9	40	49.3	40.3
50	38.9	50	49.3	43.6
40	38.9	60	49.3	43.9
30	38.9	70	49.3	45.3
20	38.9	80	49.3	47.5
10	38.9	90	49.3	48.3
90	57.7	10	49.3	50.5
80	57.7	20	49.3	49.3
70	57.7	30	49.3	48.3
60	57.7	40	49.3	47.5
50	57.7	50	49.3	45.5
40	57.7	60	49.3	43.9
30	57.7	70	49.3	41.7
20	57.7	80	49.3	45.5
10	57.7	90	49.3	47.3
90	54.5	10	49.3	53.3
80	54.5	20	49.3	52.0
70	54.5	30	49.3	50.5
60	54.5	40	49.3	49.3
50	54.5	50	49.3	48.0
40	54.5	60	49.3	45.5
30	54.5	70	49.3	42.8
20	54.5	80	49.3	46.4
10	54.5	90	49.3	47.7
90	55.8	10	54.3	54.75
80	55.8	20	54.3	53.6
70	55.8	30	54.3	52.6
60	55.8	40	54.3	51.25
50	55.8	50	54.3	49.3
40	55.8	60	54.3	47.55
30	55.8	70	54.3	48.6
20	55.8	80	54.3	51.85
10	55.8	90	54.3	53.00
90	43.3	10	50.5	47.7
80	43.3	20	50.5	46.9
70	43.3	30	50.5	45.5
60	43.3	40	50.5	44.4

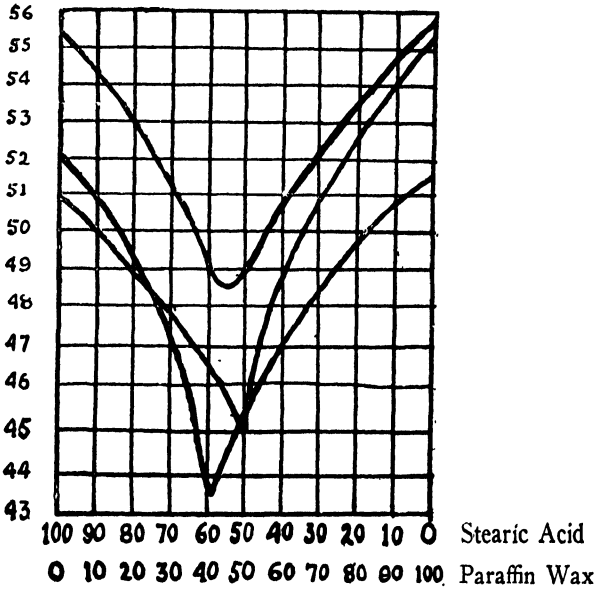
Mixed Paraffin Wax and Stearic Acid
(*Continued*)

Paraffin Wax		Stearic Acid		Mixture Melting Point ° C.
Per Cent	Melting Point ° C.	Per Cent	Melting Point ° C.	
50	43.3	50	50.5	43.3
40	43.3	60	50.5	42.7
30	43.3	70	50.5	44.9
20	43.3	80	50.5	48.0
10	43.3	90	50.5	48.6
90	43.45	10	54.3	48.0
80	43.45	20	54.3	47.0
70	43.45	30	54.3	45.5
60	43.45	40	50.5	43.75
50	43.45	50	50.5	45.0
40	43.45	60	50.5	48.15
30	43.45	70	50.5	49.9
20	43.45	80	50.5	51.4
10	43.45	90	50.5	55.0
90.0	36.5	10.0	54	36.5
66.6	36.5	33.3	54	39.0
33.3	36.5	66.6	54	45.75
10.0	36.5	90.0	54	51.75
90.0	37.5	10.0	54	36.5
66.6	37.5	33.3	54	35.5
33.3	37.5	66.6	54	47.0
10.0	37.5	90.0	54	52.0
90.0	40.75	10.0	54	39.75
66.6	40.75	33.3	54	40.50
33.3	40.75	66.6	54	47.50
10.0	40.75	90.0	54	52.00
90.0	45.0	10.0	54	44.0
66.6	45.0	33.3	54	40.75
33.3	45.0	66.6	54	40.0
10.0	45.0	90.0	54	52.5
90.0	48.5	10.0	54	47.5
66.6	48.5	33.3	54	45.0
33.3	48.5	66.6	54	47.75
10.0	48.5	90.0	54	52.50
90.0	50.0	10.0	54	49.0
66.6	37.5	33.3	54	35.5
33.3	54.0	66.6	54	47.0
10.0	54.0	90.0	54	52.5

Mixed Paraffin Wax and Stearic Acid
(*Continued*)

Paraffin Wax		Stearic Acid		Mixture Melting Point
Per Cent	Melting Point ° C.	Per Cent	Melting Point ° C.	° C.
90.0	56.5	10.0	54	55.5
66.6	56.5	33.3	54	52.0
33.3	56.5	66.6	54	47.5
10.0	56.5	90.0	54	52.5

MELTING POINT DIAGRAM OF STEARIC ACID-PARAFFIN WAX MIXTURE



LEATHER FINISHES

W. A. Kingman

In the finishing of leather and also of products made from leather, wax of some description is one of the important constituents of the finish mixture. In the case of tanned hides or skins,

all leather, except sole leather, splits or suede-finished leather, is given a coating of a finish mixture, either clear or pigmented, as the case may be. This finish is composed primarily of wax, casein and shellac, with the possible addition of other ingredients such as albumen, latex, synthetic resin emulsions, or water-soluble colloids. The wax most commonly used is carnauba wax, and the grade selected depends on the color of the finished products, although No. 1 or No. 2 grades are most commonly used. Formerly, this wax was emulsified by long boiling with a castile soap solution, the finished emulsion containing about two pounds of wax and four to five ounces of castile soap to the gallon. The film of wax formed on drying such an emulsion was dull and opaque and had a matt surface, so that the finished leather had to be "jacked" or polished by friction in order to produce a glossy finish. About 1925, it was discovered that by special procedure and by special emulsifying agents, it was possible to produce a very fluid and semitranslucent carnauba wax emulsion, with the wax much more finely dispersed than in the previous type of emulsions. Emulsions of this type were soon used by the manufacturers of tanner's finishes. Many of these emulsions are still made by melting the wax with 15 to 20 per cent soap and cooking till the water is entirely boiled off. Boiling water is later added very slowly and, if the procedure is properly carried out, a fluid emulsion is obtained, on dilution, which will dry to a transparent, glossy film.

The modern method is to melt the wax with a fatty acid, then add a base to form a soap in situ and, finally, to add boiling water slowly until the desired dilution is obtained. If the proper precautions of manipulation are carefully observed, a thin, translucent, or milky emulsion results which will dry to a transparent, glossy film.

By varying the fatty acid and the base used as well as the proportions of the two, countless varieties of emulsions can be produced, which may be used for some particular method of application or to give some particular effect on the finished leather. By the selection of the proper fatty acid and base, an emulsion with a very low surface tension may be produced, which will spread very readily, with a minimum tendency to

"crawl." A different combination will give an emulsion of a much higher surface tension which will give less foam when spread on the leather with a sponge or brush.

In addition to the use of wax in finishing skins, wax emulsions are very largely used in shoe factories to give a final dressing to finished shoes. These finishes are made up of shellac, wax and sometimes casein and dyestuff. The shellac is dissolved in water with the aid of an alkali, and the wax is emulsified to produce a thin, bright-drying emulsion. These two solutions are mixed in varying proportions, according to the finish desired and the type or nature of leather being finished. If the finish is applied by a sponge, a foam-retarding agent is necessary, but if applied by a spray, the foam is of less importance; the finish must level off quickly and show no tendency to crawl. In both the tanner's finish and the shoe factory finish, the same type of wax emulsion is used.

A few typical formulas will show the general method of preparation of such emulsions.

Formula No. 1

Carnauba Wax	11.2 lb	Morpholine	2.2 lb
Oleic Acid	2.4 lb	Water	67.0 lb

Melt the wax with the oleic acid and bring the temperature to 90° C. Add the morpholine and stir till clear. Add the water, which should be boiling, very slowly, with vigorous and constant stirring, so that the mixture forms a clear but viscous mass of petrolatum-like consistency. As further water is added, the mixture gradually thins and becomes more or less translucent.

No. 2

Carnauba Wax #1	60 lb	S489 (Emulsifier)	14 lb
Water-White Distilled Linseed Oil Fatty Acids	16 lb	Water, To Make	375 lb

Use the same procedure as described in the previous formula.

No. 3

Carnauba Wax #1	120 lb	Caustic Soda (50%)	8 lb
Oleic Acid	20 lb	Water	32 lb
Trigamine	20 lb	Water	800 lb

Melt the wax in the oleic acid, add the Trigamine and heat to 90° C. Then add the caustic soda and the water at 95° C. Stir till a gel is formed. Then add the balance of the water, which must be boiling, and stir till cool.

Although carnauba wax, on account of its hardness, color and emulsifiability, has been very largely used as most suitable for emulsions for tanner's finish and shoe dressing, other natural waxes, such as ouricury wax and vegetable fiber wax, have been substituted for carnauba wax with very good results during the scarcity of the latter. One new synthetic wax, S688, has proven a good substitute for carnauba wax for certain applications, as it can be emulsified to produce a thin emulsion, drying to a transparent film. The film produced is slightly "tacky" but this "tack" or "drag" can be eliminated by the addition of a small percentage of an organic colloid such as casein; 15 to 20 per cent of casein with the S688 wax forms a mixture which dries to a transparent film with no objectionable tack. This can be used to replace carnauba wax in a number of applications to leather or leather goods.

PAPER FINISHES

W. A. Kingman

In the finishing of paper, it has been the practice, for many years, to use wax in the finishing or coating mixture to produce certain results in the finished paper. In flinted papers and in friction-calendered paper, it is necessary to use wax in the coating to act as a lubricant during the mechanical polishing and to aid in producing the desired gloss.

At first beeswax was emulsified, and the emulsion added to the coating mixture, but, on the introduction of carnauba wax, this was adopted by the flinted paper trade and largely by the friction-calendered paper finishers. For such purposes the wax is emulsified as follows:

Carnauba Wax	**50 lb**	Castile Soap	**12 lb**
Water	**50 gal**		

The three ingredients are boiled together, until the wax is emulsified, and sufficient water is added to bring the volume to 50 gal.

The following formula will illustrate the use of such an emulsion in a coating mixture:

Clay	300 lb	Wax Emulsion	12 gal
Water	20 gal	Casein Glue	25 gal
Talc	18 lb		

The casein glue may be made up as follows:

Casein	100 lb	Borax	17 lb
Water	50 gal	Ammonia (26° Bé.)	1 qt

Another formula, for making a wax emulsion for flinted papers, is as follows:

Laundry Soap	7 lb	Water	12½ gal
Carnauba Wax	50 lb		

Boil with live steam till thoroughly emulsified (generally for four to five hours). Cool to 35° C. and add 26° ammonia 2 lb. Make up to 50 gal with cold water. The emulsion should be allowed to stand, before using, as it seems to improve with age.

A beeswax emulsion, suitable for friction-calendered papers, is made as follows:

Yellow Beeswax	150 lb	Water	25 gal
Castile Soap	28 lb		

Melt soap in water and add wax. Melt and stir till emulsified and smooth. Add water to make 150 gal.

In the manufacture of coated boxboard, a wax emulsion is sometimes added to the casein coating mixture to make the coating more flexible and to improve the bending and folding properties of the coated board. Such an emulsion is usually made with Japan wax.

Japan Wax	75 lb	Water	25 gal
Stearic Acid	17 lb		

Boil till the waxes are melted. Cool slightly and add 10 lb of borax dissolved in 10 gal of water. Boil till a smooth emul-

sion is formed, cool and add 1 qt of 26° ammonia and make up to 75 gal.

In the manufacture of special grades of paper and of boxboards, a recent development in sizing is to use an emulsion of paraffin wax with the usual rosin size and, when this is thoroughly mixed with the paper stock in the beater, the wax and rosin are simultaneously precipitated on the fiber by the addition of alum. This combination wax and rosin size is claimed to produce a sheet of paper or boxboard with superior waterproof and folding properties.

WATERPROOFING OF KRAFT PAPERS*

Water repellency is characterized by a resistance to wetting by water. A water-repellent paper should shed drops of water or show a "ducks-back" effect yet may, under slight pressure, allow free passage of water and may offer little or no resistance to the transmission of moisture or water vapor. Waterproofness indicates an ability to resist the passage of water. A paper, heavily impregnated with wax, may resist the passage of water under normal conditions yet allow some passage of water vapor at the same time. Moistureproofness indicates an ability to resist the passage of water vapor. A paper, coated with a heavy, continuous film of wax, will probably be moistureproof to all intents and purposes under normal conditions. The normal conditions is the qualifying statement in these definitions because true water and moistureproofness are extremely difficult to obtain under all conditions.

Paper consists of countless cellulose fibers felted together and bonded with an adhesive or size. As a result, there is a continuous contact of cellulose to cellulose throughout the sheet, with minute openings between the fibers. Since liquid water, in passing through the sheet, does so primarily through the interstices rather than through the fibers, the paper can be made water tight by filling these openings with wax and the degree of water tightness will depend upon how completely and uniformly this is

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* Killingsworth, *Paper Ind.* **8**, 526 (1943).

accomplished. Paper, waxed in this manner, i.e., where the wax is confined entirely within the paper, is called "dry-waxed."

Moisture (water vapor), on the other hand, is transmitted by cellulose fibers, as well as through the interstices. Dry waxing, even though filling the openings with wax, does not completely cover the cellulose fibers and many of them protrude above the surface of the paper. These surface fibers serve as wicks which absorb moisture from a humid atmosphere at one side of the sheet and carry it through to the other side, where it is given off to a less humid atmosphere. Dry waxing is, therefore, incapable of producing a moistureproof sheet. This can be accomplished only by completely covering the surface fibers with a continuous film. If wax is used, this paper is called "wet-waxed."

A type of paper, having the advantages of both wet- and dry-waxed papers, is obtained by laminating with wax. Here, two layers of paper are bonded together with a layer of wax, forming a continuous barrier resistant to the passage of water vapor. Since the wax film is covered by paper on both sides, the continuity and effectiveness of the film is protected against injury by careless handling or scratching. The most important, fundamental precaution, to observe in lamination, is to prevent contact of surface fibers through the bonding medium.

The most common type of dry waxing, for imparting water repellency to paper, is by beater sizing. Here, a wax emulsion, or a dispersion of wax in water, through use of emulsifying agents, is required because of the necessity of depositing an accurately controlled, small amount of wax on the fibers. The emulsion must be compatible with the pulp and rosin size during the beating and capable of being broken by alum for complete deposition and retention on the fibers.

Another form of sizing, with wax emulsion, for water repellency, is known as top sizing. Here, the proper concentration of emulsion is applied to the paper, usually in the water-box or size press. The emulsion must not wet the paper too easily and should be resistant to alum which is leached from the paper as it passes through the bath.

Where higher degrees of water repellency or fair waterproof-

ness is desired, paper is often passed over a roll partially immersed in molten wax. The roll picks up wax and transfers it to the paper. The amount and type of transfer depends on the speed of the roll, the density of the paper, the temperature of the wax, the type of wax, the time allowed for penetration while the wax remains molten, the pressure on the squeeze rolls, etc. With machines, now in existence, it is possible to obtain almost any wax content desired from 10% up to saturation. Below 10%, it is extremely difficult to obtain uniform coverage by hot waxing methods. To aid in the distribution of molten wax through the sheet, it is common practice to use high temperatures in the wax bath and to pass the coated sheet over the hot rolls or even winding the paper while still hot.

Wet waxing for water and moistureproofing is usually conducted on the same machines used for hot dry waxing. By keeping the temperatures low, the speed of the machine high, and chilling the coated paper, the wax film may be solidified on the surface, without a great amount of penetration. Where both penetration and surface wax is desired, actual submersion of the paper in molten wax is employed. Frequently, paper, coated with molten wax, is immediately plunged into cold water or passed over cold rolls, which produces a glossy, shiny surface wax film, a characteristic desirable in certain applications. In this operation, the thickness of the film is adjusted by means of scraper bars or by the pressure of a set of squeeze rolls.

Lamination of two sheets of paper is most easily carried out on equipment designed particularly for this purpose. However, quite often, existing equipment may be used provided care is given to the essential details. It is necessary to apply molten wax to one of the papers to be laminated and effect the lamination by the squeeze rolls, before appreciable penetration has occurred. The laminant should set almost at the time of contact with the squeeze rolls. Where two sheets of porous paper are to be laminated, extremely close control of temperatures and speed, or the use of very viscous laminating material, is required. The alignment of perfectly machined combining rolls is also essential.

Petroleum waxes have been extensively used for waterproof-

ing in the paper industry and, from the viewpoint of price, supply and ease of handling, they probably represent the most satisfactory materials available at this time. They are divided into two broad classes, paraffin-type waxes and microcrystalline-type waxes. The paraffin-type waxes include fully refined waxes and crude scale waxes. Both are relatively hard and brittle, white, crystalline solids and are sold in various melting grades ranging from about 120 to 140° F. The microcrystalline-type waxes, also called amorphous or petrolatum waxes, differ from paraffin-type waxes in several important respects. There are

1) Considerably smaller sized crystals
2) Higher melting points (145–190° F.)
3) Greater ductility at all temperatures
4) Greater tackiness
5) Generally darker colors (lemon yellow-dark brown)
6) Higher viscosities in the molten state.

It is important to keep these differences in properties in mind when a wax is chosen for a particular application. Each type has its drawbacks and often blends of the two are required to meet service conditions.

From a practical standpoint, a heavy, uniform film of the crystalline-type wax may be as water- or moisture-resistant as an equal film of microcrystalline wax, but because of its crystalline and brittle nature, this film cannot stand rough handling or flexing and retain its water- or moisture-resistance. It is primarily the tough, ductile character of the microcrystalline waxes over wide ranges of temperature that makes these waxes more effective water- and moistureproofing agents.

The crystalline waxes are employed for coating paper where a hard, non-tacky, glossy film is desired. Also because of their low viscosities, when molten, they are usually preferred for hot impregnation of paper. The microcrystalline waxes and their blends are useful for wet waxing where the wax film may be subject to adverse conditions. Also because of their tackiness, rather sharp solidification points, and fairly light colors, they are superior laminating compounds. The operations are clean, the bond good, and the aging qualities of the laminated paper excellent. The microcrystalline waxes are more grease-resisting

than the crystalline type and are useful where this characteristic is desired.

ADHESIVES

The familiar sealing wax, that is sold in sticks and used for sealing letters and for taking impressions of seals, etc., on important documents, is a misnomer. Such sealing waxes rarely contain any wax but are composed of resins, plasticizers, fillers and pigments.

Heat-selling agents, containing wax, are, however, made and used commercially in large quantities. They are thermoplastic materials which are applied hot (150–300° F.) to each of two surfaces. On bringing these surfaces in contact with each other and cooling, the two layers will combine to form a single layer which serves to unite the surfaces to which they have been applied. Similarly, surfaces may be coated with such compositions and allowed to cool, without contact. Such surfaces, at ordinary temperatures, are non-sticky and may be stored, under proper conditions, for indefinite periods. To unite such treated surfaces, they are pressed together and heated to fuse the coatings. On cooling, the surfaces are firmly united. Heat-sealing agents are also made as foils or sheets that are interposed between two surfaces to be united.

There are two types of heat-sealing agents that are applied to foils or sheets, one that really melts to a liquid and the other that changes to a sticky mass.

Paraffin wax is typical of the agents which are coated upon a film or sheet and which truly melt. Waxed paper, still the most widely used heat-sealing material, was the earliest product to bring the advantages of heat sealing to packaging. Paraffin wax is not particularly sticky at ordinary temperatures, but melts at somewhat elevated temperatures, ranging from about 130 to about 140° F., depending upon the grade of wax used. If two pieces of waxed paper are pressed together and are sufficiently heated through to their interface, the paraffin on their surfaces will melt. While molten, the wax is not sticky, hence will not hold the two sheets together, but if they are held in position until the fused wax, in the interface, chills, the wax will have sealed

the two sheets together. It is characteristic of most true melting agents that their seals must be held in position while the sealing material solidifies.

The force required to separate the two pieces of sealed waxed paper, that is, the tightness of the seal is easily seen to depend upon the cohesion of the wax and the adhesion of the wax to the paper.[1] It is common experience that neither the cohesion of paraffin nor its adhesion to paper is very great, therefore, the tightness of the seal, or, the seal strength of waxed papers, is not very great either, although, it is obviously adequate for many purposes. It should be noted that within limits, the seal strength of waxed paper increases with an increase of the thickness of the waxed coating. It should also be noted that until a certain thickness of wax is coated on the surface of paper, it does not become heat-sealing. If, under the heat of the seal, too great a proportion of the wax is absorbed into the paper or among the irregularities of its surface, too little remains on the surface to effect a seal. Thus, it takes less wax on smooth surfaced, non-absorbent glassine to make it heat-seal than it does on rougher, more absorbent sulphite papers. However, given enough wax on a sulphite paper, the rougher surface has the effect of better adhesion of wax to paper and the seal of the waxed sulphite paper will be stronger than that of waxed glassine, whatever the other attendant, functional qualities of either paper.

The relationship between the absorbency of the base sheet and the minimum coating weight, for effective seal, is important and applies to any type of heat-sealing agent and to any type of base sheet.

In order to improve the seal strength of waxed papers, it is necessary to cause both the cohesion of the wax and its adhesion to its base sheet to be strengthened. This is done by adding materials like rubber, rubber derivatives, resins, or related compounds. Suitable materials of these types not only raise the melting point of the wax, but also make it become quite sticky when hot. In fact, blends of this type do not have a true melting point, but as the temperature increases, they become sticky

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[1] Leinbach, *Modern Packaging* **16**, 85 (1943).

("tacky") and softer until they finally do approach what might be termed a molten state, though never so fluid as molten wax. The relation between temperature increase and progressive softness is known as the "melting" or "softening" range of the blend. As indicated, such blends can be made to be quite tacky when hot and thus yield quick and firm heat seals with a minimum of chilling required before the seal "sets." In some cases, at sealing temperatures, the material of the coating is so tacky that no chill is required, for the tackiness of the material, though hot, is sufficient to hold the seal together. Blends of this type usually have excellent adhesion to many materials, and papers or films, coated with fairly heavy coatings, have found widespread application, such as in bags for wet pack frozen foods, in cheese wrappers, and in "heat-seal" labels, where the tackiness of the hot material coated on the back of the label is useful in adhering the label to almost anything including glass, the sealed ends of waxed bread paper, individual frankfurters, etc. As may have been noted, such modification of wax tends to direct it into the class of the second type of agents which on heating do not melt, but become very sticky.

FOIL COATINGS

Harold A. Levey

Since food products have been packaged, it has always been a desideratum to prepare a wrapping material of such a nature as to retain, as long as possible the original moisture content of the food product. In certain types of foods, such as most confections, and candies, in particular, the objective is to prevent the taking up of moisture, and this is equally true of crackers. On the other hand, certain types of cakes, meats, tobacco goods, and the like lose their moisture, even if the surrounding atmosphere is of very low relative humidity, e.g., as low as 15%. In order to maintain the proper conditions, a wrapping membrane, which offers unusually high resistance to the transmission of moisture or water vapor is the type of product desired.

If complete transparency of the wrapping is not required,

a wrapping sheet of relatively low moisture transmiscibility offers no serious problem. Wrapping sheets of this type are used in the manufacture of large paper bags for the purpose of containing such food products as granulated sugar and other commodities which possess a distinct avidity for water vapor. Such sheets are obtained by coating two sheets of kraft paper, each on one face, with an asphaltic solution in some suitable, volatile, organic solvent, or with an asphaltic water emulsion, or a combination of the two in what is known as a "cut back." After the emulsion is broken, which occurs quickly in view of the fact that the water phase is readily drawn into the paper stock, leaving the minute globules of asphalt, together with the stabilizing agent (which may be bentonite, or casein) on the surface of the paper stock. The coated faces are then allowed to dry and placed in contact with each other. The two sheets are then passed through steam-heated calender rolls, and, under the action of heat and pressure, quickly and permanently bonded together. This type of packaging sheet of low moisture permeability is extensively used as a wrapping for war equipment shipped in crates and it relieves the more costly task of completely covering, with a film of grease or heavy oil, the exposed metal parts which would otherwise rust.

When transparency or translucency, in a wrapping, is required, then we resort to such types of wrappings as the glassines, vegetable parchments, and tissue papers. These are made moisture-impermeable, to a high degree, by impregnation and/or coating with waxes or wax-like bodies. The animal and vegetable waxes, used for this purpose, include carnauba, bayberry, and candelilla, which are the most effective ones, though beeswax and other animal waxes may also be used. Among the wax-like bodies are paraffin and ceresin, as well as the higher fatty acids such as palmitic and stearic, and certain synthetic, products such as the chlorinated naphthalenes (Halowaxes), and other chlorinated hydrocarbons of very high molecular weight which are usually solid at room temperature. Frequently, these waxes are blended with resins to improve their working characteristics. The harder waxes are often compounded with

certain of the softer waxes which function as plasticizing agents, providing the flexibility required of wrapping sheets. When papers are both impregnated and coated with wax, to such an extent that a film can be scratched off from their surface with the fingernail, the ultimate product of high moisture resistance is then designated as "wet-waxed."

All of the above types of sheets are translucent to varying degrees, none, however, possesses complete transparency as they all diffuse light to a greater or lesser degree. The cellulose or cellulose derivative sheets, such as those of the viscose-type or Cellophane, and the cellulose acetate and ethyl cellulose sheets are the chief types of completely transparent wrappings on the American market today. Other types of transparent sheets on the market in a limited quantity are gelatin sheets, rubber sheets made either from rubber chloride or rubber hydrochloride, and vinyl sheets made from the copolymer of vinyl acetate and vinyl chloride, formal vinyl acetal, butyl vinyl acetal, and the like, and starch hydrate. These types of sheets possess varying degrees of moisture transmiscibility, but none of them has a low enough value to be suitable for a food wrapping when the food product must maintain a constant moisture content. In order to improve the moisture resistance of these sheets, they are frequently coated with a composition containing a wax or wax-like material. The wax alone would substantially reduce the moisture transmission of such sheets, but their transparency would be affected when coated with a wax film. Accordingly, a thin lacquer-like coating is formulated which contains relatively small amounts of waxes, and results in a surface which is not only flexible, but completely transparent. A representative formulation of such a coating, which is used in rendering a viscose sheet moisture-impermeable and making the commercial product known as moistureproof Cellophane, is as follows:

Solid Constituents	Per Cent by Weight	Solid Constitutents	Per Cent by Weight
Cellulose Nitrate	52.0	Dibutyl Phthalate	8.7
Ester Gum	35.0	Paraffin Wax	4.3

It is interesting to note that a Cellophane sheet coated with a film of the above composition will transmit about 1/100th of the moisture transmitted by the same sheet uncoated. The above set of solids is dissolved in a suitable solvent mixture such as is used for most cellulose nitrate solutions, of which the following is representative:

Solvents	Per Cent by Volume	Solvents	Per Cent by Volume
Ethyl Alcohol	25	Toluene	18
Ethyl Ether	43	Butyl Acetate	14

Approximately four parts by weight of solvent are used to one part of the solids. The sheet is passed through this solution, and thence, in vertical direction, through a tower which is heated and which operates at reduced pressure, carrying off the solvent vapors which are subsequently condensed for reuse. Under these conditions, after evaporation of the solvents, the paraffin exudes to the surface, and is deposited as a continuous film over the outer surface of the sheet. The total thickness of the moisture-proofing film approximates 1/10,000th of an inch, and it has a remarkable moisture resistance, i.e., it actually transmits less than 0.5 grams of water as vapor in 24 hours, per 100 square inches, with a relative humidity pressure difference of more than 75% on each side of the sheet.

This solution can, of course, also be applied to other types of transparent sheets to render them moisture-impermeable to approximately the degree described above. In addition, it may be applied to paper stock including glassines, vegetable parchments, and tissue papers, which will then possess a higher degree of translucency, approaching transparency, with the same high degree of moisture impermeability.

There are obviously three commercial methods for applying wax finishes to paper and similar forms of films or sheets:

1. Dissolving the waxes in suitable solvents
2. Liquefying the waxes by application of heat
3. Emulsifying the waxes in water

The solvents or solvent mixtures for the waxes may be found in the technical literature, or by experimentation. It may be

necessary, in some cases, to use the solutions at elevated temperatures, in view of the fact that the waxes, or certain types thereof, separate out as suspensions or dispersions at room temperature.

Emulsions of the waxes may be readily prepared by known means, and usually contain from 10 to 20% by weight of the wax or wax mixture, and from 1 to 2% of a suitable emulsifying agent, of which the triethanolamine fatty acid soaps are representative. Other emulsifying agents are also used, and those containing morpholine are particularly desirable where it is necessary to avoid reemulsification of the wax coating. Other emulsifying agents, which can readily be destroyed by heat, are equally effective.

It is interesting to note that many of the animal and vegetable waxes are compatible with certain varieties of ethyl cellulose, particularly those with a combined ethoxy content of from 44 to 50%. In addition, a limited amount of paraffin wax may be introduced into the mixture with the waxes which are compatible with ethyl cellulose, provided the paraffin wax content is kept under one third of the total weight of waxes used. The addition of ethyl cellulose renders the coating free from smear, and more permanent, as well as maintaining a degree of flexibility, particularly at sub-zero temperatures, not obtainable with the usual plasticizing agents for the waxes. It must be further remembered that only very thin coatings are required to produce the desired degree of moisture impermeability. In using ethyl cellulose wax mixtures, it is important to maintain a high content of aromatic hydrocarbons, approximating 80% by volume of the solvents, and to avoid alcohols and ketones which would precipitate out the paraffin wax.

WAXED PAPER *

The wax composition used consists essentially of a moisture-proofing wax or waxy substance, a hard wax (either vegetable

* T. G. Finzel & D. E. Drew, U. S. Patent 2,108,809.

or animal), and a blending agent which is generally a resin. As the moistureproofing wax, the white crystalline high-melting paraffin wax, e.g., one having a melting point of over 50° C., such as 52° C., 55° C., 60° C., or indeed higher is preferred. The amorphous paraffins, particularly those having a high melting point, may be used to give increased flexibility of the composition. The low-melting, non-crystalline waxes, vaselines, etc., if used, will only be in minor quantities, since they tend to decrease the moistureproofness of the product and also to give a greasy and smeary surface.

The hard wax component imparts toughness to the composition. It also contributes greatly to the production of hard, non-tacky, non-smeary surfaces as well as strong heat-sealing properties. The hard wax may be a vegetable or animal wax, and, preferably, candelilla or carnauba wax. These waxes are generally esters of higher fatty acids and high molecular weight, aliphatic alcohols. As additional illustrative examples may be mentioned montan wax, palm wax, etc., as well as certain synthetic waxes of a similar nature, such as may be produced by esterifying the acids of montan wax with higher alcohols.

The composition of paraffin and hard waxes, although miscible well above their melting points, produce cloudy liquids or semi-solids in the region of their melting points. This condition is not avoided even by rapid chilling. The blending agent serves to prevent this separation and to inhibit haziness in the chilled composition. In other words, the blending agent primarily functions to give the rapidly chilled composition its glass-clear clarity. It may also, of course, be chosen to assist in increasing the flexibility, gloss, non-tackiness, heat-sealing, etc.

In general, the blending agents are resins. As illustrative examples of blending agents may be mentioned the common varnish or lacquer resins, such as ester gum, elemi, dammar residue or the resins from gutta percha, or some of the coal tar or anthracene-like resins or some of the synthetic resins, like properly modified alkyd resins, and hydrorosinates, including diethylene glycol hydrorosinate.

If desired, other constituents which serve some special purpose, such as imparting greater flexibility to the product, greater

slip between adjacent surfaces, assisting the resins in preventing blushing, increasing the heat-sealing qualities, etc., may be incorporated in the composition. Rubber, gutta percha, balata, etc., when used in small quantities, impart to the product a greater flexibility and toughness, as well as greater heat-seal joint strength, when the composition is coated in thin films. Other toughening agents may be used such as a suitable cellulose derivative (ethyl cellulose) or small quantities of film-forming resin, as vinyl acetate resins. For decreasing the tendency to blush, small quantities of substances, such as hydrogenated castor oil, paraffin oils, hydroxy fatty acids, beta-naphthol, hydronaphthalene resins, etc., may be used. Greater smoothness or slippage between adjacent surfaces is secured when small quantities of talc-like substances, such as zinc stearate, are added to the composition.

To increase the penetrating power of the compositions, particularly when they contain substances which give them increased viscosity in the molten condition, a small quantity of a volatile solvent, such as toluol or solvent naphtha, may be added. These solvents are used only in limited amount, such as is necessary to give the composition the desired fluidity and melting point, whereby it will penetrate well and/or be applied readily. The amount of solvent will generally be approximately equal to the amount of the composition or less. The minimum amount of solvent is preferably used to save solvent expense and time required to eliminate the solvents from the impregnated paper.

The practical limits of the ingredients constituting the composition are as follows, the percentages being by weight:

	Per Cent		Per Cent
Paraffin Wax	2 to 30	Blending Agents	
Hard Wax	20 to 80	(Resins)	20 to 80

It is, of course, impossible to make every combination of components within these ranges. Some of the combinations will not tolerate, for example, 30% paraffin. Some of the hard waxes require a much greater amount of resin to produce glass-clear films than does candelilla, but at some point within these limits

a coating composition may be formulated which will, when properly processed, be transparent, glass-clear and possess the other desirable properties.

One of the characteristic features of these compositions is that they have an index of refraction close to that of cellulose. In general, the refractive index of the composition can be readily controlled by the kind and quantity of resins used. For example, the refractive index of the composition may be increased by additions of highly refractive resins, of which coumarone and chlorinated diphenyl resins are examples. The compositions are, furthermore, characterized in that in the molten state they have a viscosity higher than that of paraffin, in the molten state. This characteristic is highly desirable when the composition is used for coating purposes. By virtue of this characteristic, it is possible to obtain a more moistureproof product than can be secured with paraffin wax, the consumption of impregnating media being substantially equal or somewhat less.

Formula No. 1

(A) A thin, porous sulphite tissue, basis weight between 13 pounds and 18 pounds ($24 \times 36 - 500$) is treated with the following solution:

Ammonium Oleate	1.9	Denatured Alcohol	77.1
Water	21.0		

The excess soap solution is removed by means of squeeze rolls and the wet tissue is passed over dryer rolls, drying the tissue until it feels distinctly moist (10 to 15% moisture). The damp tissue is passed through a super-calender stack, the rolls of which are cooled. This is followed by a second super-calendering operation in which heated rolls are used. It is possible to combine these operations using a stack in which the first half of the rolls is cooled and the remainder heated. As the tissue emerges from the hot calender rolls, it is dry and has a fine finish. Although its solid fraction has been increased, the calendered paper still retains a good proportion of its absorptiveness.

The soap-treated, calendered paper is passed into a molten bath of the following composition:

Refined Carnauba Wax	34.5	Wax B-430	17.2
Glyco Wax C-991	34.5	Paraffin Wax (M.P. 62° C.)	13.8

The temperature of the melt should be about 90° C. After several seconds' travel through the melt, the paper is drawn up through a set of doctor knives, suitably heated to prevent crystallization of the composition on them, one on each side of the paper, which scrape off all but about 15 pounds of the melt per 100 pounds of paper. The paper then passes between hot rods of small diameter which smooth out the wax surface. The impregnated paper is allowed to cool to room temperature and then wound up. At this stage of the process, the paper is thoroughly impregnated, flexible and non-tacky, but, due to the incompatibility of the slowly cooled melt component, is so badly blushed as to be practically opaque.

The blushed paper is then unwound and passed over a head roll and down through an electrically heated chamber in which the impregnated composition is thoroughly melted, but is not heated so hot as to harm the paper or to vaporize the components of the composition. While the composition is still in this molten state, the hot film is passed into a bath of water at 10 to 25° C. and then immediately out of the water. The contact of the film with water need be no more than one second. The paper is then passed between scraper rods which remove the greater portion of the water that adheres to the surface of the film. If the paper is running at high speed, a sheet of water is carried for some distance vertically out of the water bath on the film surface. It is desirable to break this sheet of water soon and allow the greater portion of the water to run back into the water bath, so that the small amount of water remaining on the film can form into easily removable globules on the surface of the film. After leaving the scraper rods, a portion of the remaining drops of water are blown or shaken from the film. The paper then passes between felt pads or cloth-wrapped rolls which remove the remainder of the water from the film.

The product obtained is transparent, is very clear and free from any haziness due to blushing of the composition or to incomplete impregnation, is glossy and smeared with great difficulty or finger-marked, is non-tacky, does not stick when stored

at ordinary weather conditions, in roll form or in sheets, is free from odors which would be objectionable for a food wrapper, is sealed by heat to a strong permanent joint, is moistureproof, and can be printed with inks, such as are used on lacquered moistureproof, transparent, regenerated cellulose sheeting.

(B) The same calendered tissue as in Formula 1(A) is treated in the same fashion as in Formula 1(A) but using the following transparentizing composition:

Candelilla Wax	55.5	Paraffin Wax (M.P. 62° C.)	16.7
Ester Gum (Low-Melting)	27.8		

If desired, the impregnated paper, after being scraped, is passed directly into a bath of cold water without the intervening cooling step, as described in Formula 1(A).

The transparent product obtained is in every way similar to that obtained in Formula 1(A), except that it is softened at a slightly lower temperature. However, it is more easily clarified by the cooling step.

(C) The same calendered tissue as in Formula 1(A) is treated with the following composition in the same manner as in Formula 1(A).

Refined Carnauba Wax	43.4	Wax B-430	21.7
Ester Gum (Low-Melting)	21.7	Paraffin Wax (M.P. 62° C.)	13.2

Instead of cooling the molten composition impregnated in the tissue, the paper is passed over polished, cold, iron rolls which are hollow and suitably fitted for circulating cold water or brine.

A product is obtained that is transparent, clear, glossy, moistureproof and otherwise similar to that of Formula 1(A).

(D) The same calendered and soap-treated tissue as in Formula 1(A) is impregnated and cooled in the same manner as in Formula 1(A), using, however, the following transparentizing composition:

Ester Gum (Low-Melting)	37.0	Dewaxed Shellac	37.0
Refined Carnauba Wax	18.5	Paraffin Wax (M.P. 62° C.)	7.5

The product obtained is very transparent, free from haze, nontacky, non-smeary and of very excellent flexibility.

No. 2

(A) The same calendered paper as in Formula 1(A) is impregnated with the following composition:

Wax B-430	30.0	Paraffin Wax (M.P. 62° C.)	15.0
I. G. Wax "E"	30.0	Rubber (Crepe)	10.0
Ester Gum	15.0		

Solvent: Toluol
Solids content: 50%

Paper is impregnated with the above solution and scraped as in Formula 1(A), except that an amount of solution is left on the paper in removing the excess such that there will be about 20 pounds of solid composition to 100 pounds of paper. In this case, the scraping knives need not be heated, since the components of the composition do not readily crystallize out of solution during the scraping operation. It is preferable that the impregnating solution should be between 40 and 60° C. After leaving the scraping knives, the paper is passed through a drying chamber at 60 to 90° C. in which the toluol is evaporated. The impregnated paper is then cooled and wound up and subsequently momentarily exposed to an elevated temperature and chilled as in Formula 1(A).

The product obtained will be transparent, very flexible and tough, and will have excellent heat-sealing properties and good slip. It will, however, tend to blush unless chilling is carried out when the composition is somewhat hotter than required in the previous example.

(B) A good 20 pound glassine ($24 \times 36 - 500$) is coated with a composition of the same solid components as in Formula 2(A). The solvent is omitted. The solvents are not necessary in this case, since the glassine is not impregnated by such compositions and since the viscosity of the composition without the solvent is not too great for good coating.

The glassine is passed through the molten composition, and the excess composition is scraped off with suitable heated knives. No time is allowed for impregnation as was the case with the calendered tissues. The coated glassine is then passed

over smoothing rolls and, while the composition is still molten, is passed into cold water. The adhering water is removed and the film wound up.

The product obtained is moistureproof, glossy and somewhat improved in transparency. It is, however, slightly hazy due to imperfections in the glassine base. The wax coating is readily chilled to be free from haze, since the thickness of the composition is substantially less than that of Formula 2(A) The glassine base is increased in thickness about 0.00005 to 0.0001 of an inch by the coating. The coated glassine is non-tacky and non-smeary. Furthermore, it can be heat-sealed to give a very strong joint, even with the thin coating which is applied.

No. 3

(A) A tissue of basis weight, between 13 and 18 pounds ($24 \times 36 - 500$) is moistened with water to about 10 to 15% moisture content by any suitable means, such as on a glassine dampener, in a suitable mist chamber, or by wetting the paper and drying it down to the desired moisture content. The dampened paper may be rolled up and allowed to stand until the moisture is equally distributed. The uniformly moistened paper is calendered on hot calender rolls, during which operation it is compacted and given a smooth surface and dried down to normal moisture content. The calendered paper is then transparentized by the same composition and process as described in Formula 1(A).

The product obtained is moistureproof, glossy, non-smeary, of good slip, and possesses good heat-sealing properties. Its clarity and transparency will be somewhat inferior to that of Formula 1(A). It will have a slightly hazy appearance, that shows up as a gray cast over a black background due to somewhat poorer impregnation.

No. 4

(A) A good 20 pound glassine is coated with the following composition according to the procedure outlined in Formula 2(B):

Refined Carnauba Wax	66.6	Paraffin Wax (M.P. 62° C.)	6.7
Diethylene Glycol Abietate	26.7		

About 5 to 10 pounds of the above composition is applied to 100 pounds glassine.

The product obtained is moistureproof, glossy, non-smeary and non-tacky and slightly improved in transparency. The product is somewhat hazy, since the glassine base is not impregnated, but the wax coating applied is glass-clear. It is essential that a thin film of the above composition should be applied, since a thick film, such as would be obtained by impregnating a calendered tissue as described in Formula 1(A), would have a slight whitish haze even with the best, rapid cooling.

(B) A film of transparent regenerated cellulose sheeting, or other transparent sheeting, such as cellulose acetate, ethyl cellulose, gelatin, etc., about 0.001 of an inch thick is coated as in Formula 4(A). Between 5 and 10 pounds of wax composition per 100 pounds film is applied.

The product obtained is moistureproof, glossy, non-smeary, non-tacky and glass-clear. The wax coating is tough and flexible. The film can be crumpled, without chipping off portions of the coating or leaving objectionable marks or fractures in the coating.

HOT-MELT COATINGS

W. S. Lawrence

By far the greater amount of coating, in industry, is done with a liquid solution of the ingredients in a volatile solvent which plays no part in the finished film but merely serves as an agent to dispose the non-volatile materials over the surface to be coated. Unless the solvent is recovered, which is in itself a somewhat troublesome and expensive operation, except in the cases where large quantities are involved, it is a total loss and disappears into the atmosphere. Moreover, some materials used in coatings tend to hold the solvent tenaciously, and it is very difficult to entirely free the coating from the last trace of volatile ingredients.

With these problems in mind, it is easy to understand how, for certain purposes, it is desirable and economical to apply the coating in liquid form by the use of heat and non-volatile ingredients. There is no expense involved for lost solvent and the coating is disposed in its final form as far as ingredients are concerned.

There is no hazard due to explosive vapors in the air and, in the absence of volatiles, solidification is very simply accomplished by cooling to room temperature, or to as near that state as is practical.

The disadvantages are that, since there is no liquefying agent to aid in the spreading of the solids, there are serious limitations imposed as to the viscosity and type of ingredients that can be used in a hot-melt coating, spread by knife or roller. Some materials, commonly used in solvent coatings, which are susceptible to change or decomposition under the application of heat, cannot be used at all or only in very limited amounts. Nitrocellulose and vinyl copolymers may be mentioned in this connection. The requirement imposed by the fact that the melt, under fusion heat, must have a viscosity and spreading behavior that falls within certain practical limits, constitutes one of the serious limitations of hot-melt coating by knife and roller.

Calendering, where it is used to apply a coating to fabric, etc., is, in a sense, a type of hot-melt coating, but it may be said to be a specialized form of application, and its use greatly extends the field and the classes of materials that can be applied hot. It is not intended to discuss here the use of waxes in compounds that can be calendered on, since the problems of application, in this field, are in a class by themselves.

It is broadly true that the film-forming materials, as well as the elastomer-type of materials have, under heat, a relatively high viscosity as compared with most other resins, and it is in this respect that the limitations of practical coating are most keenly felt. Viscosity, in the melted state, generally decreases with increasing temperature and this offers some help, but it is readily realized that increasing temperature introduces problems of stability and discoloration that have to be considered in relation to the properties of the finished coating.

The ingredients of hot-melt coatings, to be spread by knife and roller, are quite similar to those used in solution coatings. The formulation is very different, especially as regards proportions.

Resins are widely used in hot-melt coatings to promote adhesion and to give hardness, toughness, and tensile strength to the film. The film-formers are particularly valuable in respect to the last three properties named, but their proportion is seriously limited compared with solution coatings due to the considerations of viscosity, as discussed, alone. The non-film-formers are not too high in viscosity, when used in higher percentages, and, in general, they are valuable ingredients of hot melts for certain purposes.

Plasticizers, both oil and chemical, are widely used to adjust tack, melting point, and viscosity, but they have to be carefully chosen for their effect on the other ingredients of the coating, as well as in regard to the properties of the coating itself.

Pigments, dyes, and fillers may be used for colored or opaque coatings, or to reduce cost, and their use is similar to that in solvent coatings.

Stabilizers and special chemicals may be employed in minor quantities to perform special functions.

Waxes have been widely used in hot melts for numerous reasons. In fact, coatings of wax alone are very common on paper, producing the familiar waxed paper used in the home and elsewhere. And many, if not most, coatings made by the use of a hot melt contain a large proportion of wax.

There are many different types of waxes, including the natural waxes (of animal, vegetable and mineral origin), synthetic waxes and numerous fatty acids and esters that are not true waxes, but function the same way.

In contrast to their use, in a restricted measure, in solvent coatings, waxes in hot melts contribute highly desirable properties, both in aiding the practical application of the melt and in modifying the properties of the finished product. Since the term wax covers such a wide scope of products, both natural and synthetic, with a correspondingly wide range of properties, any wax employed has to be first considered from the viewpoint of

what its presence will contribute to, or how its presence will modify, the finished product, independently of its performance in the coating job. Most waxes, with few exceptions, aid the actual coating job since their viscosity, in the hot state, is low, and they make for ready flow and smooth spreading at lower temperatures. By virtue of this property, they permit the use of more highly viscous materials which contribute valuable properties to the finished film.

As regards the finished product, their utility is wide and varied, as would be expected from a class of compounds some of whose members are completely water-soluble, others water-insoluble, some soft, flexible and tacky, others hard, brittle and dry.

Waxes have one definite property in which, as a class, they are unique, namely, their limited solubility in the other ingredients of the melt in the cold. Although, this is not always the case and is a variable characteristic, depending in great measure on the nature of the other components of the system, it is a fairly common property among waxes and makes possible the production of coatings that have good slip, and are free from blocking tendencies. The value of this should not be underestimated, especially when it is realized that hot-melt coatings are most often wound in a roll, under pressure, and often not completely cooled.

Coated papers, produced by use of hot melts, have come into increasing use because of the shortage of foils, particularly those made of metal. Since moisture plays such a large part in some products, either by the necessity to retain it or by the necessity to exclude it, the moisture vapor transmission of a film is often highly important. Waxes, especially those of an amorphous nature, are very valuable with regard to this property of a coating.

Heat-sealing glue is often used on foils and paper to seal containers; in the case of a hot-melt-coated paper or cloth, heat-sealing is inherent in the nature of the coating and is accomplished by running a hot wheel or bar over the seam which cements the surfaces together.

A hot-melt coating always possesses this characteristic to

some degree, but it can be greatly increased by a proper choice of materials. In some cases, sealing is accomplished by pressure alone, especially where it is to be of a temporary nature or of not too great strength.

Waxes enable the formulator of hot melts to produce a coating for package and container liners that will seal readily, be soft, flexible and free from blocking tendencies even when the product made in rolls is sheeted and stacked. In a broad sense, waxes are rightly the principal ingredient of most hot melts since, as a class, they contribute to easy working characteristics, at lower temperatures, and, at the same time, to the properties of the finished film, to a great degree.

In this class of materials may be found members that can increase water and oil resistance or decrease it; decrease or increase moisture-vapor transmission, as well as produce slip, tack, freedom from tack, hardness, flexibility, brittleness and softness. The range of properties is very wide and since many of the waxes are solvents, in the hot state, for film formers and resins, an almost endless variety of melts can be produced by a careful choice of materials.

As in so many other fields, the development of synthetic waxes has extended the range of application, and though shortages have somewhat curtailed the formulator's choice, there is still a wide range of desirable waxes with which to tailor-make a melt to meet the specific problem at hand.

TROPICAL WAXED PAPER

Leonard S. Levitt

When candies and food products are wrapped hot with waxed paper, difficulty arises in the prevention of wax-transfer to the food product during the wrapping operation, as well as in storage during hot weather or under conditions of abnormal heat.

In order to overcome this difficulty, some manufacturers have specified to their converter that the waxed-paper coating should comprise a percentage of a higher-melting wax, carnauba, in an amount from 7 to 10%. Satisfactory results were obtained

within the limits of temperature that the added carnauba afforded. However, where especially hot wrapping was desirable, or temperature conditions, on storage, were abnormally high, the problem was again manifest. To increase the percentage of carnauba meant to sacrifice flexibility of the sheet as well as increase the cost beyond reasonable limits. Thus began the search for a "synthetic" which would not only satisfy the physical requirements, but also bring the paper cost down to respectable dimensions. It developed, however, that to satisfy the requirements the wax must possess rather unique properties. These qualifications may be classified into two categories: one, dealing with the wax itself and two, a group concerned with the resultant blend, as listed below:

Physical Properties of Wax

1. Color—light, preferably white.
2. Form—as hard as carnauba.
3. Luster—preferably very high.
4. Melting point—85° C. or higher.
5. Compatibility—give a homogeneous blend with paraffin wax.
6. Toxicity—none.
7. Reactivity—non-corrosive to metal.
8. Solubility—water-insoluble.

Furthermore, the cost should be considerably less than that of carnauba.

Properties of Blend

Since volume production could be obtained best with the water-waxing system, the following properties are requisites of the wax blend:

1. Melt to a thin liquid below 250° F. (scorching point of paper and paraffin).
2. Compatibility with paraffin in following ways:
   a. Give a homogeneous melt.
   b. On quick cooling (down to 40° F. in water system), the higher-melting wax should crystallize partially or "bloom" to the film surface.

3. Have quick-setting properties.
4. Seven per cent added high-melting wax should be sufficient to give a higher-melting coating to maintain cost limits.
5. Give good sheet flexibility for automatic wrapping and not detract from heat-sealing properties should they be desired.

The wax, which seemed to comprise experimentally these varied properties and has since proved itself in actual production and subsequent use, is a blend of synthetic wax (Albacer) and paraffin wax. This new synthetic is a white, hard wax having a very high luster and a melting point of 95–97° C. It is insoluble in water, but completely soluble hot in hydrocarbons. It has been used for its high luster as a coating material for linoleum and paper products as well as in various types of polishes.

Although there is little or no increase in the EMP (English Melting Point) of the synthetic paraffin blend, the wax film of paper, coated with this combination by the water-waxing system, possesses a relatively high melting point. This suggests the probability of a partial "blooming" or orientation of the synthetic wax to the paraffin surface, which results in a high melting point of the film, approaching that of this synthetic wax itself. In view of the fact that this new wax has a melting point about 14° C. higher than that of carnauba, this offers another distinct advantage over the latter wax. Furthermore, this property of "bloom" seems more pronounced with the new material, which in effect gives a somewhat harder surface film without sacrificing flexibility of the sheet. Still another desirable feature of the use of this new synthetic, that can be attributed at least partly to its property of "blooming," is the much quicker setting of the film, which allows for speedier production.

In the use of this type of wax, two important factors must be borne in mind: one, a water-waxing system is required and two, a fairly critical temperature of the melt must be maintained. This temperature, 240° F., has been determined after quite a number of commercial runs. It seems that below this point poor results are generally obtained and when the temperature rises as much as 8 to 10 degrees above this optimum, scorching of the paper or souring of the paraffin occurs. The water-waxing unit is necessary, since the action of the new wax is dependent

upon a partial crystallization from the blend, obtainable only by a quick drop in temperature. Luster, too, which is highly desirable, is dependent upon this lowering of temperature that only the water-waxing unit can give. Because temperature plays such an important part, a thermostatically controlled system is suggested for assurance of consistently good results.

Excellent results are now being obtained by the addition of this new synthetic blend to 138–140 EMP paraffin. The waxes are melted together, with slow agitation, to insure complete blending up to 240° F. From this point on, the converter needs only to apply regular procedure of his waxing system.

Paper, made with this new wax, is now being utilized for wrapping of caramels, hard candies, chocolates, etc. Advantages which are pointed out are: lowering of cost by as much as one-half, increased temperature limits of wrapping and storing by virtue of a higher-melting film surface, increased luster of the wrapper lending itself to greater sales appeal and good sheet flexibility for automatic wrapping.

NON-STICKING (ANTI-BLOCKING) COATINGS

Certain materials, or coated surfaces, have a tendency to adhere to each other during hot weather and when subjected to even slight pressure as when they are superimposed on each other. This is especially true of certain materials, during the summer and all year in the tropics. Such materials are natural and synthetic rubber, resins, thermoplastics (e.g., polyvinyl butyral), hygroscopic materials (e.g., glue), paraffin-waxed paper, etc.

Carnauba wax, because of its high melting point, has been used effectively to prevent sticking or blocking of coated paper or cloth, rubber, etc. Its disadvantages are that it is brittle and not too adhesive. Synthetic waxes such as Albacer, Ozowax and Acrawax C are gradually displacing it in this field. The latter waxes are usually incorporated in the coating or in the composition (as in the case of rubber or resins). They bloom to the surface and form a non-sticky film which does not crack off and thus gives permanent protection.

TEXTILE PROCESSING

Waxes and wax-like materials are among the most valuable assistants in the textile processing industries. Their use in sizing, finishing, printing, waterproofing, polishing, etc., is as old as the finishing industry. Almost every formula for sizing, finishing, waterproofing, etc., contains, in one form or other, a wax or wax-like material.

Most of the natural fibers contain a certain amount of natural wax or wax-like material as a protective agent against atmospheric influences. These natural waxy substances are eliminated, during the manufacturing process, by scouring or boiling, to assure uniform dyeing and bleaching of the fibers. By removing the waxes, we change some of the most valuable properties of the fibers, as the softness, pliability and elasticity. It is often possible to regain these lost properties by treating the fibers or finished yarns with waxes or wax-like materials.

In textile processing, waxes and wax-like materials can be used in two different ways:

1. To produce a non-permanent effect. An effect which will be removed from the yarn or goods in a following operation, but which is absolutely necessary to assure a better workability of the material. It is quite natural that, for this purpose, waxes should be used, the removal of which is easy, and where the removing operation does not affect the fibers. For instance, it would be a mistake to use for wool a wax which requires strong alkalies for saponifying.

2. To produce a permanent effect, which is desired to give the finished goods or yarns a specific appearance, for instance, high luster, softness or water repellency. In this case, the application of the wax is always combined with a mechanical after-treatment, like calendering, polishing, rubbing, etc.

Sizing

The purpose of yarn sizing is to provide

1. Better weavability
2. Specific finish
3. Increased weight

The basic materials, used in the sizing process, are starch, glue, gums, etc. They increase the tensile strength of the yarns, but diminish the elasticity and softness. The softeners compensate for this loss, maintaining the higher tensile strength of the yarns. The softeners are as important as the starches themselves. They make the starch film pliable and flexible. They also reduce the harshness, lubricate the surface of the yarns, increase elasticity, and improve "hand." A very important role of the waxes in sizings is that they improve the adhesion of the size to the fiber, diminishing the formation of dust during weaving.

The most frequently used waxes are Japan wax, beeswax, paraffin wax, spermaceti and tallow. Under trade names, there are a large number of softeners, on the market, containing chiefly waxes, in emulsified form, and other ingredients.

A very important factor, in the use of waxes in sizings, is that only waxes should be used that can be easily removed later. An unsaponified wax very often causes unlevel dyeing and most unpleasant difficulties in the bleaching.

The very same precaution should also be taken in the use of polishes. The polishing of yarns is useful, chiefly for knitting purposes, where softness and smoothness is more important than higher tensile strength. The polishing or waxing is made simply by passing the yarn over wax rolls. The use of paraffin wax, which is very difficult to eliminate, very often causes difficulties in dyeing and bleaching.

Printing

The reserve printing processes used large amounts of waxes. From the great variety of these processes, only the "Batik" printing process is still in use, all the others were replaced by more modern printing processes.

The Batik technique originates from Java, where it is still in use, as a home industry, producing highly artistic designs. The fundamental difference between Batik and ordinary printing is that in the Batik, the design is dyed completely through. It appears on both sides of the cloth in the same strength. The Batik is rather a dyeing than a printing process. In the original Javanese Batik, the dyeing is always combined with some sort of

printing process, like block printing, to produce various effects. There are a great variety of designs which can be produced by the Batik process, depending upon the mode of application of the wax reserve. It can be applied to the whole surface of the cloth, or only in spots, before dyeing, between two or more dyeings, or after dyeing. The waxes used are paraffin wax, ozokerite, vegetable waxes, and other ingredients such as rosin.

The beauty of the designs achieved by the Batik process led to a great variety of imitations, produced on a large scale. It is natural that for large-scale manufacture, there were developed special processes none of which could ever produce anything as artistic as the original Javanese Batik.

The bleached cotton goods are impregnated with the molten wax, by passing through squeezer rolls. After the wax hardens, the goods are irregularly broken, followed immediately by the dyeing. The dyeing is done mostly in cold or at low temperatures, using cold-dyeing, vat dyestuffs. The dyestuff penetrates into the fiber only where the wax resist is broken, leaving the covered spaces undyed. After drying, the wax is removed, e.g., by organic solvents. The effect is a one-colored marble-like design. By applying the wax reserve again and dyeing in another color, or by repeating the whole process several times with different colors, beautiful, multicolor effects can be achieved. As in the Javanese Batik, the process can be combined with block, screen or roller printing effects.

Regarding the waxes used in Batik printing, almost always the cheap varieties are used. Ozokerite is more in use than paraffin wax.

Finishing

To produce goods, with a high and possibly lasting luster, has always been the desire of the finishing industry. To imitate the soft, silky luster on cheap materials, like cotton goods, has always been the dream of the finishers. Mercerizing was an important step forward in this direction.

Waxes can produce a high luster, when applied to textiles and properly after-treated. There are thousands of types of goods with specific effects obtained by wax finishes and a proper,

mechanical after-treatment. "Chintz," the well-known furniture covering, a typical high-luster material, is finished as follows: The dyed and printed goods are humidified, rolled, and kept in a humid surrounding for over 24 hours, to distribute the humidity evenly all over the goods. Before humidifying, a finish, containing starch or dextrose, or methyl cellulose and a large amount of a hard wax, is applied. The humidified goods are then calendered by a three-roll, friction calender.

A similar process is used to produce rayons and acetates, with a chintz effect, for ribbons and other goods for the millinery industries. It is evident that all these effects are not lasting. The first washing or dry cleaning eliminates them.

Yarn Finishes

The ability of waxes, to produce smoothness and luster on textile materials, is used also in the finishing of special yarns as sewing thread, shoemaker's thread, fishing lines, thread for shoe laces, and many others. The wax, usually along with other ingredients, such as starch or gum is applied to the yarns. After drying, the yarns are polished by brushing and rubbing. Another method consists in brushing, over the finished yarns, wax as an emulsion or dissolved in an organic solvent. This treatment gives the finished yarns a high luster, a deeper, more brilliant color and higher elasticity and tensile strength.

Waterproofing

The purpose of waterproofing is to prevent the penetration of water through a textile material. There are two different types of water-resistant finishes:

a. Waterproofing
b. Water-repellent impregnation

The waterproofing of a textile material consists in forming a highly hydrophobic layer on one or both sides of the fabric, which fills out the pores of the goods and is sufficiently resistant to prevent the penetration of water through the cloth. A great variety of substances is used to attain this goal. Waxes, in combination with rubber, drying oils, metallic soaps and fillers, are

the materials chiefly used. The waterproofing composition can be applied by a doctor blade or by passing through the liquid and squeezing out the excess. After drying, a suitable after-treatment, like calendering, follows. Articles, treated in this manner, are used for rain-coats, heavy ducks, osnabrucks, etc.

The water-repellent impregnation is a more recent development in the finishing industry. Applied chiefly to clothing, it has the characteristic of not filling the pores of the fabric, but rendering the surface of the cloth highly repellent by the application of hydrophobic substances. The most widely used wax for this purpose is paraffin wax in the form of a stable emulsion. The water-repellency, produced in this manner, does not resist repeated washing or laundering or dry-cleaning operations.

The newest development in the water-repellent impregnation embraces modifying the surface of the cloth, by chemically binding the waxy material to the fiber. A cloth, subjected to such a treatment, will resist repeated washing and dry-cleaning operations.

The water-repellent effect is sometimes combined with other properties, like softness. Ladies' hose is rendered smooth and water-resistant in one single operation by the use of waxy finishes. Sometimes, smoothness is desired without rendering the material water-repellent. Certain wax emulsions are frequently used for giving smoothness and "hand."

The development of synthetic waxes opened many new fields for the application of waxes in the textile industry. The finisher now has available materials which are very easy to handle and which are chemically pure and uniform. By an appropriate choice, combining different types, almost any kind of finish can be produced. Waxes, which are compatible with synthetic resin finishes, have a big future. The modern trend in the finishing industry is to produce lasting finishes, which withstand repeated washing and dry-cleaning operations, maintaining the original finish and appearance of the textile material. The task of the synthetic wax industry is to investigate such waxes and possibly provide waxes which combine chemically with the fiber, giving a more lasting bond.

TEXTILE PRINTING

W. D. Baird

Waxes come into consideration, to a small degree, in the pigment type of printing. That is, for purposes of pliability and "hand" of the printed goods, a wax such as beeswax is incorporated into the varnish or other types of fixing vehicle.

Essentially, "Batik" printing consists of applying molten waxes or resins, in any desired pattern or design, to the carefully calendered and stretched fabric. The work is generally carried out on a table or bench which has been covered with several layers of cheap cotton cloth. A thin layer of sand or china clay separates the fabric under treatment from the under layers of cotton. A "Batik" pencil, brush or mold is used to apply the molten waxes or resins. Upon solidifying, the required resist is thus formed.

The wax resist printed goods, after hardening for at least 24 hours, are placed in cold water where the breaking or cracking of the resist is carried out in order to produce the desired "veiny" design.

Transference of goods to the dye bath follows immediately, where the desired depth and shade are obtained. Removal of the wax is then effected in a hot or boiling water bath. Multicolor effects are produced by repeating the entire procedure with new and different dye baths.

Cold dyeing Amanthrene, Indigosol, Sulphur and Amanil Napthol AS dyes are used when good fastness is required. Where speed of dyeing and shade brilliance are of greater importance than fastness to color destroying agents, the basic class of dyestuffs comes into consideration. Likewise, fast dyeing acid colors such as the Amacid Milling colors, which draw well from a weakly acid bath, are employed.

The kind or composition of wax resist varies with the type of goods under treatment, as well as the nature of the dyes to be used. As an example, a dye bath containing caustic soda as, for instance, in vat or naphthol work, would necessitate the use

of a large proportion of an unsaponifiable wax, such as paraffin wax, in order to preserve the resist against the strong alkali.

A knowledge of melting points is essential because a moderate elevation of dye-bath temperature is sometimes necessary for reasons of fastness, affinity of dye for fiber, etc.

A listing of some of the usable waxes and resins, together with their resistance to saponification, follows:

Item	Melting Point ° F.	Resistance to Saponification
Paraffin Wax	90–120	Excellent
Carnauba Wax	190	Very good
Palm Wax (Raw)	220	Very good
Japan Wax	110	Poor
Chinese Wax	180	Very good
Stearic Acid	150	Poor
Spermaceti	110	Poor
Rosin	210	Poor
Petroleum Jelly	150	Excellent
Beeswax	170	Poor

Thus, at a glance, it may be ascertained that where cold dyeing, from a strongly alkaline bath, comes into consideration, a firm resist, which will remain hard at temperatures below 75° F. and highly resistant to saponification, may be obtained with paraffin wax as its base. Should a slight rise in temperature be necessary, such as for certain vat colors, yet preserving the resistance to saponification, carnauba or palm wax or both may be combined with the paraffin in amounts consistent with the temperature increase.

Brittleness is sometimes imparted to the wax resist for the purpose of producing a sharper break or crack. In the absence of a strongly alkaline dye bath, rosin, in the required amount, serves well.

PAINT AND VARNISH

A. O. Allen

Many different types of natural and synthetic waxes are used, in protective and decorative coatings, to impart useful and unique properties. Some of the more commonly used are par-

affin waxes, carnauba wax, candelilla wax, shellac wax, montan wax and many synthetic waxes sold under trade names.

Waxes are incorporated in coatings for one of the following reasons:

1. To produce water-repellent films
2. To produce non-tacky films
3. To produce marproof films
4. To produce dull finishes
5. To retard evaporation in paint and varnish removers

Paints, for use on awnings, tents, tarpaulins, canopies, also, for wood and masonry surfaces, as well as paper and Cellophane, are improved in moisture-repellent properties when certain waxes are incorporated. At the same time, film flexibility is increased.

The following are typical formulae:

MOISTUREPROOF COATING FOR WOOD, CANVAS, ETC.

Linseed Oil	313 gal	Paraffin Wax	724 lb
China Wood Oil	94 gal	Zinc Stearate	50 lb
Ester Gum Cut (60% Solids)	130 gal	V.M. & P. Naphtha	365 gal

Incorporate sufficient pigment, ground in a portion of the linseed oil, to give desired color and opacity.

MOISTUREPROOF COATING FOR CELLOPHANE AND PAPER

Ester Gum	42.5	Diethylene Glycol	12.7
Ethyl Cellulose	34.1	High-Flash Naphtha	80.0
Dibutyl Phthalate	6.4	Acetone	2.0
Paraffin Wax	4.3	Ethyl Alcohol	8.0

Incorporate sufficient pigment, ground in a portion of the dibutyl phthalate, to give desired color and opacity.

Frequently, a small amount of a wax is added to a paint to produce a non-tacky film. This is often necessary when painted objects are to be stacked or packed, immediately after the paint film has been baked.

A marproof film, which will not show nicks and scratches, is very desirable in finishes for metal furniture, kitchen equipment, hospital and school equipment, etc. This can be accomplished by

incorporating a small percentage of wax in the baking enamel. Many different waxes may be used for this purpose. Those in most common use are the high-melting-point, micro-crystalline paraffin waxes, or montan wax. Montan wax has the advantage of not interfering with the adhesion of succeeding coats.

A convenient method of incorporating wax in paints and enamels is to melt the wax in a steam-jacketed kettle and reduce with a solvent such as mineral spirits, turpentine or xylol. The wax is usually reduced to a solid content of about 40%. This gives a soft wax paste that can be conveniently handled. In order to get a uniform distribution of wax in the enamel, it is advisable to add the wax paste to the enamel paste before grinding.

Wax is usually added in percentages ranging from ½ to 1% for producing non-tacky and marproof finishes.

Waxes can only be used to produce non-tacky and marproof films when such films are properly baked, after application. All waxes, which have a tendency to produce these properties, also interfere with the drying of paint films and, therefore, cannot be used in air-drying films for many applications.

Clear, non-mar, baking finishes can be made by incorporating small percentages (¼ to ¾%) of waxes. The waxes, mentioned above, have proven satisfactory. A convenient procedure is to add the wax to the hot varnish directly after thinning or during the thinning operation.

All waxes have a tendency to reduce the gloss of baked finishes and are often used to produce low-gloss or dull, baked finishes. For this purpose, various waxes are incorporated in the enamel in the same manner as described for marproof finishes. Usually, the percentage of wax, used for this purpose, is somewhat greater than that used to produce non-mar finishes.

Flat finishes can be produced by incorporating such synthetic waxes as Stroba wax. This is usually accomplished by adding the synthetic wax to the varnish while the varnish is still hot. The varnish can then be used as a clear flat varnish or can be pigmented to form flat finishes.

Paint removers are made effective by incorporating some wax which holds the solvent and allows it to do its work on the old

film before evaporation. Without the wax, a large part of the effectiveness of the remover is lost. The following is a typical formula:

Benzol	15	Acetone	25
Toluol	15	Ethylene Dichloride	20
Alcohol	20	Ethyl Acetate	5

Melt in 8 to 16 lb paraffin wax.

Paste removers can be made by increasing the wax content 10 to 15%.

ANTI-DIM (NON-FOGGING) COATINGS

The glass surfaces of binoculars and telescopes, the eye-pieces of divers' masks, gas masks, spectacles and goggles, the surfaces of windshields, and similar surfaces have a tendency to condense moisture. As a result of such condensation, the vision of the observer is diminished and often totally obscured.

Of the many compounds, used for their anti-dimming properties, the most frequently employed have been those based principally on soaps, sulfonated oils, saponified Turkey red oil and some hygroscopic agent such as glycerol. However, compounds prepared from these materials have not proved entirely satisfactory. They have a tendency to form films which pass too readily into solution in the water condensed on their surfaces. The compounds prepared from soap bases are alkaline in character, while those prepared from sulfonated oils are either acid or alkaline or tend to develop acid characteristics. Either of these deviations from chemical neutrality is undesirable, for the reason that the compound is then likely to damage the treated surfaces or the materials adjacent thereto. In the case of fine, delicate, optical equipment and instruments, these potentially harmful characteristics are matters of considerable concern.

Furthermore, when they are exposed to moisture-laden atmospheres, the sulfonated oils, used as surface-tension depressants, in anti-dimming compounds, have a marked tendency toward liquefaction due to their inherent solubility in the water condensed on the lenses or other surfaces. Under such conditions, the anti-fogging film is readily washed away. When the

atmosphere is dry, the sulfonated oil compounds tend to undergo spontaneous desiccation. Under these conditions, the anti-dimming film, spread over the treated surface, tends to dry out and develop perceptible opacity. The desiccated film shrinks and cracks, exposing parts of the underlying surface which condense moisture.

Other deficiencies or inadequacies of the anti-dimming preparations heretofore used will be recognized upon consideration of the following properties which should be present in an ideal agent for such application. In order to meet the rigorous requirements, demanded of an anti-dimming composition, it should:

a) Greatly lower the surface tension of water
b) Readily form a uniform, adherent, cohesive, and transparent film of maximum optical qualities
c) If soluble in the water, condensed on the filmed composition, the solution should not readily run off the treated surface
d) Be chemically inert to the surface filmed therewith as well as the materials adjacent thereto
e) Not lower the dielectric strength of the materials with which it must come into contact
f) Be non-irritating to tissues and eyes
g) Be non-toxic on direct contact or upon inhalation in vapor phases
h) Not contain gritty materials or have a tendency to develop them so as to cause damage through scratching, on filming or defilming the optical surface
i) Have a consistency that will not vary greatly, upon changes in temperature or atmospheric conditions
j) Not dry out on standing and become too hard or brittle for easy handling or application
k) Not absorb moisture too rapidly so as to become too soft for storage, handling, or application
l) Not undergo spontaneous chemical or physical changes during storage that will impair its utility in any respect.

Preparations, markedly superior to those mentioned before, can be produced from certain polyhydroxy alcohols that have

been partially esterified with higher fatty acids. They produce anti-dimming agents which can readily be spread out in thin layers, approaching monomolecular dimensions, over optical surfaces, to form films of excellent transparency and great durability, resulting in clearer vision and lengthened life of the film. The films formed from these anti-dimming preparations reduce the glare of sunlight or other bright lights, thus producing better vision. Camera lenses, so treated, minimize the ill effects of glare in photographic operations.

These partial esters also lower surface tensions to a decided degree. Although, they absorb moisture, the hydrated products thus formed do not thin out and run off. On the contrary, when these partial esters absorb moisture, they actually thicken and develop greater viscosity. They spread evenly over the entire lens or other surface to which they are applied. Since their fluidity is not dependent on the presence of water, as is the case when using sulfonated oils, they will not dry out either in storage or in their filmed phase. These characteristics eliminate the need for incorporating either hygroscopic agents such as glycerol, or non-drying mineral oils, in order to maintain the requisite degree of fluidity demanded of an anti-dimming composition. Furthermore, they are non-injurious to the surfaces over which they are filmed and do not damage textile fabrics on which they may be spilled.

They are non-toxic, non-irritating and possess a bland odor. Since they are neither acid nor alkaline, they do not etch or spoil the surfaces of glass, cellulose nitrate, cellulose acetate, acrylic or vinyl resins, ethyl cellulose, Cellophane, Pliofilm, Koroseal, or other synthetic resins or plastics. Their low surface tension causes them to spread well over all these surfaces.

ANTI-DIM (NON-FOGGING) COATINGS

Formula No. 1

Nonaethylene Glycol Mono Stearate	50
Ethylene Glycol Stearate	50

No. 2

Nonaethylene Glycol Stearate	50
Ethylene Glycol Palmitate	50

No. 3	
Polymerized Glycol Stearate	60
Polymerized Glycol Oleate	40

RUBBER

W. E. Leistner

The use of waxes in rubber is almost as old as the history of rubber compounding. It dates back to 1881, when it was first added to retard the deterioration of rubber products, which was so prevalent at that time. Strangely enough, this still constitutes its principle use in the rubber industry.

Hydrocarbon waxes are added to rubber in proportions ranging from 0.25 to 3% (based on actual rubber content) for protection against the deterioration caused by the action of light, oxygen, and ozone. This phenomenon is commonly known as sun checking or atmospheric cracking. Waxes are a very effective age resister for this type of aging, but are of no value in combatting the other factors which also cause the deterioration of rubber.

These waxes, which are usually paraffin, ceresin, and ozokerite, probably function by blooming to the surface of the rubber article, and thus forming a thin, flexible, protective film. In actual compounding practice, these waxes are added in conjunction with an antioxidant, which is usually some kind of organic amine. This greatly intensifies the protective action of the wax and constitutes the best known protection for sun checking or atmospheric cracking.

Waxes are sometimes added as softeners for rubber. Due to their slight swelling action, they cut the time required for mastication and aid in the general processing which follows the compounding of the rubber. In the calendering of highly-pigmented stocks, waxes are of definite aid.

A large amount of wax is used by the electrical wire industry in insulation compounds. Here, waxes serve the purpose of aiding in the tubing of the wire as well as improving the moisture-proofness and insulating characteristics.

Waxes are also used in molded goods, where they aid in processing and impart smoothness to the finished article. Waxes are generally used with rubber in all cases where moistureproofing is very important, such as in marine cables and water-impermeable diaphragms.

PLASTIC MOLDING

The use of waxes in plastics is entirely for lubrication purposes and this may be broken down into two phases: (1) The wax, in a plastic composition, lubricates the surface and reduces the tendency of the plastic to stick to the mold; (2) it lubricates the particles of the compound in themselves, thus reducing the friction and, consequently, increasing the effective plasticity of the molding material during its plastic stage in the mold. It is important that the wax should be at least partly compatible with the resin in order to avoid undesirable "blooming" on the surface of the molded article.

It is necessary, for convenience sake, that a wax should have a melting point above 70° C. in order that it should not become soft during the grinding operation. Mostly vegetable-type waxes have been found satisfactory for use in plastics.

More specific information as to tests whereby the wax can be chosen on its characteristics alone is not available, and until such time, as a more complete study of waxes in plastics can be made, it appears that a more or less fool-proof method of cut and try, must be used in establishing whether or not a wax is suitable as a lubricant in plastics.

METAL PROTECTION

Helen Beretvas

The protection of metals may be temporary or permanent. The permanent coating gives the final finish to the metal. For this purpose, waxes play a small part only, when compared with the use of other well established materials such as lacquers and varnishes. In temporary coatings, however, waxes are widely used.

The temporary coating should stay on the metal as long as required and wash off readily with inexpensive solvents, without leaving stains or rust on the metal surface. It must be resistant to chemical influences and protect the metal under any condition.

There are many reasons that make waxes ideal materials in metal protection. They give a water-insoluble, continuous, smooth film, thick or thin as required. The wax film is not only water-insoluble but also water-repellent, hence keeping away one of the most dangerous factors in causing corrosion. The coating medium is in permanent contact with the metal surface, therefore, it is essential that materials, used for this purpose, shall exert the least possible effect on metals. Due to their chemical character, waxes, with low acid numbers (not far from O), will not attack metal surfaces by forming any kind of chemical compounds. This is true of natural and synthetic waxes as well as similar petroleum products.

Besides the above mentioned characteristics, waxes also have other properties which are important for coating. They are mixable with many materials used for the same purpose which makes their use for various blends possible. Rust inhibitors of a different nature may be incorporated in waxes, increasing their protective power. Their relatively high melting point, adhesive properties, the forming of non-tacky films at ordinary temperatures and flexibility are all valuable factors in the metal-coating industry.

From the large variety of waxes, the most adequate has to be selected for each special purpose. The ready compound has usually to comply either with some official specification, or must meet the individual requirements of various machine and tool producers.

Dry and hard finishes call for hard waxes. The nature of additives, the form of applying the coating to the metal surface, and all other details must be known, before a proper wax can be chosen. Hard, high-melting-point products, like carnauba, montan, certain petroleum and synthetic waxes, will provide hard, dry coatings, easy to handle.

Low-melting-point waxes, as some paraffin waxes, will increase the smoothness of films showing high resistance to water

and weathering. They can be applied only if care in handling is assured. The danger of "fingermarks" is evident as well as the possibility of involuntarily removing some of the coating itself.

The survey of tables, dealing with the chemical and physical characteristics of waxes, facilitates selection of the proper wax or mixture for a definite purpose.

A wax, which is solid at room temperature, cannot be applied as it is. It rather should be brought from the solid form to the liquid stage by any of the available methods. This may be: Heating to temperatures above melting point; applying solvents that give a soft, grease-like consistency to the medium; taking larger amounts of solvents which bring the rust preventive into a fluid stage at room temperature. The medium prepared, in one or the other way mentioned is ready for application to the metal surface by dipping hot or cold, brushing or spraying.

For certain purposes, wax-in-water emulsions are used and are applied to the metal by dipping or spraying. The hot-dip method is used for protective waxes which are solid at room temperature. They usually consist of a wax or blend of waxes, with special rust inhibitors and, sometimes, mineral oil. The metal parts are dipped in the rust-preventive wax, heated and kept at a temperature above its melting point. Taken out from the hot dip, the metal is allowed to drain hot. The coverage will be uniform, providing good protection against corrosion.

Wax compositions of soft, grease-like or fluid consistency may be applied by brushing, cold dip, or spray at temperatures ranging from 40 to 125° F. For this purpose, waxes are usually mixed with other components containing special rust inhibitors, surface-active agents, and mineral oil. An appropriate solvent is added to the rust-preventive medium, to obtain the desired consistency. The nature and amount of solvent varies according to the materials used and the intended coating. The solvent may be a petroleum or a coal tar product. The metal dipped in, brushed, or sprayed with the waxy medium is allowed to dry by evaporation of the solvent.

Wax has a great tendency to solidify, even if dissolved in relatively large amounts of benzene or petroleum spirits. Fluid

compositions, therefore, may contain low percentages of waxes only. In such case, care shall be taken that the rust preventive is well dissolved and that it gives no sediment when standing, after it has cooled.

The use of wax emulsions, that is, of wax, suspended in a watery medium, is a new branch of this industry. Wax, if emulsified, forms a milk-like liquid homogeneous to the eye. Applying it by the dip or spray method, the emulsion adheres to the metal surface. Under an air current, the water evaporates, leaving a continuous and rather thin wax film on the metal. From small metal parts, the water can also be removed by centrifuging.

This kind of wax coating is usually applied for permanent protection of tools and metal parts. For this purpose, wax can be applied in combination with some permanent coatings of other nature as, e.g., lacquers. It is believed that wax films, not exceeding 0.001 mm in thickness, raise the protective action of lacquers and the endurance of metals considerably.

Wax emulsions are also used on painted or plated surfaces, giving the metal a hard and dry, final finish and high grade protection. A black color of finished goods is frequently preferred, therefore, wax emulsions are sometimes colored with lamp black. Such dark emulsions give black color to the finish. Finishes, obtained from wax emulsions, have a satiny wax luster which can be intensified by polishing.

Waxes are used in other permanent coatings to give the finish a dull effect. This lusterless effect is produced by diffusion of reflected light due to microscopic particles dispersed in the coating film.

Waxes may also act as emulsifiers. Oil-coated metal surfaces, exposed to excess humidity, will show more resistance to corrosion if the coating will form an emulsion. Some waxes, selected possibly from the synthetic group, can be used for this purpose. The wax incorporated in mineral oil, applied together with special rust preventives, will provide good protection to the metal surface.

The natural protective qualities of waxes, their physical properties and chemical inertness undoubtedly warrant a thorough investigation of this relatively new field of industry.

ELECTROPLATING

C. B. F. Young

In the field of electroplating, waxes are being used for: (1) Coating insulating racks so that the supporting mechanism of the plating work is not covered with the metal being deposited, (2) a "stop-off" for multicolored electrodeposits and/or bright and dull polished areas, or for polishing certain areas, and (3) insulation on anode racks used for electrolytic polishing.

In the case of rack insulation, the unit, supporting and leading the current to the work, will receive appreciable amounts of the metal being deposited, provided it is not insulated. This acts as a thief and upsets plans in specification work and can be quite expensive in the case of the deposition of noble metals.

Many designs are produced by the combination of colors of different metals or alloys. For instance, an object is plated with nickel and then certain areas are coated with a relief of some type and design. The unit is again plated with copper, for instance, and the coating removed. Thus, a red design on a white background is produced. In this procedure, which is becoming more and more important, the rack, holding the work, is made the anode in a special solution which contains, in general, the following acid radicals: Perchlorate, acetate, phosphate, sulfate, nitrate, chromate and fluorides. Being the anode, the rack material will soon dissolve, unless the metal or alloy used is insoluble in the solution (which is a rarity) or is insulated from the solution by an inert material such as wax.

The properties of a theoretical wax for plating are as indicated below:

In the first group mentioned before, the wax should have good adhering qualities, be applied easily, not chip if used at room temperature, be firm if used at boiling temperature in alkali solutions, be insoluble in most acid and alkali solutions and be insoluble in boiling trichlorethylene. In some cases, if possible, the material should be insoluble in most lacquer thinners or materials which are used to strip lacquers. This is

not essential in most cases, however. Repair work on this wax should be done easily and it should have a long life.

In the second group, the wax must have good adhering qualities in alkali cleaning baths, acid, alkali, and cyanide plating baths. The material should not chip or flake easily and must be firm at temperatures up to 75–80° C. This material should be capable of being applied and removed easily. In the case, where the wax is used to produce multi-finished, buffed surfaces, it must have good resistance to abrasion.

The last group requires that the wax should produce a rugged surface which will stand temperatures up to 80° C., without flaking or chipping when the rack is handled roughly. The material should be capable of being reapplied over old coats and must not be attacked by chemical or electrochemical oxidation at temperatures up to 80° C.

ELECTROLYTIC CONDENSERS

G. F. Coggins

Waxes are used extensively in the condenser industry. Large quantities are used (1) for potting the capacitor elements in their cases (2) for moistureproofing paper containers and (3) for seals. Smaller quantities of miscellaneous types of waxes are also used in categories outside the three listed above.

In order to understand the uses, to which the compounds are put, and to appreciate the requirements, it is best to study each application separately. Condensers vary considerably in type as well as application, and, since present-day electrical equipment may be required to operate under widely varying and sometimes extreme conditions of temperature, humidity, voltage and vibration, strange specifications are developed for waxes, and highly specialized test methods devised.

The paper tubular condenser, used so widely in all radio circuits, contains a large amount of wax and its life is dependent upon wax. This type of condenser is used in almost all electronic equipment and must operate in swampy, tropical climates such as are encountered around the Gulf of Mexico, the Dutch East

Indies, Ecuador, etc., where the humidity remains at a high level month after month, and the temperature varies over wide limits during each day. The cyclic temperature changes cause the tubular condenser to "breathe" and, unless the protection is very good, failure, due to the lowering of the insulation resistance, will result.

This type of condenser consists of a condenser "section" encased in a paper tube, having the ends plugged with wax, through which the wire terminals of the "section" protrude. The "section" is composed of dried, high-grade paper impregnated with wax or other dielectric material, such as oil. This paper is separated by alternate sheets of foil, the whole being rolled into a small round mass. Most of the sections are about the thickness of a fountain pen barrel and about one inch long. These sections are fitted into a paper tube, allowing about one quarter of an inch on either end, for filling with wax of a type called "end fill wax." The paper tube is wax-impregnated before assembly and the whole assembly is finally given an "overall dip" in moistureproofing wax.

The "end fill wax" extensively used has the following characteristics:

1.) It will withstand a "cold flow test" at 185° F. for 24 hours. This means no flow from a can full measuring 2″ × 1¾″ × 1″ stood on end.

2.) It will pour easily from a pour pot having a hole of ⅛″ diameter when the temperature is about 400° F. When small-diameter tubes are being filled, the temperature used is 375 to 425° F. and when large-diameter tubes are used, the temperature is lowered to 275 to 340° F. These temperature differences are determined by experience and are fixed so as to allow the wax to flow well into the end of the tube and to adhere to the walls and wire terminal. If the adherence is improper, moisture leakage is easy from the exterior to the interior of the unit and a weak mechanical assembly will also result.

3.) It will have a plastic range such that bubbles of air, forced out of the assembly because of expansion due to the heat of the end fill, will not freeze on the surface of the seal so as to mar the appearance.

4.) It will not be attacked excessively by mineral oil or Halowax, the two impregnation materials used in the section.

5.) It will contain no soluble chlorides or sulfates.

This wax will cost no more than about 12¢ per lb. It is manufactured by several companies and is composed largely of rosin and a filler. Use of a synthetic resin is preferred, for then better control is possible during the wax preparation. Careful control of polymerization is a critical requirement for control of the cold-flow point as well as color (tan preferred).

The "overall dip" wax is usually the same as that used for moistureproofing the paper tube. This is not necessarily so, however. This wax must have a melting point of no lower than 160° F.; (200° F. is better) and afford a high degree of moisture seal. Paraffin waxes are not suitable. Compounded waxes, containing petroleum bases and anti-wetting compounds, such as aluminum stearate, are the rule. Ceresin is too brittle and a little low in melting point, but is good for moistureproofing. The microcrystalline waxes (both yellow and white) are commonly used. They have the advantages of being clear enough in color so that printing on the tube can be seen distinctly and also of having high melting points and lack of tackiness. The moistureproofing characteristic of overall dip wax is always determined by subjecting complete condensers to life tests under 95 to 100% humidity and noting time of break down when on voltage.

The wax used to impregnate the paper of the paper tubular condenser section is generally Halowax #1001, but any wax, having a dielectric constant above 6.0, a low power factor, high insulation resistance and chemical stability, would be useful. Hydrogenated vegetable oil has been used extensively. Opal wax is also in use.

The electrolytic condenser uses wax for potting, sealing, and moistureproofing.

The potting waxes are usually pitches and many suitable compounds of this class are available. The common use is to pot the condenser element in the can. Adhesion is necessary and ability to withstand 185° F. without flow. Freedom from soluble chlorides, sulfates, and chemicals corrosive to aluminum is

required because any corrosion of the delicate aluminum connections would cause faulty operation or failure of the unit in service.

The sealing waxes are the same as those used in the paper tubular condenser, but the range of choice is larger, because larger tubes, ranging from ½ to 1⅜ in. diameter, are the rule.

Moistureproofing of paper tubes is done the same way as for paper tubular condensers, although on some cheaper assemblies, there is one notably different impregnant—paraffin wax.

Electrolytic condenser manufacturing also uses up large amounts of waxed paper, usually waxed with paraffin. This paper is used for covering benches, trays, etc., and, in general, for the handling of merchandise to prevent the contamination of component parts, which might cause corrosion in the final assembly.

Any waxes, designed for use in connection with electrolytic condensers, should be free from soluble chlorides, sulfates, and any chemicals that will corrode aluminum.

The mica condenser uses waxes for potting, moistureproofing, and also during processing. The potting "waxes," usually pitches, must have low power factor (electrical energy loss) or high "Q" and are usually not acceptable unless they can withstand 200° F. without flow and have a "Q" of 400 or better 550 kc.

Moistureproofing waxes are used to impregnate the Bakelite molded cases of the smaller type mica condensers. These waxes are similar to those used for paper tube moistureproofing. Vacuum impregnation is used to secure penetration into the molded casing. Supula wax #1254 and ceresin have been used extensively. Very good electrical characteristics are demanded for this wax.

Low-melting, highly-refined waxes of the petroleum series are used, during mica condenser assembly, to hold stacks of foil and mica elements together. After the heating of the element, the wax flows between the mica and foil sheets providing a solid mass that can be handled easily. This wax must have high insulation resistance and "Q."

High-voltage condensers use wax for filling creepage space

between parts of porcelain insulators. Such compounds must have high-voltage breakdown characteristics and be moisture-resisting. The Aroclors have been used widely, particularly #1262.

One trend is very evident in the condenser industry. It is toward the use of higher temperatures in the neighborhood of 220° F. and lower temperatures of the order of 50° F. These conditions will have to be withstood by waxes, or the condenser industry will eliminate waxes from its designs.

FRUITS AND PLANTS

M. P. Hofmann

The use of various waxes to produce water resistance or water repellency on fabrics, paper, etc., is so firmly fixed in the average mind that rarely is any other use for waxes thought of by the average person. However, the use of various waxes as a protective coating for fruits and plants has been developed recently to such an extent that many tons of waxes are now used for this purpose yearly.

Although apples and pears have been coated with wax and wax-and-rosin combinations to enhance their keeping qualities, appearance, etc., the greatest use for these coatings is found in the citrus fruit field. Oranges and limes, when coated with wax and polished, not only are much superior to the uncoated fruit in appearance, but keep better with less drying up of the skin.

Several of the best grades of Florida juice oranges ripen to a russet or greenish color. Although the fruit itself is superior to other varieties in juice content, it is unsalable because of its poor eye appeal. To remedy this difficulty, these oranges are coated with a wax to which color has been added. When this coated fruit is polished, its appearance is so improved that it compares quite favorably with the bright-colored California fruit. These coating waxes are in emulsified form and their formulation conforms, in a general way, to the "Dry-Brite" type of floor waxes. As hardness of these coatings is not particularly essential, various additions of such waxes as paraffin, montan, etc., are per-

missible. These must be used with discretion, however, as the coatings must not show any signs of "tackiness" or stickiness. Flavor or taste of the wax is not very important as the skins of the fruits are almost always removed. However, waxes with marked odors or flavors should be avoided.

For the commercial coating of large quantities of oranges, a long, shallow, wooden tank is provided. Through this runs a continuous chain which picks up the fruit and brings it out of the bath. It then moves along an inclined chute for drying. From this, it is fed between rapidly-revolving, long-haired brushes which impart the final polish, after which the fruit is packed. The waxes are manufactured and sold in concentrated form, containing as high as 50% or more wax. These are added to the bath to give it a wax content of from 6 to 10%. Color is usually added to the wax before emulsifying, but it can also be added to the bath. If added to the wax, oil-soluble colors are used, whereas certified food colors are used as additions to the bath.

A typical formulation * is as follows:

(1)	Carnauba Wax	121 oz
	Oleic Acid	37 oz
(2)	Triethanolamine	22 oz
	Water	56 oz
(3)	Montan or Paraffin Wax	48 oz

Both (1) and (2) are heated to 90° C. and combined with stirring. A dark, clear jelly-like mass results; this must be kept at 90° C. and the montan or paraffin wax added. This is stirred until the montan or paraffin wax is all incorporated into the mix; then water, which has been heated to 90° C., is added slowly with constant stirring until the desired dilution is reached. When made up to ten gallons, the above formula contains approximately 14% solids.

The addition of color depends largely on the ripeness of fruit, color of same, color desired, amount of wax used on fruit, etc., and is a matter of experiment as no formula can be given. Small additions of ammonia-dissolved shellac or Pontianac gum may be made to the formulation, the same as to floor waxes,

* This product is covered by U. S. Patents 1,943,468 and 2,057,413.

and they will be found to increase luster and diminish stickiness and "tackiness."

A similar product is manufactured for use by nurserymen for coating roses, shrubs, trees, bulbs, etc., to prevent drying out during winter dormancy and during shipment. A standard procedure formerly was to dip bulbs, dormant roses, etc., in a bath of warm paraffin wax. This method produced a thick coating which had a tendency to peel or chip off, thus rendering the stock unsightly. If the paraffin wax was heated sufficiently to get a thin coating, the stock was frequently injured by burning. By the use of wax emulsions, these troubles are eliminated and bright, clear and transparent coatings result. As these coatings are thin, they do not chip off and mar, but greatly enhance the appearance of shrubs, tubers, etc. These waxes may be applied by dipping, spraying or brushing. Fungicides, such as colloidal sulfur, etc., can be added to the wax thus serving a two fold purpose. Another use for this type of wax is in the horticultural field for coating wreaths, pine cones, etc., with these waxes in which colors, aluminum and bronze powders have been incorporated. Very beautiful effects are produced in this way.

A typical formulation * for these coatings follows:

(A)	Carnauba Wax	125 lb
	Oleic Acid	22 lb
(B)	Sodium Hydroxide	1 lb
	Triethanolamine	10 lb
	Water	30 lb

Heat both to 90° C., add (B) to (A) with rapid stirring; this forms a jelly-like mass. Add water, which has been heated to 90° C., to make up this formula to 550 lb. This mixture may be further diluted as desired.

PHOTOMECHANICS

J. S. Mertle

Beeswax, paraffin, and certain mineral waxes are extensively used in various photomechanical processes.

* This product is covered by U. S. Patents 1,943,468 and 2,057,413.

An early employment of wax, in this direction, was for the production of so-called "artificial" (factitious) negatives, or those made by engraving line designs in an opaque or non-actinic wax coating on a transparent glass plate. The image so produced can then be used as a "negative" for exposure on sensitized paper, glass, or metal.

For protection of photographic equipment, particularly dark-room benches and plateholders, used in the wet collodion process, coatings of wax or paraffin offer a surface impervious to the corrosive silver nitrate solution employed with collodion plates.

Beeswax and paraffin wax also are used for transparentizing or rendering translucent the support of paper negatives, the added transparency reducing the time of exposure of line and halftone negatives when used for contact printing in photo-lithography and kindred processes. For this purpose, the wax can be applied to the paper base with a hot iron, though a more convenient procedure is to apply a solution, consisting of one ounce of white wax dissolved in five ounces of hot turpentine.

For production of photographic prints, possessing a surface of high gloss, and for drying of rotogravure carbon tissue, after sensitization in bichromate baths, it is usual to apply the wet surface to glass or special ferrotype plates of japanned iron or chromium-plated steel. To prevent sticking of the print or tissue to these surfaces, after drying, the plates are sometimes coated with paraffin wax, using a solution of ten grains of paraffin in one ounce of benzol or carbon tetrachloride.

The use of waxes, in printing inks, is well known, but such materials also are employed in special inks for photomechanical plate-making, either because of their acid-resisting properties in photoetching methods, or because of their greasy nature, the latter a requisite in photolithography. An etching or "starting" ink, for rolling up bichromated albumen ("ink top") exposures on zinc and copper for relief halftone and line etching (photo-engraving), may consist of this simple formula:

Black Letterpress Ink	4	Thin Litho Varnish	1
Beeswax	4		

The ingredients are melted together, then thoroughly ground.

A "soft" etching ink for photoengraving comprises:

Black Litho Ink	8	Thin Litho Varnish	8
Tallow	3	Beeswax	3
Asphaltum	1		

First melt the solid ingredients, then add the litho varnish: when cool, work well with a muller on an ink slab.

A "finishing" ink for rolling up the plate prior to the final 'bite" or etching period is composed of:

Black Litho Ink	8	Rosin	2½
Beeswax	4		

Add sufficient turpentine to give desired working consistency.

Special acid-resisting inks are employed for *rolup* procedure in halftone zinc etching, the following being an indication of their composition:

Black Letterpress Ink	8	Beeswax	1½
Asphaltum	2	Turpentine	5
Rosin	1½		

The etched plate must be warmed to a proper degree before applying the ink, the contained heat then causing the applied ink to melt and run down the sides of the partially etched dots.

For staging of halftone plates during relief etching, fluid inks of acid-resisting nature are locally applied so that the remainder of the plate may be further etched to obtain correct tone values. An ink for this purpose may contain:

Asphaltum, Powdered	4	Beeswax	2
Turpentine	6	Dragon's Blood	2
Benzol	6		

Processes of "mechanical staging" have been devised for relief halftone etching on zinc and copper, such processes aiming to dispense with staging in favor of applying a waxy composition to the partially etched plate. A representative composition of this type is:

Petrolatum	8	Beeswax	8

The ingredients are melted together and enough printing ink added to impart a black color to the mixture. The final compo-

sition is rubbed into the plate, after the first (flat) etch, and the plate then rubbed with fine sawdust, leaving the middletones and shadows of the image more or less protected by a greasy layer of composition.

In the matter of etching powders, mineral waxes have been proposed as a partial substitute for natural resins, and at least one such "synthetic" powder has been offered to the American photoengraving trade.

Opaquing of images is a necessary operation in photomechanics, not only for the elimination of pinholes and other blemishes in the image, but also for partial obliteration of parts of the image, such as is sometimes required in color reproduction. A popular material, for this purpose, is that known as "turpentine opaque," containing the following:

Turpentine	2½ oz	Beeswax	40 gr
Asphaltum	¼ oz	Carbon Black	20 gr

The wax is dissolved in the turpentine by heating, after which, the asphaltum is added, finally stirring in the carbon black.

For correction of photolithographic halftone images, in color reproduction, recourse is had to dot etching procedure, wherein the halftone negative or positive is staged during etching, following along the principle of halftone relief etching. A number of solutions have been proposed for staging on plates and films, one entailing the use of wax:

Asphaltum, Powdered	50	Yellow Beeswax	15
Venetian Turpentine	20	Turpentine	150

Dissolve by heating the mixture, but do not boil off the turpentine.

In photolithography, a fluid (developing) ink is used for imparting a greasy foundation to bichromated albumen images on grained zinc and aluminum. Such inks are articles of trade, though a suitable substitute can be had from the following, all ingredients of which contain wax in some form:

Transfer Ink	4	Etching Ink	8
Black Letterpress Ink	4		

The materials are ground in sixteen ounces of oil of turpentine, to which have been added twenty drops of oil of lavender to provide a more agreeable odor to the final ink. For use, the mixture may be thinned with rectified turpentine to the consistency of heavy cream.

For inking up images on photolitho transfer paper, a stiffer ink is required, such as the following:

Palm Oil	1	Burgundy Pitch	2
Beeswax	1	Black Litho Ink	8
Asphaltum	2	Litho Varnish	2½

If desired, the ink can be thinned by working up with litho varnish.

Work can be introduced on litho plates by drawing or painting with litho crayons or tusche. A simple formula for the required grease crayon is:

Lampblack	2	Wax	4
Soap	4	Spermaceti	4

The materials are melted together and the mass then poured into paper molds in pencil form.

Like crayons, litho tusche is an article of trade, the following formula giving an idea of its composition:

Yellow Wax	2	Shellac	3
Mutton Tallow	2	Lampblack	1½
Marseilles Soap	6		

The tusche should dissolve fairly easily in distilled water, and the resulting liquid should flow freely from brush or pen. Liquid tusches are supplied commercially; they differ in principle from the above formula merely by having the materials ready dissolved in water or other solvent.

Washout solutions are preferred by some lithographers for strengthening the image or design, prior to its use on the litho press. An old formula for a washout solution is:

Asphaltum, Powdered	6	Yellow Wax	1
Mutton Tallow	3	Turpentine	40

The ingredients are dissolved in the turpentine by the aid of heat, and a thin film of the cool solution allowed to dry on the litho printing surface.

Both beeswax and paraffin wax have been suggested as damp-protectors for engraved steel plates, their presence preventing the formation of rust. Although either substance can be used separately for the purpose, some engravers prefer a coating containing equal parts of beeswax and paraffin wax, on the score that paraffin does not absorb oxygen and, therefore, retards oxidation of the stored plates.

POLISHES

Wax polishes are of two types: those made with water (emulsions) and those made with organic solvents. In both types, the water, or solvent, evaporates, after application, to leave a waxy film which is rubbed to give a polish or luster. Since one specific wax rarely gives the result desired it is usually blended with other waxes and sometimes resins or other products, to obtain certain effects. The price question often is a factor that prompts the introduction of excessive amounts of low-priced waxes (e.g., paraffin) in many polish compositions.

FLOOR POLISHES *

The cost per pound of a wax means very little because a pound of one may give 1½–2 times as much coverage as another and look just as well. Then, experience has shown that some waxes take several times as long to apply and polish as others. Again, there is a wide variation in the wearing qualities of waxes as well as in the appearance of the finished job. Some of the more subtle things, such as odor, appearance, and color weigh very heavily in selling, and may or may not add a great deal to the cost of wax. The red and yellow oil dyes, most commonly used, cost, as a rule, very little per pound of wax, and the perfumes such as alpha terpineol, oil of cassia, benzaldehyde, etc., usually add

* Faucett, *Drugs, Oils & Paints*, 64 (1935).

but slightly to the manufacturer's cost. Some plants have expensive machinery to obtain the right texture and appearance of the paste, whereas others seem to accomplish good results with hand apparatus. Waxes, such as carnauba, candelilla, or I. G., decrease cost by allowing the addition of cheaper solvents, whereas beeswax, paraffin, and ozokerite work in the opposite way.

Nearly all buyers of waxes desire a paste with a smooth or glossy surface, free from oozing solvents or cracks. Waxes of the carnauba type usually give a flat, rough, paste surface when melted in solvents and allowed to cool in cans. The adding of beeswax or ozokerite as well as high-melting paraffin and ceresin will improve the smoothness. I. G. wax is reported to produce mirror surfaces in certain combinations. Rapid cooling aids greatly in developing smooth surfaces on paste wax, and it eliminates cracking in some cases.

Yellow and orange colors seem to hold the field, no doubt, on account of the stimulating effect upon the eyes of the buyer.

Evaporation from the can depends upon the solvents used (usually benzine, distillate, and turpentine) and the solvent retention of the waxes. Ceresin, paraffin, and ozokerite are quite poor in this respect, whereas carnauba and candelilla will usually stand at the opposite "pole."

Almost any paste wax will lose solvents if it gets hot enough, and many a good wax will become soft when standing in the sun. It would be an excellent idea for wax makers to use labels which have great ability to radiate light and heat. White seems to be the best. Pastel colors could be used without increasing heat absorption materially, and yet lending sales appeal to the product. The use of too much very volatile petroleum thinner will cause wax to form deposits around the lid of the can. Allowing the melted waxes and their solvents to cool too slowly will often cause a granular texture which "bleeds" out solvents badly. Too large a percentage of volatile solvent also produces this defect, whereas the non-crystalline waxes, as a rule, tend to prevent it.

The odor of a wax is very important in retail sales. The perfume chosen should arouse ideas of cleanliness, luxury, etc. A mixed perfume will, no doubt, please the largest number of

people. One should avoid perfumes which are used in cheap soaps, etc., on account of the suggestion of cheapness which may become associated with one's product in the retail buyer's mind. The use of carefully selected petroleum solvents is necessary because there is a great difference between them as regards their odor. Some distillates and benzines smell like gasoline or kerosene, and give a suggestion of cheapness by their disagreeable odor.

The consistency of a paste wax should be such that it may be easily removed from the container with the hand and applied through a cloth. The consistency is easily controlled by increasing or decreasing the percentage of liquid ingredients.

Ease of application or spreading is improved by slow-evaporating solvents, and non-sticky waxes: carnauba, montan (candelilla is fair), ceresin, shellac wax, paraffin wax, etc.

A paste will not spread uniformly if the solvent evaporates too rapidly, or if it has too much of a resin-forming liquid, such as turpentine, in it. The selection of proper waxes, for the combination, is also vital. Beeswax and ozokerite should not be used too liberally, because of their gumminess. Carnauba, montan, ceresin, paraffin, glyceryl stearate, etc., will aid uniform spreading.

Some of the best-selling waxes dry in about five minutes after application. This may be partially accomplished by the use of 10 to 20 per cent petroleum benzine with No. 1 distillate. Turpentine may be substituted for part of the distillate, but its expense precludes the use of large quantities. It has also a tendency to reduce paste consistency. Paraffin wax, beeswax, and ozokerite are also inhibitive to rapid drying.

Carnauba and candelilla give gloss, but accomplish it more easily if accompanied by montan or ceresin, to aid uniform spreading, and beeswax or ozokerite to allow enough plasticity to the almost dry waxes so that uneven smears of dried paste may be spread out with a little rubbing. Paraffin wax also aids gloss, if just a little is used. Large amounts produce a hazy or slightly dulled surface.

For light floors, and especially linoleum, light-colored waxes

should be used, because repeated applications may darken a floor. Overheating the waxes, to combine them with the solvent, will darken the paste, especially carnauba or beeswax.

A smearproof combination will require the sparing use of low-melting paraffin wax, Japan wax, and low-grade ceresin. Slow-evaporating solvents, such as pine oil, No. 2 or 3 distillate, etc., should be very sparingly used or avoided except for special-purpose waxes. Carnauba wax, I. G. wax, candelilla, and the other hard waxes are usually quite smearproof.

A wax should not dry to a brittle surface which will powder off when used. The use of a wax such as beeswax increases toughness. Adding calcium stearate to a wax will give an apparent toughness or scratch resistance to a wax finish.

The coverage of a wax finish is improved by moderately slow-evaporating solvents, high non-volatile content, and sparing use of sticky waxes. Using lots of high-boiling solvents may make a wax spread farther, but it is likely to give such a thin film that gloss and utility will be impaired.

If a wax is free from high-boiling solvents and low-melting paraffin, too much beeswax, or ozokerite, and other soft waxes, it will aid greatly in reducing the labor of housekeeping.

Some agents, which reduce the slip on waxed floors, are beeswax, ozokerite, and, best of all, calcium stearate.

Water-spotting will be noticed in waxes containing too much beeswax. Calcium stearate will greatly improve "non-spotting."

There are waxes on the market which dry without polishing, but some of them wash off with water. This may be caused by the use of some soluble soap of caustic soda or borax. If ammonia soaps are used, the ammonia will evaporate and leave the resin or fatty acid in its original, waterproof condition. Triple-pressed stearic acid is a good emulsifying acid for use with ammonia.

The formation of a white or opaque light substance in cracks and nail holes is avoided by the use of moderately slow-evaporating solvents; but more especially by a moderately increased use of beeswax, or better still about half as much ozokerite. These waxes give a horn-like texture to dried wax finishes. A solution

of carnauba, in light petroleum thinner, will dry to a soft, porous, crumbly cake which, when broken up, forms a product similar to one type of powder polish sold for use on floors.

Some lacquers and a few other finishes will turn white under a wax finish which contains too much "non-volatile" solvent. The use of powerful solvents such as toluol or xylol may wrinkle fresh varnishes or lacquers which are long in oil. The petroleum benzines and distillate are best for all 'round use on all surfaces.

There are two well-known methods for preventing paste waxes from solidifying in layers, with the heavy or most insoluble waxes at or near the bottom. One is quick cooling, and the other is rapidly agitating the wax while cooling, in a water-jacketed kettle until the first solidification point is reached. A few seconds after this, the wax is quickly filled into cans. This transferred wax resolidifies the second and last time. The first solidification point may sometimes be seen, or it may be detected by falling of the mercury in a thermometer followed by a slight rise before the final solidification.

One should select a wax or a combination of waxes which will not partially melt when the sunlight strikes the surface on which it is placed. Surprisingly high temperatures are sometimes attained by dark surfaces when exposed to sunlight.

A very cheap wax can be made by melting 42 lb of candelilla wax and adding 22 gal of No. 1 distillate to it.

A better-grade wax is composed of: 36 lb ceresin wax; 28 lb carnauba; 26 lb beeswax; 28 gal of No. 1 distillate; 4 gal of petroleum benzine; ½ oz of alpha terpineol; yellow and red dye solutions to suit.

A wax which is especially good for old floors is as follows: 31 lb carnauba; 33 lb bleached montan; 32 lb ozokerite; 5 gal pure gum turpentine; 39 gal No. 1 distillate.

A good non-slipping wax may be made by melting: 6 lb carnauba; 6 lb beeswax; 8 lb bleached montan; 20 lb calcium stearate and thinning with 12½ gal No. 1 distillate. A liquid polish may be made by diluting any of these to about 11% of non-volatile matter by weight.

A non-inflammable polish may be made by heating 32 lb car-

nauba; 33 lb bleached montan; 22 lb ozokerite in a drum until just melted. Add 8.7 lb of stearic acid and just melt.

In a separate vessel, 25 gal of boiling water are mixed with 4 lb of triethanolamine and the whole poured, with stirring, into the wax and acid melt. Have 25 gal of boiling water in a third vessel which may be added as samples are removed and tested on a cold sheet of metal until the desired paste consistency is obtained.

SAPONIFIED SHOE CREAM *

Saponified creams offer an opportunity of cutting down manufacturing costs as well as reducing fire risks. When regarded from other aspects they are nevertheless found to involve some serious drawbacks in the absence of suitable precautions. They do not keep particularly well in very cold weather, or in metallic containers; their viscosity is relatively high, and the applied film is not so resistant as that of ordinary creams to dampness and rubbing; in course of time they are liable to render shoe leather hard and brittle. In spite of this, at first sight, formidable list of drawbacks, suitable measures can be taken to reduce them to a very large extent. It must also be recognized that these creams are more suitable than the water-free colored types for the treatment of colored leather.

Waxes can be thinned with water after partial saponification with an alkaline emulsifying agent. Owing to the variations in acid value and other properties, each wax requires separate consideration as regards its behavior on emulsification.

Carnauba wax (saponification value 83) is readily emulsified by soap, preferably rosin curd or soft soap; also by Japan wax or rosin in conjunction with potassium carbonate. In itself it is only employed in special cases, its usual function being to improve the quality of cheaper waxes. Bleached carnauba wax with the much lower acid value of 11 is more resistant to emulsification and can only be used in saponified creams in association with other, more readily emulsifiable, waxes. It finds occa-

* Kirchdorfer, *Mfg. Chemist,* 328 (Oct., 1934).

sional use in the manufacture of high-grade, snow-white creams.

Beeswax (saponification value 92) is best emulsified with potassium carbonate in very little water at boiling temperature. Excessive water in this case causes granular precipitation of the myristic acid, while soaps do not yield good emulsions. When properly carried out, saponification of unadulterated beeswax leads to perfectly homogeneous, smooth creams which do not smear during polishing, are free from tackiness, and leave behind a durable, elastic, highly glossy film.

Crude montan wax (saponification value 80) is just as popular for black saponified creams as for the solvent creams. As it is not readily saponified by alkali carbonates, it is usual to incorporate 20 to 30 per cent rosin and up to 50 per cent paraffin wax (the latter to reduce tackiness). In addition to, or in place of, the rosin, resort may be had to beeswax, carnauba wax residues, or Japan wax. Pure montan wax (acid value 77) is even more difficult to saponify than the crude wax, and the creams produced are not so glossy or homogeneous. For this reason, the addition of the waxes mentioned above is again advisable.

Rosin (saponification value 160) exercises a very favorable action upon the saponification process, in addition to improving stability and smoothness. In fact, it is almost indispensable in shoe cream compositions containing ingredients which are not amenable to emulsification.

Paraffin wax (saponification value nil) increases the body and renders the cream thinner and more uniform when rubbed; it improves water resistance, reduces the greasy, tacky nature of the soft waxes, and prevents bubble formation when the cream is being filled off. The best grade is the 50°/52° scale or block paraffin with a low oil content.

Potassium carbonate has been mentioned as a saponifying agent owing to several advantages which it possesses over the cheaper sodium carbonate. For example, when the manufactured creams are stored at low temperatures, sodium carbonate is apt to crystallize in fine needles, but potassium carbonate does not suffer from this disadvantage.

Regarding the function of soaps as emulsifiers, attention may

be drawn to a second valuable characteristic, their function as stabilizers (protective colloids).

Calculation of theoretical quantity of alkali required for saponification is a very simple matter. The saponification value of the wax (expressed in grams) is multiplied by 1.5, the result being the number of grams of technically pure 96 to 98% potassium carbonate required for each kilogram of that particular wax.

The most suitable dyes for black water creams are the alkali-resistant nigrosines.

For preservation of water creams, of the older agents by far the best is formaldehyde (formalin), while modern milder-smelling materials are represented by the hydroxybenzoic esters, such as Moldex.

Manufacture of Saponified Creams

In the most customary procedure, the so-called "two-pot process," the wax is first cautiously melted in a polished iron or enameled pot, and separate solutions of saponifying agent and dyestuff, each in about one-third of the total of water required by the formula, are kept in readiness in the vicinity. The dye solution is filtered before use if at all cloudy. When the temperature of the molten wax has fallen to 70° C., cautious additions are made of: (1) saponifying solution, (2) dye solution, (3) one-half of the remaining quantity of water. Violent foaming of the wax can be arrested by more rapid addition of the solutions, but slow introduction should then be resumed. Good stirring is essential from the very start of the incorporating stage, and the stirrer must be rotated in the same direction throughout the operation. If the wax is too cold before mixing begins, this will be revealed by "curdling," which can be rectified by rewarming until the mass is perfectly fluid. Perfect incorporation of all the ingredients is indicated by the absence of skin formation when the stirrer is stopped and by the absence of any change in the homogeneity of the cream.

To sample the batch, a little is placed upon a clean, dry glass plate and allowed to cool to room temperature, when it should be uniformly firm and have a smooth, delicate, and glossy sur-

face. No moisture should appear under finger pressure. A deficiency in any of these respects can be rectified by one or more of the following measures: brief boiling or warming; successive additions of potassium carbonate or soap solution (to improve smoothness); a little ammonia; some Japan wax, semi-saponified rosin, olein, or stearin (to promote binding power and uniformity). Stirring should be avoided as far as possible during these corrective measures in order to reduce foaming. Bubbles can be avoided either by incorporating 1% of spindle oil (although it reduces surface gloss somewhat) or by reducing the height through which the warm mass falls into the jars during filling-off. The temperature for the latter operation is much less critical than in the case of unsaponified creams. In general, the lowest practicable temperature is desirable, and the tins should only be sealed after complete cooling, which may take 24 to 48 hours.

PRINTING INKS

C. R. Bragdon

Waxes have long been used in printing inks as means of controlling their working and drying properties, and to improve scratch-resistance. On account of their tendency to build up a flocculated structure within the vehicle, they promote "shortness," and aid the production of sharp, clear-cut impressions from the type or other matter, without fuzziness such as may result when the ink is too "long" and stringy, or has too much penetration. The effects produced are out of all proportion to the minute amounts required, ranging from fractions of a per cent up to a maximum of about 3%.

The animal and vegetable waxes were first used in this way, and beeswax, candelilla, carnauba and Japan waxes are still used for this purpose. Beeswax improves the lifting properties of process inks, preventing crawling. Carnauba, on account of its hard, brittle nature (its melting point being higher than that of any other common natural wax), its solubility for organic

dyes, and its ability to absorb mineral oil, almost as a sponge takes up water, has a unique place among the ink maker's raw materials which very few others, either natural or synthetic, can quite fill.

When the cheaper waxes derived from petroleum became available, they were found to have other useful characteristics which adapted them for an even wider market, and paraffin wax now enters into a greater variety of formulations than any other. Both the refined and microcrystalline types have been used. The crystalline paraffins are almost insoluble in litho varnish vehicles used in usual typographic and litho inks, etc., and a sort of granular layer forms on the surface of such inks on standing, for a short time, in the can. This is less noticeable when the microcrystalline type is used, but these waxes are often stickier, and do not impart as much scratch-resistance.

Another use of paraffin wax, not as common now as it was before the advent of the modern heat-set inks, is as an anti-offset spray. Linseed-base magazine inks require some hours to dry thoroughly, especially where several layers are built up, as in four-color process work, and to permit the paper to be rolled up or stacked quickly without making an impression on the back of the facing sheet. Here, a mist of molten wax is sprayed over the print as it emerges from the impression rolls. This wax solidifies before it reaches the paper, so that the droplets do not coalesce but remain as a cushion of fine solid spheres to hold the surfaces apart by an infinitesimal distance, preventing offset and permitting oxygen to reach the ink to complete its drying. Such an expedient is unnecessary with the newer resin-solution base inks, which dry perfectly in a fraction of a second by evaporation of the solvents under intense heat. These are now used in the typographic printing of almost all magazines of national circulation.

Wool-grease or lanolin, which according to chemical composition should be classed as a wax rather than a fat, is another material which is used in inks, partly to regulate shortness and partly as a lubricant to improve the "slip" characteristics. It has more length or string than most other waxes; and when

used with paraffin, for which it has some solvent properties, it tends to prevent the crystallization and graininess above described. It is an ingredient of many "ink compounds," sold for use by the printer in adjusting the working properties of his ink to the temperature, humidity, type of paper stock, etc., for the particular job.

A patent [1] issued to Bradley in 1932 discloses the use of ½ to 2% of paraffin or ceresin wax in nitrocellulose printing compositions, to retard the evaporation of volatile solvents and thus improve the printing qualities, by forming a thin solid crust at the surface. This is similar to the action of wax in paint and varnish removers, but the claim is made that much smaller ratios of wax are effective.

A radical departure in the employment of waxes is brought out in patents [2] issued since 1938. These refer to compositions containing major proportions of wax, with resins, plasticizers and pigments, which are solid at ordinary temperatures and are applied in the molten condition, using heated fountains, distributing rollers and forms. Such inks have been developed for both intaglio and typographic printing; one metropolitan daily tabloid newspaper, of considerable circulation, uses the latter process. The ink solidifies instantaneously on contact with the cold web of paper, and prints sharply and relatively smudge-proof. Waxes are particularly well adapted for such applications because of their sharp freezing points and quick transition on cooling, from liquids of comparatively low viscosity to rigid, but usually slightly flexible solids. This is in contrast to the higher viscosity of most molten resins, and their gradual thickening through a stage of extremely high viscosity to final rigidity and even brittleness.

Wax-set inks, such as are covered in a particular modification of the Mock patent,[3] need not, and usually do not, contain

[1] Bradley, T. C., U. S. Pat. 1,884,553, Oct. 25, 1932: Composition Intended for coating, Decorating and Printing Wood, Metal, Paper, Cloth and Other Surfaces.

[2] Jones, W. L. and McLeod, E. H., U. S. Pat. 2,147,651, Feb. 21, 1939: Method of Multicolor Intaglio Printing.

[3] Mock, W. W., U. S. Pat. 2,081,949: Method of Printing.

any wax in their composition, but they are instantaneously dried by absorption of their solvents in the excess of molten wax when the printed web is passed through a bath of it, as in waxing bread-wrappers. The ink binder, which may be a cellulose ester, alkyd resin or other binding material insoluble in wax, is precipitated along with the pigment in intimate contact with the fibers of the paper. In addition to the speed gained by combining the printing and waxing operations in a single machine, a further great advantage is the freedom from odor and taste.

As new synthetic waxes are developed which combine in increasing extent the qualities necessary for successful use in inks, they will undoubtedly find a much larger market in this field. One important property possessed in unusual degree by some of these products, particularly those which are made by esterifying various fatty acids with polyhydric alcohols and those of the amide type, is that of acting as wetting agents, thus aiding the grinding and improving the degree of dispersion of the pigments.

FLUORESCENCE OF WAXES

Jack De Ment

When various waxes and wax-like substances, either natural or artificial, are placed under filtered ultraviolet light, they are often seen to fluoresce or glow strongly and characteristically. This light-emission is frequently characteristic of the substance, its chemical and physical nature, origin, manufacture, age, or previous history. In a pure material, the fluorescence may be due to specific chemical bondings or to radicals which act as light emitters or fluorophors.

Impure waxes, which fluoresce, often have a phosphor-like constitution in which the wax itself acts as a solvent or host to smaller amounts of organic, or even inorganic, impurities which act as centers of emission. Although these organo-phosphors, as they are called, have been investigated only scantily, the development of the science of fluorochemistry has come to de-

pend upon them. Anthracene, for example, fluoresces a medium blue color when pure, but the commercial product contains small amounts of chrysene which activate luminescence and cause a spectacular green glow. This can be considered to be the case for many commercial waxes and related substances which are of varying purity.

There are two important uses of the fluorescence of waxes: (1) in fluorochemical analysis, for testing waxes and wax-like materials for contamination and adulteration and (2) in the make-up of fluorescent and phosphorescent paints, pigments, inks, and other strongly glowing liquids or solids.

In the fluorochemical analysis of waxes, long wave length ultraviolet light, i.e., wave lengths approximating 3650Å, are most reliable, although at times short wave length radiation, i.e., wave lengths approximating 2537Å, has proven of value. The ultraviolet absorption by waxes and similar organic substances is greater for all practical purposes in the longer wave length regions. However, in the excitation of luminescent substances which contain waxes, and for special studies, shorter wave lengths make it possible to introduce almost twice as much energy into the system.

In testing the newly developed synthetic waxes and wax-like materials, the examination under ultraviolet light has proved a very efficient and reliable method. It is simpler and requires much less time than chemical analysis.

Although it is beyond the scope of the present discussion to list the fluorescence of all known waxes and synthetic, wax-like products, a short table will give an idea of the results which may be obtained by simple inspection of the unchanged sample, or preferably its freshly broken surface, under ultraviolet light. Some of the more important natural and synthetic waxes are listed in the accompanying table. The interested reader is further referred to books which cover this aspect of waxes, and their fluorescence under various types of radiation.[1]

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[1] Dake and De Ment, *Fluorescent Light and Its Applications;* De Ment, *Fluorescent Chemicals and Their Applications,* and Dake and De Ment, *Ultraviolet Light and Its Applications* (New York, Chemical Publishing Company, 1942).

FLUORESCENCE OF WAXES AND WAX-LIKE SUBSTANCES

Substance	Fluorescence
Ambergris	Bluish tinged
Beeswax	Bluish (variable)
Carnauba	Strong yellow
Ceresin	Strong white
Diethylene Glycol Monooleate	Strong blue
Diethylene Glycol Phthalate	Bright blue-green
Diethylene Glycol Monoethyl Ether Citrate	Bright blue
Diethylene Glycol Monoethyl Ether Phthalate	Bright blue-green
Ethylene Glycol Monolaurate	Very bright blue
Ethylene Glycol Monooleate	Bluish
Ethylene Glycol Monoricinoleate	Green-blue
Glyceryl Formal	Pale blue
Glycerin	Bluish
Glyceryl Tristearate	Bright violet-blue
Glyceryl Monostearate	Bright yellow-blue
Glyceryl Monooleate	Bright yellow-blue
Glyceryl Ricinoleate	Blue-green
Mannitol Glyceryl Monolaurate	Deep green-brown
Mannitol Glyceryl Monooleate	Bright brown-blue
Mannitol Glyceryl Monostearate	Blue-gray
Myricyl Alcohol	Blue-yellow
Myristic Aldehyde	Bluish
Myristone	Yellowish
Palmitic Aldehyde	Blue-white
Palmitone	Yellowish
Polymerized Glycol Monolaurate	Strong blue
Polymerized Glycol Dilaurate	Yellow-blue
Polymerized Glycol Phthalate	Strong pale blue
Polymerized Glycol Maleate	Blue-yellow
Polymerized Glycol Monooleate	Strong blue-brown
Polymerized Glycol Monostearate	Brown-yellow
Stearone	Blue-green
Stearic Aldehyde	Bluish
Sorbitol Triricinoleate	Green
Sorbitol Lactate	Deep blue-green
Sorbitol Tartrate	Strong yellow-blue
Zinc Palmitate	Blue-white
Zinc Sebacate	White
Zinc Stearate	Strong blue

Carnauba wax fluoresces a bright yellow color, with a faint brown mottling. In organic solvents, this fluorescence changes to milky blue or violet. In chloroform solution, it is possible, by the Radley method, to detect as little as 1% carnauba mixed with other waxy substances. Chinese wax usually luminesces a

bright white, and it has been found that coconut oil (white-colored solid) glows with a bright white color also, although a tinge of blue may be present according to the purity of the specimen.

Beeswax fluoresces variably: the English variety exhibits a brownish-yellow fluorescence with a green tinge, foreign beeswax glows a brown color which frequently shifts into the orange. White beeswax fluoresces white with blue. The chloroform solutions of most of these waxes are practically non-fluorescent.

Solution of the specimen is the best approach to reliable fluorochemical assay of wax-like substances. Often in liquid glyceryl compounds, dissolved waxes are more easily characterized on the basis of their fluorescence. The addition of paraffin, which fluoresces a brilliant blue, to ceresin or beeswax may intensify the luminescence, but the method has been found to be uncertain.

Diglycol phthalate is an interesting substance from the standpoint of its fluorescence. The solid material luminesces a strong blue color but pulverization changes the glow to a deep violet. Many other solid polyhydric alcohol esters behave in a similar fashion. Butyl carbitol palmitate fluoresces a brown-blue color. Substances such as Albacer, Yumidol, Abopon, and trihydroxymethylamine stearate, fluoresce strong lavender, blue, pale blue, and coral-brown, respectively.

The fatty acid esters of mannitol often fluoresce with brown or yellow hues, and the oleates, stearates, and palmitates often emit in the blue and green regions of the spectrum. Ricinoleates nearly always fluoresce some shade of green, although compounds, which contain organic substances of a high degree of fluorescence, may modify this to blue-green or yellow-green. In general, most glycol and glyceryl esters of fatty acids containing six or more carbon atoms are characteristically luminescent. Fatty acid esters of polyhydroxy alcohols having a high molecular weight are also fluorescent.

Mention should be made of the remarkable fluorescence noted in ambergris, the wax-like material formed in the intestinal tract of *Physeter macrocephalus*, the sperm whale, which is so valuable for fixing the odor of delicate and expensive perfumes.

Genuine specimens of ambergris examined, exhibited a strong blue fluorescence, overshadowing the original brown or tan color, and in ethanol solution, this emission is more readily observed.

As yet, the use of waxes in fluorescent paints, and similar products, is not as widespread as their properties merit. However, certain of the pure waxes and also those of a phosphor-like constitution, i.e., with a brilliant glow under ultraviolet light, find limited application in the arts, sciences, and industries.

For example, polymerized glycols possess a strong fluorescence which is usually characteristic of the material under examination. This fluorescence is not unlike that seen in many natural waxes. This means that these artificial wax-like materials might be used as substitutes for some of the uses for which natural products are generally relied upon.

In fluorescent drafting inks, and invisible hand-stamping inks, used in theatrical and police work, these fluorescent polymerized glycols should serve the purpose well. Now it is realized that fluorescent inks, and paper treated with luminescent materials, can be of utmost importance in both peace and war time for reading and writing in the dark.

Carbon is rarely depended upon as the activator in luminescent pigments, but the boric acid phosphors are a series of phosphorescent substances in which carbon acts to enhance light absorption and/or emission. The introduction of easily reducible waxes or solid glycol derivatives is suggested in lieu of the tartaric acid and other chemicals now employed.

Waxes can play an important role in making phosphorescent or fluorescent substances into paint or ink. They may serve as a vehicle or solvent when comparatively non-fluorescent, or if strongly luminescent, they may be added to alter the final hue. They may serve as media in which to grind, store, and handle inorganic phosphors which are prone to lose their luminescent qualities after comminution. They may serve as plasticizers or drying agents where the phosphor must not be acted upon over a period of months or years.

The gylcerol esters of fatty acids, for instance, are almost

always brightly fluorescent and if these substances are harmless to living tissue, they may find their way into the preparation of an important branch of cosmetics, protective creams and lotions, whose efficacy depends upon their strong fluorescence.

In protection from sunburn, especially important in tropical and semi-tropical areas, these fluorescent waxes and related materials may be incorporated into a cream or preferably a lotion, which absorbs the erythemic or burning rays (ultraviolet) in sunlight and emits the energy as harmless, visible light through degradation by fluorescence. Petrolatum, lanolin, and other such materials already play this role in protective creams, but the use of brightly luminescent substances whose efficiency is relatively high, may well supplant the formerly used substances. These waxes may be used singly or in combination. The selection of luminescent, wax-like chemicals should depend wholly upon data previously obtained by spectrophotometric study of the absorption characteristics in the abiotic ultraviolet regions.

In general, many of the fluorescent waxes, particularly those which are solid and have a high melting point and good stability in air, can be employed where a bright and characteristic emission is required. In addition to the previous examples, a few others might be cited from the many which have already developed:

Waxes can go into solutions of fluorescent dyes, e.g., uranine, dispersed over the water from life-rafts in signaling to aircraft during emergencies. They may be used in the body of compounds, in the patented processes of detecting hair flaws in metals, because of their ease of handling, inexpensiveness, and the wide choice possible in wetting power, viscosity, and homogeneity, as well as the important factor of stability to heat These substances may also be employed in the patented processes of fluorographic printing and engraving. In criminology, they might serve for tagging objects and catching thieves. In the theatrical world they can be used in fluorescent cosmetics for a wide variety of comic and weird effects.

The military applications of fluorescent waxes are very promising. These substances can find their way into cartography for

preparing luminescent maps, and, quite obviously, in intelligence work for preparing secret messages (butter and animal fats, and natural waxes have been used on occasion), for inter-tank signaling by use of ultraviolet light, in marking food, narcotics, explosives and other objects, and for fingerprinting by the methods of fluorophotography. The solid and brilliantly luminescent, wax-like materials may serve in testing gas masks, and the gas-tightness of food boxes, medicine containers, suits, etc., because of their fluorescence.

For tracing sewage, drinking water, and streams, the liquid, wax-like substances may be used, to a limited extent, when the expensive dyes are not available. The detection of mercury in the laboratory is possible by use of fluorescent wax screens and short wave length ultraviolet light. Waxes are suggested as binders and cementing agents in delicate screens used in X-ray work, where retention of crystalline structure of the inorganic phosphor is important. For vitamin and drug standards in fluorometric assay, pure liquid waxes and wax-like materials, either alone or in solution, might be employed because of their stability under continued irradiation with ultraviolet light.

For the study of minute skin structure, diseased tissue, and other surfaces, where intricate and detailed investigation is significant, fluorescent waxes used in conjunction with ultraviolet light and photography can be of considerable value.

To simulate the life-like appearance of natural tissue, some of the waxes can be incorporated into the make-up of supporting media for dentures, as well as artificial replacements for tissue burned or injured beyond repair and of unsightly appearance. The low order of brilliance presented by the fluorescence of many substances is now being employed to give a life-like luster to artificial teeth.

Petrolatum, paraffin, and a few other brightly glowing waxes and similar substances, can be used, because of their fluorescence, to provide illumination which will not violate the restricted conditions of a blackout. Examination of documents, paintings, and art objects, in laboratory practice, etc., may entail the use of fluorescent waxes or wax-like substances.

COLORING OF WAXES

Jesse Werner

In many phases of the wax field it is necessary to dye or color wax products either to make them more attractive for marketing or because the very existence of the product depends almost entirely on the fact that it is colored. Cases in point, which fall into the former category, are decorative candles, toys, and textile dressings. Examples of the latter class are floor polishes, shoe polishes, auto polishes, china marking pencils and copying papers.

Dyestuffs applicable to waxes fall into two groups, namely, those that are soluble in molten waxes and those that are insoluble. In the first case, the dye is usually dissolved in the molten wax using as low a temperature as possible, or first mixed with stearic acid or polychlorinated biphenyl (British Patent 459,797) before dissolving in the molten wax. In the second case, the dyestuff or pigment is dispersed in the molten wax or first dispersed in stearic acid and this dispersion added to the molten wax. This type of wax-insoluble dyestuff is usually more expensive than the soluble type, because it must be manufactured in a very finely divided, easily dispersible form, or else must be incorporated into the wax melt by a special procedure to give completely uniform dispersions. These pigments are, therefore, not used unless very special effects are desired. Spirit-soluble dyestuffs are sometimes also employed. They are dissolved in a minimum amount of alcohol and this solution is then mixed with an alcoholic solution of stearin. The mixture is left to set hard and is then added to molten wax in the amount necessary to impart the desired shade.

Insofar as the coloring of wax emulsions is concerned, the wax is colored in the melt or in solution with wax-soluble dyes, while the aqueous phase, before being combined with the wax melt or solution, is colored with water-soluble dyes.

Materials like decorative candles may be prepared from colored stock or from colorless stock and then coated by dipping

the object in molten colored wax for a moment and then removing. For coloring candles, pigments containing volatile poisonous compounds should not be employed. Among the pigments which should not be used for candles or for anything that will be handled such as toys, textile dressings, etc., are orpiment, verdigris, vermilion, red lead, red chrome, zinc yellow, and chrome yellow. Insoluble earth colors and also lampblack are sometimes used for the production of very cheap articles. They are brought into a very finely divided state and dispersed in the molten wax, but it is extremely difficult to get completely uniform dispersions.

Insofar as the constitutions of dyestuffs and pigments useful for coloring waxes are concerned, the structures are extremely varied. Azo dyes, not containing any strongly acidic groups, may be used and also the oil-soluble nigrosines and indulines. Complex metal salts of the mordant colors and triphenyl methane colors are sometimes employed. Various simple anthraquinone compounds are used and in cases where it is desired to render the wax fluorescent, complex polycyclic compounds of known and unknown structure (see U. S. Patents 2,123,245; 2,123,-246; 2,135,259; 2,138,381; 2,158,296; 2,163,950; 2,178,521; 2,183,629; 2,187,819) are applied.

With reference to actual dyestuffs and pigments that may be used, the following Sudans are soluble in waxes and have good fastness to light and sublimation: Sudan Yellow GRD, Sudan Red BBA, Sudan Red 4BA, Sudan Brown SBA, Sudan Corinth B, and Sudan Black BR. A general formula for making candle coatings using the Sudan colors is:

Dissolve:

0.05 g Sudan Color in a melt of
25.00 g Stearic Acid and add a melt of
75.00 g Paraffin Wax

However, where very excellent fastness to light, sublimation, and aging is required, the following Fast Candle colors are suitable: Fast Candle Yellow A, Orange A, Orange B, Red A, Blue B, Green A, Green B, and Green C. These dyestuffs are very easily dispersible pigments. The formula for their application is similar to that of the Sudans, except that a melt of 2 g Fast

Candle color with 25 g stearic acid is used for 75 g paraffin wax.

If very intense coloring effects are desired and fastness properties are not of importance, the use of the following so-called "bases" is well suited: Auramine Base, Chrysoidine Y Base, Bismarck Brown TSS Base, Rhodamine B Base, Victoria Blue BA Base, Victoria Green Base, Methyl Violet Base A, etc. These colors require the use of at least three to five times as much organic acid such as stearic acid or oleic acid in order to develop full tinctorial strength. The nigrosine and induline bases are in the same class and are of good tinctorial strength and good fastness to light.

If it is desired to produce more opaque or so-called "whiter" effects in wax objects such as candles, Herculean N Powder may be used for this purpose.

The aforementioned Sudans are suitable as dyestuffs for various types of polishes, such as floor, shoe, and auto polishes. In addition there may also be used the following: Autol Brilliant Red BND, Sudan Blue GA, Alizarine Irisol N Powder (soluble in oil), Alizarine Sky Blue B (soluble in oil), Sudan Green 4B, and Sudan Violet BR. The latter five products have good fastness to light.

For copying papers, the aforementioned "bases" may be used as well as various basic dyes, such as, Magentas, Methylene Blues, Methyl Violets, Victoria Blues, Victoria Greens, etc. For spirit-hectograph paper Crystal Violet AON Concentrated Pure and AON Supra may be used. They require special milling in the oil-wax composition in order to obtain proper dispersion.

In general, a rather wide range of wax-soluble dyestuffs and wax-insoluble pigments are available for various specialized uses and applications in the field of colored waxes and wax products. By suitable combinations of these dyestuffs, practically any desired shade may be obtained in colors that are fast to light, heat, and weather.

CARBON PAPER INK COMPOSITIONS

B. J. Staneslow

The following wax mixtures have been studied: Carnauba-montan; carnauba-paraffin; esparto-montan; esparto-paraffin; montan-paraffin.

1. Wax mixtures with maximum desirable properties for use in carbon paper manufacture range from the mixture 50% esparto–50% montan to and including 100% esparto and through 25% esparto–75% paraffin.
2. Carnauba wax contracts greatly upon cooling. This is not desirable. Mixtures of carnauba with montan or paraffin show undesirable contraction and rough surfaces. The surface is grainy and the mixtures are not homogeneous throughout.
3. Montan and paraffin waxes do not form satisfactory mixtures. Surfaces are not smooth or flat. Although montan wax itself is very hard, it is not dominant in mixtures with paraffin, which is soft.
4. Esparto wax forms good mixtures with either montan or paraffin wax. In this respect it is superior to carnauba. Alone, it has very little contraction, is less brittle than carnauba, has a scratch hardness nearly equal to carnauba, but has an appreciably lower melting point.

Mixtures of various percentages of "ink oil" #512 (a mineral oil) with carnauba, esparto, montan, and paraffin waxes:

1. The vegetable waxes (carnauba and esparto) form better mixtures with "ink oil" than do the mineral waxes (montan and paraffin). The former can combine with a larger amount of "ink oil" than the latter. Of the mineral waxes, montan seems to be somewhat soluble in the "ink oil." Paraffin is also soluble but to a lesser degree.
2. The only beneficial quality of "ink oil" in mixtures with the above waxes, is its effect in decreasing the brittleness of the waxes. The resulting mixtures are very tough.
3. Montan wax mixtures with "ink oil" show the greatest

change in scratch hardness. Although "ink oil" tends to decrease the scratch hardness progressively with increasing amounts of the oil, yet this change is most pronounced with montan wax-"ink oil" mixtures.

4. Flatness of surface is not appreciably affected by "ink oil" although 40 to 60% "ink oil" with carnauba decreases the flatness slightly while 20% "ink oil" with paraffin wax increases the flatness slightly.
5. "Ink oil" decreases the smoothness of surface of waxes. With carnauba and esparto waxes, greasy surfaces are formed due to the better combination of the wax with the oil, while with montan and paraffin waxes oily surfaces are produced. This checks with the previous statement that the vegetable waxes can combine with larger amounts of the oil than the mineral waxes.
6. "Ink oil" does not affect the graininess or pittiness of the wax surface except in amounts of 60% and up of "ink oil." In this range the graininess or pittiness is increased.
7. "Ink oil" seems to decrease contraction of the wax with increasing amounts of the oil. The exception is with esparto wax where the contraction is appreciably increased with 20 to 60% "ink oil."

The above factors indicate that the use of "ink oil" must be carefully regulated, especially with montan and paraffin waxes present. Excess amounts of "ink oil" will be brought to the surface by temperature rise or by pressure. This may explain the transfer of oil from the carbon coated sheet to the printed form.

Esparto wax holds 40 to 60% of "ink oil" satisfactorily according to the rough tests made. This is also true of carnauba wax. Montan wax will hold 20% "ink oil" while 40% is in excess. Paraffin will not hold 20% satisfactorily. These results were obtained by pressure tests.

Effect of Various Percentages of Paraffin Wax Upon Esparto-Montan Mixtures

Various percentages of paraffin wax were added to a 50% montan–50% esparto wax mixture and a 25% montan–75%

esparto wax mixture. The following observations were made:

1. The best all-around mixtures are as follows:
   a. With 50% montan–50% esparto wax, satisfactory mixtures were obtained with 100%, 125%, and 150% paraffin wax. The percentage of paraffin wax is based on the combined weights of montan and esparto waxes.
   b. With 25% montan–75% esparto wax, satisfactory mixtures were obtained with 75%, 100%, 125%, and 150% paraffin wax.
2. A minimum ratio for satisfactory mixtures exists between the paraffin wax and the montan wax.
   a. In 1a., the minimum satisfactory ratio is 2 parts paraffin to 1 part montan.
   b. In 1b., the minimum satisfactory ratio is 3 parts paraffin to 1 part montan. It is possible that 2 parts paraffin to 1 part montan might be satisfactory.
3. The mixtures become softer with increasing amounts of paraffin wax. Montan wax, being hard, exerts some influence in retarding the effect of paraffin. This is true only with smaller amounts of paraffin.
4. Small amounts of paraffin wax increase the toughness of the mixture, especially with higher montan wax content. Beyond a certain point, the changes are not so pronounced.
5. Paraffin wax does not exert any undesirable effects on the flatness of the mixture.
6. Small ratios of paraffin to montan wax decrease the smoothness of the mixtures. As a guide for this ratio, see 2a and 2b.
7. The cross section or homogeneity of the mixture is but slightly affected by the paraffin wax. In any case, it is never any greater than carnauba wax alone.
8. Small ratios of paraffin wax to montan wax greatly affect the graininess of the mixture. With 50% montan–50% esparto wax, graininess is most apparent in the ratio paraffin 1 to 1½ parts, to 1 part montan wax. With 25% montan–75% esparto wax, graininess is most apparent in the ratio paraffin 1 to 2 parts, to 1 part montan wax.

9. Paraffin wax decreases the contraction.

The above observations show that the ratio of paraffin wax to montan wax must be regulated for the best results.

Study of mixtures of dark green petrolatum with carnauba wax, esparto wax, crude montan wax and paraffin wax lead to the conclusion that:

1. Increasing amounts of petrolatum gradually decrease the scratch hardness of carnauba and esparto wax. Scratch hardness of montan wax is appreciably decreased with 20% petrolatum. Change in scratch hardness is more gradual with paraffin wax.

2. Petrolatum noticeably decreases the brittleness of waxes, especially montan wax.

3. Large amounts of petrolatum with carnauba wax decrease flatness of surface. With other waxes, flatness is improved.

4. Increasing amounts of petrolatum tend to produce a more homogeneous mass but at the same time, to increase tackiness, with gum-like characteristics.

5. Small amounts of petrolatum (about 20%) tend to increase the graininess of the surface while larger amounts have very little effect. Exceptions are carnauba wax where large amounts of petrolatum appreciably increase graininess and paraffin wax, where graininess is decreased noticeably by a large percentage of petrolatum.

6. Petrolatum decreases contraction of carnauba wax to small extent but increases that of esparto wax to same extent. No change shown with montan wax except in large amounts. No change shown by paraffin wax.

7. Mixture of 20% esparto wax–80% dark green petrolatum exhibits great glossiness.

Additions of "ink oil" to mixtures of 42.8% esparto wax with 14.3% montan wax and 42.8% paraffin wax, and 37.5% esparto wax with 12.5% montan wax and 50% paraffin wax have been studied.

1. "Ink oil" noticeably decreases scratch hardness of the above mixtures.

2. "Ink oil" decreases brittleness producing a tough material.

3. "Ink oil" has no effect on flatness of surface.

4. "Ink oil" slightly decreases smoothness of surface by form-

ing a greasy surface. This greasiness of surface increases with increasing amounts of "ink oil" and is more apparent in the latter of the two mixtures mentioned above.

5. "Ink oil" increases homogeneity in small amounts but decreases it in amounts 30% and over.

6. "Ink oil" has very little effect on graininess of surface except in large amounts, where graininess is decreased slightly.

7. "Ink oil" has no effect on contraction in small amounts but increases it in moderate amounts.

STENCILS

The most common stencils come under the heading of two types of formulae, the cellulose and the protein base. It is in the latter or protein type stencil that waxes play an important part.

The manufacture of stencils is a very exacting and delicate operation not to be attempted without exhaustive experimental work. A general procedure of operation can be broken down into the following steps: 1. Compounding of the "dope" or solution; 2. Coating of each sheet, individually; 3. Conditioning and drying; 4. Setting or hardening with a second coating; 5. Drying; 6. Trimming; 7. Aging.

The principle involved in any stencil is to coat a loose web paper, like Yoshino, with a continuous film. This film must be absolutely free from pin-holes. Beyond this, the film must be even and uniform and free from stickiness, whereas the sheet itself remains flexible. The texture must be firm enough to withstand a cutting type blow without cutting the letters out.

On examining a cut stencil, ready prepared for use, it is seen that the type, on striking, has squeezed the coating aside leaving the letter held in place by a mesh of paper fibers. Since no stain is made on the backing sheet, as a result of striking the stencil, the material has not been disposed of in the manner of ink from a carbon paper but has been broken down and pressed aside.

In discussing the relation of wax to the function of the stencil solution, it is advisable to review a general formula. This formula cannot be claimed as reliable since the very quality of the component parts may even necessitate a reformulation.

Mineral Oil	130	IG Wax S	10
Sulfonated Oil	60	Colored Pigment	25
Clay Filler	4	Gelatin	10
Stearic Acid	9	Water	300

Many of the hard waxes can be substituted in this formula; other IG waxes, crude montan, and carnauba have proved practicable. The part the wax plays in the formula is important since it is this element that adds the body to the coating. However, in order to obtain a fluid easily workable mixture, the wax must be readily emulsified through the aid of the sulfonated oil.

Wax is also an extremely important factor in producing the proper firmness and in waterproofing the dried film against atmospheric moisture.

As, in most cases, where wax is employed as an ingredient in manufactured products, advantage is taken of the peculiar but very special physical properties of this class of compounds. Since waxes are solid at room temperatures but can be liquefied readily by heat this is the most common physical characteristic required of this class of compounds. Waxes have many other special advantages over other types of materials such as ease in blending and good wetting ability.

In stencils, as in other wax formulae certain physical advantages are utilized without a thorough understanding as to what has taken place chemically.

CARBON PAPER INKS

Alan B. Olsen

There are two classes of waxes employed in carbon paper inks. The amorphous type waxes such as ozokerite, ceresin and petroleum waxes, accomplish the purpose of bodying an ink or absorbing and holding the oil vehicle. The hard crystalline waxes are the essential ingredient in carbon paper inks. These waxes hold the ink in a solid form and permit the handling of the coated papers with a reasonable amount of cleanliness.

In the manufacture of carbon paper inks and typewriter rib-

bon inks it is essential that all the ingredients be completely non-drying. Most waxes conform to this specification. Carnauba wax is particularly desirable because it gives a product with a good shine and hard finish that permits handling. A carnauba ink is usually free from stick and smudging while some of the other hard waxes do not set as hard when mixed with an oil vehicle.

Other hard waxes that can be used in carbon inks are montan, ouricury, candelilla and numerous compounded waxes sold as carnauba substitutes. There is, however, no carnauba substitute that can be used in a carnauba formula without providing proper adjustments to the ink.

The compounding of a carbon paper ink is very specialized and requires experience and familiarity with the component parts. Essentially a printing ink made with non-drying animal, vegetable or mineral oil containing a sufficiently high percentage of wax could be called a carbon paper ink. The ink, which must remain hard at room temperature, must necessarily be mixed and handled in the melted state. This is best carried out in steam jacketed equipment to prevent "burning."

A simple workable carbon ink can be made by mixing two parts of hard wax, two parts of non-drying oil, and one part of carbon black. The requirements for a good carbon paper ink are: First, the ink must be liquid with good flow so it can be smoothed out in a thin even coating on paper. If the above formula should fail to do this it may be that the color chosen has too high an oil absorption and thickens the ink, or it may be that the wax lacks the proper wetting and flow qualities. Having a flowing ink, if we let it cool, it should harden into a solid mass that will fracture. If the ink when cool is soft or pasty the results will be unsatisfactory on paper.

Better carbon paper inks are made by making the black appear blacker through the incorporation of blue or purple pigments or dyestuffs. If a dye is used, a non-evaporating and non-drying solvent must be used with it.

The amorphous waxes find their use in carbon paper inks as secondary waxes and are used in relatively small quantities to prevent the oil from "sweating" out of the ink. Other pur-

poses of these waxes are to remove the greasy feel and to prevent excessive brittleness.

The ideal carbon paper ink would be a mixture of wax and color but this is not practicable. This ink would not adhere to the paper and would flake off when the paper was bent or folded. Further, the ink would be too hard and would not write when struck by the type. It is because of this that the oil is usually used to produce a wax with softer and better adhering qualities.

Each wax has qualities that characterize it and make for specialized use in formulation. There is perhaps no other use for wax that demands so much or depends so completely on the numerous physical and chemical properties of a wax as does carbon paper ink.

Solubilities of Common Waxes Used

Carnauba wax

This wax will mix in all proportions with all oils whether of animal, vegetable or mineral origin. Whenever the amount of oil exceeds 70% of the oil-wax mixture the oil is not usually retained.

This wax mixes with most other waxes both of vegetable and mineral types in all proportions. Fatty acids act like the oils.

Resins and ethyl and nitro cellulose are miscible in some proportions but are not soluble in the wax.

Candelilla wax

This wax behaves much like carnauba in its blending and solubility qualities but will carry a smaller percentage of the oils.

Ouricury wax

Has similar qualities to that of carnauba and holds about the same amount of the oils as carnauba, but retains a somewhat harder consistency due to a certain amount of a resinous compound in its composition.

Montan wax

Has an unusually smooth curve when the oil proportions are plotted and will retain at least as high a proportion of oils as carnauba.

Ozokerite wax

Blends in all proportions with all types of oils. In carbon papers its main purpose is to increase the absorption of the oils into the harder waxes.

Esparto wax

About the same blending qualities as candelilla wax. Perhaps holding as much as 60% of the combined oil-wax mixture in oil. (40% Esparto, 60% oil.)

Wetting Qualities of Natural Waxes

The wetting qualities of natural waxes seem to be inversely proportional to their acid numbers when tested for the wetting of pigments. To explain, the lowest acid number wax will wet the most pigment with the best flow to the ink. The highest acid content will give the thickest mixture. This holds true to an acid number of about 4 but when the acid number is below this the rule does not hold.

Nypene and Piccolite resins are compatible with waxes. Mixes in carbon paper ink formulas of 4 parts of wax to 1 part of resin, with the usual mineral oil diluent, give wax-like mixes with little if any resin-like qualities. In other words, these resins are cheap partial substitutes for the more expensive natural waxes, without sacrificing the necessary wax-like qualities. If the resin is first put into solution in the mineral oil at temperatures above the melting point of the resins and then cooled down to temperatures tolerated by the waxes, formulation is quite simple and easy due to the oil-solubility of the resin.

Synthetic Wax

B.Z. wax will replace beeswax, ozokerite and ceresin in all vegetable wax mixtures. Since B.Z. wax is a little softer and

more effective in producing the necessary results it is found that a direct replacement of two-thirds of the plastic wax with B.Z. wax will give the same high-quality product with certain advantages. Among the properties improved are adhesion without chipping, better uniformity in color dispersions, removal of excessive brittleness and general surface toughening, rapid and more uniform aging.

Three years use has shown that:

1. In carbon paper ink B.Z. wax promotes retention of the oil in the wax mixture.
2. B.Z. wax will not "bloom," that is frost the surface of the carbon paper, and helps prevent that phenomenon when other materials are present that tend to "bloom."
3. Carbon paper inks containing B.Z. wax age much less than those containing beeswax, ozokerite or ceresin and do not continue indefinitely to get harder but do most of their aging in the first three days.
4. B.Z. wax cements the ink into the fibers of the paper so that more ink can be coated without flaking. Flaking is a condition where the ink chips off or cracks when the carbon paper is bent or folded.
5. B.Z. wax, being a little softer than beeswax, ozokerite or ceresin, needs a smaller quantity to accomplish its purpose; about two thirds as much.
6. B.Z. wax by itself will not improve the shine of a wax mixture in carbon paper ink but, because of better dispersion of pigment, a better finish is often obtained.
7. B.Z. wax does not increase surface stickiness as do some waxes.

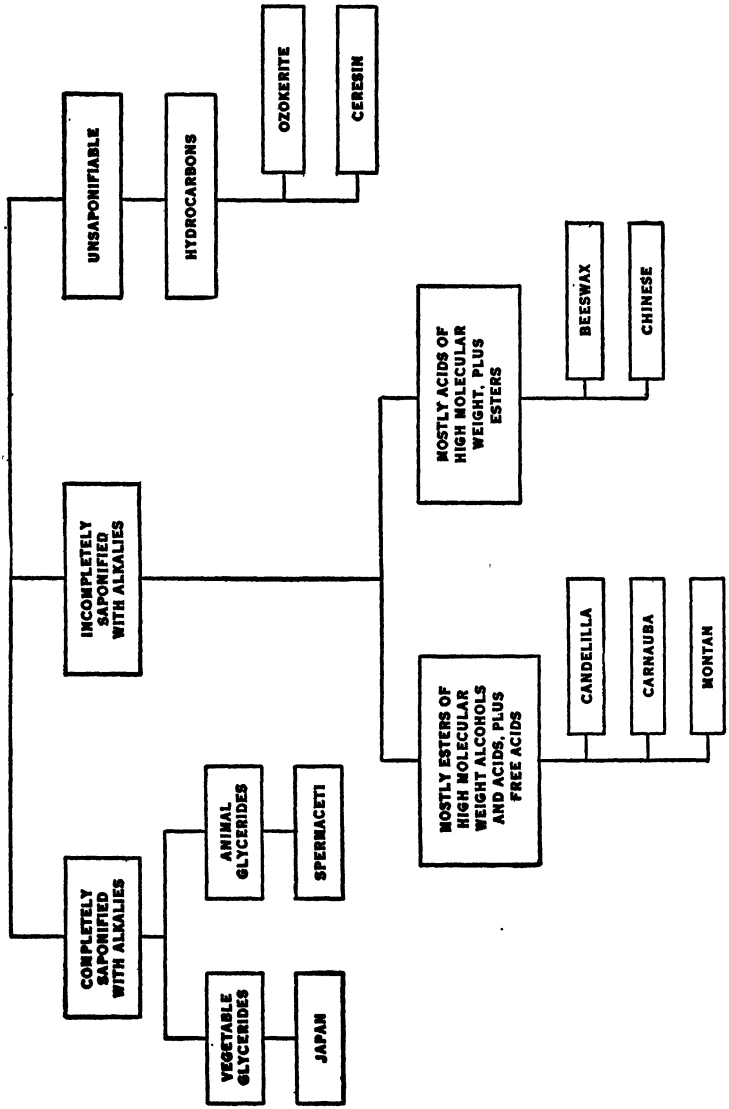
CARBON PAPER INK

	Formula No. 1	No. 2
Carnauba Wax	35	35
B.Z. Wax A	5	7
Mineral Oil, Light	37	..
Dye Solution *	3	3
Carbon Black	20	20
Petrolatum	..	35

* Dye solution

Victoria Blue B Base or Crystal Violet or Methyl Violet Base	}	1
Oleic Acid		2

TABLES AND GLOSSARY



ORIGIN AND USE OF WAXES

Wax	Type	Source	Locality of Origin	Original Color	Hardness	Commercial Grades
Beeswax	Insect	Apis Mellifica	World-Wide	Light Yellow to Dark Greenish Brown	Fairly Brittle, But Plastic When Warm	Crude; Yellow Refined; Bleached White
Candelilla	Vegetable	Euphorbia Antisyphilitica	Mexico, and Southern Texas	Dark Brown, or Brownish to Greenish	Harder Than Beeswax, Not so Hard as Carnauba	Technical
Carnauba	Vegetable	Corypha Cerifera	Brazil and South American Countries	Sulphur-Yellow or Yellowish Green	Very Hard and Brittle	# 1 Yellow; # 2 Yellow; # 2 North Country; # 3 North Country; # 3 North Country Refined; # 3 Chalky
Ceresin	Mineral	Purified Ozokerite from Lignite		Yellow or White		White; Yellow; Orange, Sold According to Melting Point Range, 130–133°, 135–138°, 140–145°, 150–160°, 160–170° F.
Insect Wax, or Chinese Wax	Insect	Coccus Ceriferus	Western China	White, Opaque, Fibrous		
Japan	Vegetable	Rhus Succedanea, Rhus Vernicifera	China, Western Provinces of Japan	Greenish, Pale Yellow or Light Brown	Hard and Brittle	Kitagumi, and Chickusan
Montan	Vegetable	Lignite	Saxony, Thuringia	Dark Brown, Brownish Black	Hard and Brittle; Conchoidal Fracture	Crude, and Bleached
Ozokerite	Mineral	Lignite	Chiefly Galicia, Tcheleken Islands; Also in Utah, Austria, Egypt, Jugoslavia, Orange Free State	Pure Yellow to Dark Brown, Greenish Brown, or Dark Amber	Varies from Quite Soft to as Hard as Gypsum	Crude; Natural Yellow; White
Spermaceti	Animal	Physeter Macrocephalus		White, Crystalline and Glistening	Very Brittle, Readily Powdered	Blocks, Cakes, Technical, U.S.P.

ORIGIN AND USE OF WAXES (*Continued*)

Wax	Containers and Weights, lb.	Special Features	USES	Other Names
Beeswax	Barrels 300, Kegs 100, Cases and Bags	Distinctive Odor	Manufacture of Wax Polishes, Furniture Polishes, Wood Polishes and Finishes; Candles; Transparent Papers; Pomades, Toilet Preparations, Cosmetics; Food Products, Chewing Gums, Sweetmeats; Adhesive Compositions; Dressing and Polishing Leather; Modeling Fruits and Flowers; Base for Plasters, etc., Engraving, Lithography; Sizing and Finishing Textiles; in Medicine	
Candelilla	Bags 150–200	Distinctive Odor	Manufacture of Leather Dressing, Furniture Polish, Shoe Polish; Candles; Cements; Varnishes; Sealing Wax; Electrical Insulating Compositions; Phonographic Records; Paper Size; Celluloid, Rubber; Waterproofing and Insectproofing Containers; in Paint Removers; Soft Wax Stiffener; Substitute for Carnauba and Beeswax	
Carnauba	Bags and Cases of Varying Weights	Characteristic Odor of New Mown Hay on Warming. Takes a Fine Hard Gloss on Rubbing with a Cloth	Manufacture of Shoe and Furniture Polishes; Lacquers, Varnishes; Phonographic Records; Carbon Paper Coatings; Hardening Candles; Leather Finishes; Electrical Insulating Compositions; Waterproofing Textiles, Wood, etc.; Inks and Ink Compositions; Mold Lubricant; Substitute for Beeswax	Brazil Wax
Ceresin	Bags	Plasticity	Manufacture of Candles; Shoe, Floor, and Leather Polishes; Antifouling Paints; Wood Polishes and Fillers; Incandescent Gas Mantles; Paper Size; Waxed Paper; Lubricating Compositions; Waxes; Figures and Forms; Toys, Dolls; Bottles for Hydrofluoric Acid; Electrical Insulations; General Size; Impregnating and Preserving Agent; Substitute for Beeswax in Crayons, Perfume Pastes, Pomades, Cosmetics, Salves, and Other Pharmaceutical Products; Matrix Compositions in Printing; Printing Forms; Rubber Mixtures; Waterproofing Textiles and Cloth, Textile Dressing	Cerin, Cerosin, Earth Wax, Mineral Wax, Purified Ozokerite

ORIGIN AND USE OF WAXES (*Continued*)

Wax	Containers and Weights, lb.	Special Features	Uses	Other Names
Insect Wax, or Chinese Wax	Bags and Barrels	Fibrous Crystalline Structure	Manufacture of Candles; Leather and Furniture Polishes; Treating Silk and Cotton Fabrics; Sizing and Glazing Papers	Insect Wax, Tree Wax, Vegetable Spermaceti, Wrongly Called Japanese Wax
Japan	Cases 224, and Other Sizes	Effloresces; Tallowy Odor	Manufacture of Furniture, Shoe, and Floor Polishes; Candles, Wax Matches; Leather Polishing and Finishing Compositions; Substitute for Beeswax	Japan Tallow, Vegetable Wax of Japan; Sumac Wax
Montan	Bags of Various Sizes	Lustrous Appearance, Bituminous Odor on Friction or Warming	Manufacture Polishing Preparations, Paints, Varnishes, Tarry Roofing Compositions, Waterproofing Paints, Shoe Creams and Polishes; Phonograph Records; Insulating Compositions; Candles; Soaps, Adhesive Pastes; Finishing Leather Goods; Increasing Hardness of Fat Compositions; Paper Sizing; to Raise the Melting Point of Softer Waxes; Substitute for Carnauba and Beeswax	Lignite Wax
Ozokerite	Bags of Various Sizes; Stands 80–100	Plasticity; A Mixture of Hydrocarbons	Manufacture of Paints, Varnishes, Wood Fillers, Wood Polishes: Candles; Lithographic and Printing Inks; Dolls, Toys; Carbon Paper, Shoe Polishes, Incandescent Gas Mantles; Pomades, Cosmetics, Pharmaceutical Ointments; Matrices in Galvanoplastic Work; Crayons, Waxed Paper and Cloth, Linen and Cotton Sizing Preparations; Electrical Insulating; Leather Finishing; Lubricant, and Sealing Wax Compositions; Process Engraving and Lithography; Electrotyper's Wax; Rubber Filler; Substitute for Beeswax, Carnauba, Ceresin	Mineral Wax, Fossil Wax, Native Paraffin Ozacerite
Spermaceti	Cases 50–60	Odor and Taste Free When Pure	Manufacture of Emulsions, Cerates; Candles, Soaps, Sweetmeats, Candies, Confectionery; Cosmetics, Ointments, Pomades, Toilet Preparations; Finishing Linens; in Medicine	Cetaceum

SOLUBILITY OF WAXES

Wax	Acetone	Alcohol	Alkalies	Benzol	Carbon Bisulphide	Carbon Tetra-chloride
Beeswax	Insoluble Cold; Soluble Hot	Soluble Hot (76° C.)	Saponi-fiable			Soluble
Candelilla		Soluble Hot (63° C.)	Saponi-fiable			Soluble
Carnauba	Insoluble Cold; Not Very Soluble Hot	Soluble Hot (82° C.)	Saponi-fiable			Soluble
Ceresin		Insoluble		Soluble		
Chinese or Insect Wax		Slightly Soluble	Saponi-fiable	Soluble		
Japan	Insoluble	Soluble Hot (76° C.)	Saponi-fiable	Soluble		Soluble
Montan		Soluble Hot (70° C.)	Saponi-fiable	Soluble		Soluble
Ozokerite		Insoluble		Soluble	Soluble	
Spermaceti	Insoluble Cold; Soluble Hot	Soluble Hot (44° C.)	Saponi-fiable		Soluble	Soluble

Wax	Chloroform	Dioxan	Ether	Hydro-genated Naphtha	Isopropyl Ether	Kerosene
Beeswax	Insoluble Cold; Soluble Hot	Soluble Hot	Soluble		Soluble	
Candelilla	Soluble Hot				Soluble	
Carnauba	Insoluble Cold; Soluble Hot	Soluble Hot	Insoluble Cold; Soluble Hot		Soluble	
Ceresin	Not Completely Soluble			Soluble	Soluble	
Chinese or Insect Wax			Slightly Soluble		Soluble	
Japan	Soluble		Soluble	Soluble	Soluble	
Montan	Soluble	Soluble Hot			Soluble	
Ozokerite			Soluble		Soluble	Soluble
Spermaceti	Soluble		Soluble		Soluble	

SOLUBILITY OF WAXES (*Continued*)

Wax	Naphtha	Toluol	Trichlor-ethylene	Tur-pentine	Xylol	Fusel Oil
Beeswax	Insoluble		Soluble	Soluble		Soluble
Candelilla			Soluble	Soluble		
Carnauba	Insoluble Cold; Soluble Hot		Soluble			Soluble
Ceresin	Soluble	Soluble	Soluble		Soluble	
Chinese or Insect Wax		Soluble	Soluble		Soluble	
Japan	Soluble	Soluble	Soluble	Soluble	Soluble	Soluble
Montan	Soluble	Soluble	Soluble		Soluble	
Ozokerite		Soluble	Soluble	Soluble	Soluble	
Spermaceti	Soluble		Soluble	Soluble		Soluble

PROPERTIES OF WAXES

Wax	Refractive Index	Specific Gravity	Melting Point ° C.	Melting Point ° F.	Direct Acid Number
Beeswax	1.4398–1.4451 at 75° C., 167° F.	0.959–0.975	62–70	145–158	16.8–20.6
Candelilla	1.4555 at 71.5° C., 160.7° F.	0.969–0.993	65–69	149–156	16
Carnauba	1.463 at 60° C., 140° F.	0.990–0.999	83–91	184–196	4–8
Ceresin	1.4415–1.4464	0.88–0.92	54–77	130–170	0
Insect Wax, or Chinese Wax		0.926–0.970	65–80	149–176	13
Japan	1.450 at 60° C., 140° F.	0.975–0.984	50–56	122–133	6, Usually Not Over 20
Montan		Crude 1.0	Crude 76–92 Dist'd. 72–77 Ref'd. 77–84	169–198 162–171 171–183	Crude 25 Dist'd. 73–85 Ref'd. 15–20
Ozokerite	1.4415–1.4464	0.85–0.95	58–100	136–212	0
Spermaceti	1.440 at 60° C., 140° F.	0.905–0.960	41–49	106–120	0.5–2.8, Not Usually Over 0.5

PROPERTIES OF WAXES (*Continued*)

Wax	Per Cent Fatty Acids	Saponification Number	Unsaponifiables, Per Cent	Ratio Number $\left(\frac{\text{Sapon. \#} - \text{Acid \#}}{\text{Acid \#}}\right)$	Iodine Number	Acetyl Number
Beeswax	46.77	88–96	52–56	3.6–3.8	8.3–11	15.2
Candelilla	29.0	46–65	74.0	4.7	14.0–36.8	
Carnauba	47.95	78–88	54–55	31	13.5	55
Ceresin	0	< 2	100	0	7–9	
Insect Wax, or Chinese Wax	51.5	80–93	49.5	29.3	1.4–2	
Japan	4–12	217–237	1.1–1.6	11–35	4–15	27–31.2
Montan	Dist'd. 56–64 Ref'd. 11–15	Crude 58 Dist'd. 75–89 Ref'd. 70–80	Crude 3.58 Dist'd. 30–45	Crude 3–3.5 Dist'd. 0–0.3 Ref'd. 3–3 5	Crude 16 Dist'd. 10–15	
Ozokerite	0	0	100	0	7.8	
Spermaceti	52–53	121–135	51–54	124	2.6–3.8	2.6

PROPERTIES OF WAXES (*Continued*)

Wax	Dielectric Constant			Effective A.-C. Conductivity (Unit = 10^{-12} Mhos CM.)			Volume Resistivity (Unit = 10^{-12} Ohms CM.)		
	Initial [a]	After Immersion [b]	Final [c]	Initial [a]	After Immersion [b]	Final [c]	Initial [a]	After Immersion [b]	Final [c]
Beeswax	2.87–2.88	3.11–3.26	2.84–2.90	45–48	70–85	56–58	5–12	0.8–1.4	7–8
Candelilla	2.38–2.49	2.50–2.62	2.45–2.56	6.0–6.4	18	9.3–9.4	> 290	> 110	> 630
Carnauba	2.66–2.83	3.84–4.19	2.82–2.83	4.9–5.3	240–300	74–75	60–120	0.3–4	270
Ceresin	2.16–2.24	2.29–2.32	2.28–2.29	< 0.37	10–12	1.1	> 290	400– > 600	> 900
Insect Wax, or Chinese Wax	2.94–2.98	3.62–3.89	2.95–2.97	125–137	189–210	120–123	1–2	0.03–0.16	1–2
Japan	2.96–2.99	3.15–3.20	2.91	9–12	33–34	13	6–7	0.40–0.75	21
Montan	2.62–2.67	2.88–3.05	2.68	29–31	45–55	25	> 290	> 270	> 610
Ozokerite	2.37–2.43	2.50–2.55	2.40–2.47	10–12	19–24	15	30–40	7–9	30–40
Spermaceti	3.60–3.75	6–17	3.74–3.89	6.0–6.6	500–100,000	10–12	3–4	0.0006–0.0003	9–15

([a]) After drying over calcium chloride; ([b]) After 6-month immersion in 3.5% sodium chloride solution; ([c]) After re-drying.

Name	Formula	Melting Point ° C.	Specific Gravity at 15° C.	Soluble in	Occurrence
Cerotic Acid	$CH_3(CH_2)_{24}CO.OH$	77.8	0.836 at 79° C.	Warm alcohol	Free in beeswax, montan wax, carnauba; also as cerotate in insect wax and carnauba.
Montanic Acid	$CH_3(CH_2)_{26}CO.OH$	83		Methyl alcohol	Free in montan wax.
Melissic Acid	$CH_3(CH_2)_{27}CO.OH$	91			Free in beeswax and montan wax.
Palmitic Acid	$C_{16}H_{32}O_2$	62.2	0.846	Alcohol; ether	As tripalmitin in Japan wax; as cetyl palmitate in spermaceti; as myricyl palmitate in beeswax.
Lauric Acid	$C_{12}H_{24}O_2$	43.5			As laurin in Japan wax.
Cetyl Alcohol	$C_{16}H_{33}OH$	50	0.810	Alcohol; ether; benzol	As cetyl palmitate in spermaceti.
Octadecyl Alcohol	$C_{18}H_{37}OH$	59		Alcohol; ether	Spermaceti.
Ceryl Alcohol	$C_{26}H_{53}OH$	79			As ceryl cerate in Chinese insect wax.
Myricyl Alcohol	$C_{31}H_{63}OH$	88		Alcohol; ether	As myricyl palmitate in beeswax, carnauba.
Anonymous Alcohol	$C_{66}H_{68}(OH)_2$	103			Carnauba wax.

Average percentage of acids in		Capric, caprole and caprylic	Lauric	Myristic	Palmitic	Stearic	Higher saturated	Ricinoleic	Oleic	Linolic	9/11 Octadecadienoic	Linolenic	Eleostearic	Clupanodonic	Acetyl Value	Degree of Unsaturation: Thiocyanate Value	Iodine Value Hanus (1 hour)	Iodine Value Wijs (½ hour)	Bromide Value
Coco nut Fatty Acid	Dist.	ca. 11.5	ca. 45.5	ca. 20	ca. 15	ca. 5	-	-	ca. 6	3-4	-	-	-	-	-	5.5-12	8-13	-	-
Cottonseed	"	-	-	-	20-26	2-3	0.5-1.0	-	35-45	30-40	-	-	-	-	-	65-70	90-100	-	-
Cotton, High Titre Fatty Acid	"	-	-	ca. 1	40-45	4-5	-	-	22-25	25-30	-	-	-	-	-	40-50	60-75	-	-
Chinawood	"	Split	Total about 2 - 3%				-	-	5-15	-	-	-	80-85	-	-	85-90	-	Over 100	About 230-240
Hailolina-D	"	Dist.	-	-	-	-	-	-	45-55	40-45	-	-	-	-	-	30-38	120-140	-	-
Empeseed	"	"	-	-	-	-	?	-	12-15	50-55	-	20-25	-	-	-	95-100	155-165	-	-
Isolina	"	"	Total about 3 - 4%				-	-	6-9	40-45	40-45	-	-	-	-	?	155-165	135-145	170-178-M
Laurie Acid (Tech.)			ca. 50	ca. 20	ca. 9	ca. 1	-		ca. 4	-	-	-	-	-	-	2-4(*)	4-6	-	-
Linseed Fatt. Acid	"	-	-	-	2.7-3.8	5.4-7.7	-	-	6-12	35-47	-	37-42	-	-	-	Below 220	180-190	-	190M
Marine (Sea)	"	Split	Total ca 15 - 25%					-	C16 30(*)	?	Containing isoleic and therapic acid (?)				?	105-110	160-170	-	?
Myristic Acid	Dist.	-	ca. 80	ca. 65	ca. 5	-	-	-	ca. 10	-	-	-	-	-	-	1-6(*)	5-10	-	-
Palm Fatty Acid	Split	-	-	1-2	35-45	4-5	-	-	40-50	8-12	-	-	-	-	+	40-50	45-60	-	-
Perilla Fatty Acid	Dist.	Total about 6.5 - 9.0 - mostly palmitic					-	-	4.0-10.5	55-64	-	14-49	-	-	-	Below 150	185-200	-	Below 60
Rapeseed	"	-	-	0-1.5	1 - 2		1-3	-	30-40	10-20	Bro-cic 45-50	1-4	-	-	-	90-95	100-109	-	4-7
Ricinoleic	"	Split	Total about 3 - 5%					84-87	7-10	1-3	-	-	-	-	155-175	86-93	87-90	-	-
Sardine	"	Dist.	Total about 16 - 23% - mostly palmitic					-	?	?	Mostly isocoric (?) acid				+	?	110-130	-	?
Soybean	"	-	-	-	6.5-10	4.2-6.1	1-2	-	22-29	50-55	-	7-10	-	-	-	80-85	128-138	-	5-11
Sunflower	"	-	-	-	3-4	2 1/2-3 1/2	1-2	-	36-40	52-56	-	-	-	-	-	78-88	125-135	-	-

AVERAGE FATTY ACID CONTENT AND CONSTANTS OF FATS AND OILS

CHEMICAL FORMULA	COCONUT	PALM KERNEL	TALLOW	LARD	PALM	OLIVE	COTTONSEED	CORN	PEANUT	SOYBEAN	SUNFLOWER	LINSEED	PERILLA	CASTOR	TUNG	WHALE	MENHADEN	SARDINE	HERRING
SATURATED ACIDS																			
CAPROIC $C_6H_{12}O_2$	0.2	Trace																	
CAPRYLIC $C_8H_{16}O_2$	8.0	3.0																	
CAPRIC $C_{10}H_{20}O_2$	7.0	6.0																	
LAURIC $C_{12}H_{24}O_2$	48.0	50.0																	
MYRISTIC $C_{14}H_{28}O_2$	17.5	15.0	2.0	1.0	1.0	Trace	0.5									8.0	7.0	5.0	7.0
PALMITIC $C_{16}H_{32}O_2$	8.8	7.5	30.0	26.0	42.5	9.0	21.0	7.5	7.0	6.5	3.5	5.0	7.5		4.0	11.0	16.0	14.0	8.0
STEARIC $C_{18}H_{36}O_2$	2.0	1.5	21.0	11.5	4.0	2.3	2.0	3.5	5.0	4.5	3.0	3.5	Trace	2.0	1.5	2.5	1.0	3.0	Trace
ARACHIDIC $C_{20}H_{40}O_2$						0.2	Trace	0.5	4.0	0.7	0.6	Trace							
BEHENIC $C_{22}H_{44}O_2$															-				
LIGNOCERIC $C_{24}H_{48}O_2$					Trace			0.2	3.0	Trace	0.4								
UNSATURATED ACIDS																			
MYRISTOLEIC $C_{14}H_{26}O_2$																1.5	Trace	Trace	Trace
PALMITOLEIC $C_{16}H_{30}O_2$																17.0	17.0	12.0	18.0
OLEIC $C_{18}H_{34}O_2$	6.0	16.0	45.0	58.0	43.0	82.5	33.0	46.3	60.0	33.5	34.0	5.0	8.0	8.6	15.0	34.0	27.0	10.0	9.0
LINOLEIC $C_{18}H_{32}O_2$	2.5	1.0	2.0	3.5	9.5	6.0	43.5	42.0	21.0	52.5	58.5	61.5	38.0	3.5		9.0	Trace	15.0	13.0
LINOLENIC $C_{18}H_{30}O_2$										2.3		25.0	46.5			Trace			
ELAEOSTEARIC $C_{18}H_{30}O_2$															79.5				
RICINOLEIC $C_{18}H_{34}O_3$														85.9					
$C_nH_{2n-8}O_2$ UNSATURATED $C_{20}H_{32}O_2$																5.0	20.0	22.0	20.0
$C_nH_{2n-10}O_2$ UNSATURATED $C_{22}H_{32}O_2$																12.0	12.0	19.0	25.0
CONSTANTS																			
SAPONIFICATION VALUE	251-264	240-250	195-200	195-200	196-206	185-200	192-200	188-193	185-192	189-194	189-194	189-196	188-197	175-183	185-195	185-195	188-193	188-193	179-194
IODINE NUMBER	8-10	16-23	35-44	50-69	48-58	74-94	100-115	116-130	83-95	124-140	120-136	179-204	185-206	82-86	160-170	110-136	148-185	170-190	130-144
TITER—°C	20-23	20-23	37-46	36-43	38-47	18-25	32-38	18-20	28-32	20-21	17-20	19-21	12-17	—	37-38	22-24	31-33	28-34	23-27

GLOSSARY

Absorption. Taking up of a gas or vapor by a fluid in which it dissolves.

Acetyl number. Number indicating the extent to which a substance may be acetylated; in fats, oils, and waxes, measure of the number of hydroxyl groups in the molecule.

Acid number. Number indicating the amount of free acids in a substance; in fats, oils, and waxes, measure of the degree of hydrolysis.

Adsorption. Taking up (concentration) of a substance on the surface of another substance in a very thin (often monomolecular) layer.

Amorphous. Non-crystalline.

Aniline point. Lowest temperature at which equal volumes of freshly distilled aniline and the material being tested are completely miscible.

Ash. Solid residue, remaining after a substance is completely burned.

Autooxidation. Oxidation that takes place only when another oxidation occurs in the same system.

Boiling point. Temperature at which the vapor pressure of a liquid equals the atmospheric pressure.

Coefficient. Factor by which a value must be multiplied to make the calculation correct.

Cohesion. Property, caused by attraction between the molecules of a substance, which prevents separation of the substance into parts when acted on by external forces.

Color, Lovibond. See Lovibond color.

Color, Saybolt. See Saybolt Color.

Combustion, heat of. Amount of heat evolved when one gram-molecule of a substance is burned in oxygen at constant volume.

Conductivity. The relative ability of a material to carry an electric current; the reciprocal of the resistance of a circuit.

Conductivity, effective A.C. Effective conductance between the opposite, parallel faces of a portion of the material having unit length and unit cross-section.

Density. Weight per unit volume, e.g., pounds per cubic foot or grams per cubic centimeter.

Dielectric constant. Reciprocal of the force of attraction between two electric charges of unit value separated by a distance of one centimeter.

Dispersion. Fairly permanent suspension of finely divided (undissolved) particles in a fluid.

Ductility. Property that permits the drawing out of a body in the direction of its length.

Edibility. Possessing food value and not harmful when eaten in normal amounts.

Elasticity. Property of recovering original shape and dimensions on removal of stress.

Emulsifiability. Ability to form an emulsion with water or other fluid.

Emulsion. Mechanical mixture of two immiscible liquids, usually milky in appearance.

Ester. Organic compound, formed by the union of alcohol and acid with elimination of water, e.g., glycol stearate.

Ester number. Difference between the saponification and acid numbers; measure of neutral fats.

Estolide. Polymer of hydroxy acids.

Eutectic. The property of a mixture or solution, that all of its components solidify or liquefy simultaneously.

Explosiveness. Tendency to enter into violent chemical reaction, evolving heat and high-speed gaseous reaction products, thus producing enormous pressure.

Fire point. Temperature at which a substance, when ignited, first burns freely after withdrawal of the ignition agent.

Flash point. Temperature at which a substance begins to give off inflammable vapors, measured under specified conditions.

Flexibility. Ability to be bent repeatedly, within limits, without cracking or breaking.

Free fatty acid. The amount of free fatty acids present in a fat, oil, or wax, measured by the acid number.

Freezing point. Temperature at which a liquid solidifies or begins to form crystals; for pure substances, the same as the melting point.

Fusion, heat of. See Latent heat of fusion.

Gelling. Formation of a gel or jelly-like substance.

Glyceride. An ester of glycerol and a higher fatty acid, e.g., glyceryl tristearate.

Hardness. Resistance of a material to external forces, e.g.,

crushing, abrasion, indentation, or scratching. Moh's scale of hardness (below) indicates hardness with 1 as softest and 10 as hardest.

1. Talc
2. Gypsum
3. Calcite
4. Fluorite
5. Apatite
6. Orthoclase
7. Quartz
8. Topaz
9. Corundum
10. Diamond

Hydrocarbon. Compound containing carbon and hydrogen only, e.g., methane, benzol.

Hydroxyl number. See acetyl number.

Hygroscopic. Tending to absorb moisture from air or other gases.

Iodine number. Number indicating the amount of iodine absorbed by a substance, expressed as a percentage of the molecular weight; in fats, oils, and waxes, measure of the unsaturated linkages present.

Kreis test. Test for rancidity (autoxidation) of oils, fats and waxes, made with an ether solution of phloroglucin and hydrochloric acid; rancid products give red or pale red color.

Lactone. Cyclic anhydride formed by splitting off one molecule of water between carboxyl and hydroxyl groups of same molecule.

Latent heat of fusion. Quantity of heat absorbed when the unit mass of a solid is changed to a liquid at constant temperature.

Length. Stringiness of a fluid when poured or when a rod is dipped into it and pulled out; proportion of oil in a varnish.

Linear expansion, coefficient of. Ratio of change in length per degree to length at 0° C.

Lovibond color. Color value given as the ratio of the three basic colors: yellow, red and blue.

Luster. Natural or artificial brilliancy or sheen.

Malcrystalline. Having non-recognizable crystal form.

Melting point, determination of.

A. Capillary method. A small quantity of a substance is heated, in a capillary tube, to the temperature at which it reaches its fluid form.

B. Ball and ring method. The aperture of a metal ring is filled with the substance, and a metal ball is placed upon it. It is heated to the temperature at which the material

softens and is forced out of the ring by the weight of the ball.

The latter method is used for substances having no definite melting point, but softening before melting. Values obtained by the two methods differ from each other.

Molecular weight. The sum of the weights of the atoms of a molecule.

Monoclinic. Crystal type having two of its three unequal axes perpendicular to the third and oblique to each other.

pH. Hydrogen ion concentration; a measure of alkalinity or acidity of a solution or dispersion. A pH of 7 is neutral. Values above 7 are alkaline; values below 7 are acid.

Penetration. Method of expressing the hardness of a solid by the depth to which a loaded needle penetrates under standard conditions of load, time, temperature, etc.

Plasticity. Property that permits permanent alteration of shape and/or size by slight stress and without rupture.

Poisson's ratio. Ratio of the transverse contraction, per unit of a material forming a bar of uniform cross-section, to its elongation per unit length when acted upon by tensile stress.

Polenske number. Number of cubic centimeters of 0.1 N alkali, used in titrating water-insoluble, volatile acids from 5 g of fat, wax, or oil.

Refractive index. Ratio of the velocity of light in vacuum to that in the substance being tested.

Reichert-Meissl number. Number of cubic centimeters of 0.1 N potassium hydroxide used to neutralize the water-soluble, volatile acids liberated from 5 g of oil; fat, or wax under specified conditions.

Resin. Semi-solid or solid mixture of complex organic compounds having no definite melting point; insoluble in water, but soluble in certain organic solvents. Resins may be of natural origin, e.g., rosin or ester gum, or synthetic such as phenol-formaldehyde or alkyd resins.

Resistivity, volume. Reciprocal of conductivity, measured by the resistance of a body of unit cross-section and of unit length at 0° C.

Rhomboid. Parallelogram whose opposite sides and angles are equal, but the adjoining sides and adjacent angles are different.

Saponification number. Milligrams of potassium hydroxide necessary to completely saponify one gram of a particular fat, oil, or wax.

Saybolt Color. Color value measured by the Saybolt colorimeter.

Setting point. Temperature at which a melted wax stops flowing when acted on by a small, definite pressure under certain conditions; temperature of solidification.

Solubility. Degree to which a substance will dissolve in a particular solvent, usually expressed as grams dissolved in 100 grams of solvent.

Specific gravity. Ratio of the weight of any volume of a substance to the weight of an equal volume of water at 4° C. The specific gravity of water at 4° C. is 1.

Splitting. Decomposition of glycerides by hydrolysis.

Stability. Property of a substance to remain substantially unaltered over a certain period of time.

Structure. Relative arrangement and organic union of particles in a material; crystalline or amorphous.

Surface tension. Tendency of the surface of a liquid to contract to the smallest possible area.

Sward hardness. Hardness measured by the number of oscillations of the Sward hardness rocker on a polished plate glass surface coated with the material to be tested.

Tack. Stickiness or tendency to adhere.

Tenacity. Resistance to breakage under the action of stress.

Tensile strength. Longitudinal stress per unit cross section required to break a specimen; measured, e.g., in pounds per square inch.

Thermoplastic. Capable of becoming plastic on heating.

Thermosetting plastic. One that irreversibly hardens under the action of heat.

Titer (titre). Solidification temperature of a mixture of fatty acids and unsaponifiable matter, obtained by saponifying, acidulating, and washing the water-insoluble fraction of fats and oils.

Toxicity. Harmful physiological effects of a substance.

Transition point. Temperature at which two crystalline forms of a substance are in equilibrium with each other.

Triclinic crystal. One having three unequal axes intersecting obliquely.

Unsaponifiables. Residue extracted from the alkaline solution, after complete saponification of a fat, oil, or wax.

Vapor pressure. Pressure of any vapor above its liquid or solid form, at the temperature at which equilibrium is established.

Viscosity. Resistance offered by a fluid to flow, resulting from the combined effects of adhesion and cohesion.

Viscosity, Saybolt. Viscosity measured by the number of seconds required for a sample to pass through a standard orifice in a Saybolt viscosimeter under certain conditions.

CHAPTER VII

WAX FORMULARY

This section includes formulas for many commercial and laboratory products in which all types of waxes are used. These formulas should be useful as starting points and are given without any warranty or liability.

Wherever source references are not given, the formulas have been taken from The Chemical Formulary, Volumes I, II, III, IV, V, and VI edited by the author or from the author's private laboratory records.

ADHESIVES

Adhesive for Tissue Paper to Aluminum

For geological survey and other types of map work, base maps are very often printed on thin sheets of aluminum. Topographic maps of this type require the names of rivers, towns, etc., to be printed on thin tissue paper which is then fastened to the base map at the proper spot by an adhesive. It is very important in work of this kind that the tissue paper does not tear off, become wrinkled or discolored, so that photoreproduction is not made difficult or impossible.

Flexo Wax C Light	40 g
Turpentine	57 cc

The wax is melted in a porcelain dish, the turpentine is added and the solution mixed well and bottled. It solidifies on cooling, forming a tacky wax which can be remelted for use.

Laminated Glassine Paper Cement or Binder

U. S. Patent 2,098,221

Paraffin Wax (m.p. 155° F.)	40–63%
Rosin	20–45%
Rubber	3–12%
Petrolatum	7–13%

The rubber is softened in a mill and the petrolatum is worked in and heat applied while mixing. Then add this while mixing to the melted wax and rosin.

Waterproof Paper Board Adhesive

Canadian Patent 358,953

Petroleum wax 75 g and ester gum 15 g are heated to 200° F., and 10 g of coumarone resin is added; the temperature is gradually raised to 285° F. until all the solids have disappeared, and the solution cooled to 240° F. to separate the resin as a colloidal suspension, spread in sheet form upon a sheet of paper or as the bond between plies of cardboard.

Adhesives for Tapes

Formula No. 1

Manila DBB	40
Solox (Anhydrous Alcohol)	65
Butanol	65
Paraffin Wax	25
Oleic Acid	6
Triethanolamine	2

Dissolve the manila DBB in solox and butanol. Heat this solution to 85° C. and hold it at that temperature throughout the process.

Heat the paraffin and oleic acid until they are molten and homogeneous. Add the triethanolamine with stirring. Add this mixture to the warm solution of manila DBB slowly and with continued agitation. A paste forms.

No. 2

Manila DBB	40
Solox (Anhydrous Alcohol)	65
Butanol	65
Ozokerite	25
Oleic Acid	6
Triethanolamine	2

Dissolve the manila DBB in solox and butanol. Heat this solution to 85° C. and hold it at that temperature throughout the process.

Heat the wax and oleic acid until they are molten and homogeneous. Add the triethanolamine with stirring. Add this mixture to the warm solution of manila DBB slowly and with continued agitation. A paste forms.

No. 3

Manila DBB	40
Solox	65
Butanol	65
Carnauba Wax	25
Oleic Acid	6
Triethanolamine	2

Dissolve the manila DBB in solox and butanol. Heat this solution to 85° C. and hold it at that temperature throughout the process.

Heat the wax and oleic acid until they are molten and homogeneous. Add the triethanolamine with stirring. Add this mixture to the warm solution of manila DBB slowly and with stirring. A paste forms.

No. 4

Manila DBB	40
Solox (Anhydrous Alcohol)	65
Butanol	65
Japan Wax	25
Oleic Acid	6
Triethanolamine	2

Dissolve the manila DBB in solox and butanol. Heat this solution to 85° C. and hold it at

that temperature throughout the process.

Heat the wax and oleic acid until they are molten and homogeneous. Add the triethanolamine with stirring. Add this mixture to the warm solution of manila DBB slowly and with stirring. A paste forms.

No. 5

Manila DBB	40
Solox (Anhydrous Alcohol)	65
Butanol	65
Beeswax	25
Oleic Acid	6
Triethanolamine	2

Dissolve the manila DBB in solox and butanol. Heat this solution to 85° C. and hold it at that temperature throughout the process.

Heat the wax and oleic acid until they are molten and homogeneous. Add the triethanolamine with stirring. Add this mixture to the warm solution of manila DBB slowly and with stirring. A paste forms.

No. 6

Manila DBB	40
Solox (Anhydrous Alcohol)	65
Butanol	65
Crude Montan Wax	25
Oleic Acid	6
Triethanolamine	2

Dissolve the manila DBB in solox and butanol. Heat this solution to 85° C. and hold it at that temperature throughout the process.

Heat the wax and oleic acid until they are molten and homogeneous. Add the triethanolamine with stirring. Add this mixture to the warm solution of manila DBB slowly and with stirring. A paste emulsion forms.

No. 7

Manila DBB	20
Solox (Anhydrous Alcohol)	15
Butanol	15
Montan Wax	12½
Toluol	37½

Dissolve the manila DBB in the solox and butanol. Dissolve the montan wax in the toluol. Add the wax solution to the manila solution.

No. 8

Manila DBB	20
Solox (Anhydrous Alcohol)	15
Butanol	15
Japan Wax	12½
Toluol	37½

Dissolve the manila DBB in the solox and butanol. Dissolve the Japan wax in the toluol. Add this solution to the manila solution.

Wood Laminating Adhesive

U. S. Patent 2,290,833

Microcrystalline Wax	10
Rosin	13
Oxidized Asphalt	77

Cement, Linoleum and Tile

1. Sicaseal	82
2. Paraffin	9
3. Glycerin	9

Heat 1 and 3 to 80° C. and add 2, which has been melted, to

it slowly with vigorous stirring until emulsified.

Cement for Stone and Leather, Porcelain and Leather, Glass and Leather

Crude Rubber	9.1
Heavy Benzine	45.5
Japan Wax	13.6
Colophony	31.8

Adhesive Sealing Compound

(Universal)

Mix hot beeswax and Venice turpentine 1 to 1. Proportions may be varied according to needs. Can be colored if desired. This is very good to temporarily attach glass to iron or wood.

Cement for Glass or Metal

The following composition has a very low viscosity when melted and can be pressed into a thin film which will have excellent adherence when cold:

Piccolyte Resin	5
Paraffin Wax	95

Wax Putty

Beeswax	4
Oleostearin	2
Turpentine	1
Venice Turpentine	6

Adhesive to Join Metal to Glass or Wood

Formula No. 1

Black Pitch	3
Rosin	10
Yellow Wax	5
Powdered Brick	3

Formula No. 2

Tar Resin	85
Plaster	10
Venice Turpentine	8

Pipe Jointing

U. S. Patent 2,059,403

White Lead	15
Linseed Oil	15
Paraffin Wax	400

Turners' Cement

Used by model makers for mounting sheet brass on lathes.

Rosin	1
Melt and add	
Pitch	¼

Shellac-Wax Cement for Laboratory Use

Rosin	35
Shellac	20
Beeswax	15
Talc, Fibrous	0 to 30

Melt the rosin in a 6 inch hemispherical iron pan, add the shellac and beeswax with stirring, and heat the mixture over a hot gas flame, so that the temperature reaches 360° C. in about six minutes. At once, allow to cool spontaneously to about 275° C., add the talc, if desired, cool to about 90° C., and stir well as the mixture becomes viscous. Molds must be scrubbed thoroughly with household washing powder and water, rinsed and then coated with very thick, smooth dextrine-water paste. When the cement mixture, well stirred, is almost too viscous to flow, pour into molds. The talc gives a broad apparent

melting range; that is, when as much as 30 grams talc is used, the cement when heated gradually softens to a highly viscous condition which is serviceable where a sort of plastering operation is desired by the user. If the time of heating of the mixture is too short, the cement is brittle; if too long, an excessive amount (over 20 g) disappears in the process.

"Boltwood Wax"

(For cementing physical instruments)

Shellac	40
Rosin	72
Venice Turpentine	8
Beeswax	60
Talc, Dry	16
Tin Oxide, Dry	16

Melt the rosin, add the shellac. Heat to 200° C., add the Venice turpentine and beeswax. Heat the mixture strongly with stirring until it ignites spontaneously. Let it burn until the total mass has shrunk to about 40% of its original weight, then add the talc and tin oxide. This gives a tough, smooth, waxy cement easily handled on certain delicate instruments.

Heat Sealing Adhesives

U. S. Patent 2,290,563

	Composition of Hot-Melt in Percentage by Weight					Properties		
							Heat-Sealing Properties	
Formula No.	Ethyl Cellulose	Hydrogenated Rosin	Ester Gum	12-Hydroxy Stearin	Paraffin Wax M.P. 136° C.	Block Test	Melt to Melt	Melt to Paper
1	20	15	..	10	55	Satisfactory	Very good	Good
2	20	15	10	5	50	"	" "	"
3	20	15	..	15	50	"	" "	Very good
4	20	15	5	5	55	"	Good	" "
5	15	15	..	10	60	"	Poor	Good
6	15	20	..	25	40	Poor	Fair	Fair

Heat Sealing Adhesive

No. 7

U. S. Patent 2,054,112

Paraffin Wax	70–94
Crepe Rubber	30– 6

Mill together in a heated heavy-duty mixer until uniform and of desired consistency. Apply hot to paper or cloth and allow to set.

No. 8

Canadian Patent 395,145

Ethyl Cellulose	62.0
Alcohol	11.6
Ethyl Acetate	10.0
Dibutyl Phthalate	12.4
Carnauba Wax	4.0

No. 9

A label adhesive which dries on the labels yet is sufficiently thermoplastic to permit application to carton with a hot iron, is as follows:

Ethyl Cellulose (Low Viscosity)	20
Batavia Dammar A/E	40
Paraffin Wax	2
Toluol	116
Anhydrous Alcohol	14.5
Butyl Acetate	14.5

Bottle Sealing Wax

Formula No. 1

(First Quality)

Colophony (Rosin)	38
Turpentine, Thick	20
Paraffin in Blocks (50–52° C.)	4
Whiting	10
Barite	10
Zinc Oxide	18

No. 2

(Best Quality; Insoluble in Alcohol)

Carnauba Wax	30
Beeswax	20
Paraffin in Blocks (50–52° C.)	20
Whiting	4
Barite	10
Chrome Orange	16

No. 3

(Second Quality)

Colophony	30
Turpentine, Thick	22
Scale Paraffin Wax	6
Whiting	12
Barite	12
Chrome Yellow	18

No. 4

(Second Quality, Insoluble in Alcohol)

Montan Wax, Crude or Bleached	40
Japan Wax	10
Scale Paraffin Wax	15
Whiting	9
Barite	10
Zinc Oxide	16

No. 5

(Extra Flexible; Not Soluble in Alcohol)

Montan Wax	8
Japan Wax	20
Scale Paraffin Wax	52
Lithopone	20

No. 6

Paraffin, Scale	70
Beeswax	10
Japan Wax	17
Oil-Soluble Dye	3

No. 7

Beeswax	5
Carnauba Wax	1
Paraffin	1
Minium	5
Whiting	2

No. 8

Rosin	5
Ceresin	10
Paraffin Wax	5
Japan Wax	10
Beeswax	30
Turpentine, Venice	2

Preserve Jar Sealing Wax

Washes off easily with hot water.

Paraffin Wax	35
Trihydroxyethylamine Stearate	3

Odorless Barrel Sealer

Formula No. 1

Petrolatum, High Viscosity	70
Paraffin Wax (50–52° C.)	18
Beeswax	12

No. 2

Paraffin Wax (42–44° C.) or Petrolatum	98
Tallow, Hard-Fat, or Crude Palm Oil	2

No. 3

Rosin	66
Paraffin Wax	30
Beeswax	3
Carnauba Wax	1

No. 4

Rosin	55
Paraffin Wax	43
Beeswax	2

No. 5

Rosin	80
Paraffin Wax	20

No. 6

Shellac	4
Dammar Resin	5
Alcohol	90
Castor Oil	1

Cannot be used for wine barrels because the denatured alcohol would spoil the taste and odor of the wine.

No. 7

Rosin (F-G)	46
Paraffin Wax (50–52° C.)	48
Beeswax	4
Castor Oil	2

Melt at not more than 100° C., adding the castor oil last, at about 70° C. Pour into forms floating on a cold water bath, to avoid the sticking of the material to the forms. When a solid surface has formed the whole is dipped below the water to get quick cooling.

No. 8

Paraffin Wax (50–52° C.)	25
Linseed Oil	74
Oil-Soluble Black	0.8
Sodium Chlorbenzoate	0.2

Melt the paraffin, add the black and stir at about 85–90° C. until a clear solution has formed. Add the linseed oil in a thin jet and finally add the preservative.

Pour into cans near titer, covering the first by a second, quickly cooling layer.

Wine or Liquor Barrel Wax

Tallow	24
Paraffin	50
Japan Wax	5
Beeswax	5
Venice Turpentine	4
Rosin Oil	1
Talc	10

Brewers' Pitch

Formula No. 1

A. Rosin	160
Pale Rosin Oil	30
B. Rosin	168
Paraffin Wax	22
Linseed Oil	10

No. 2

U. S. Patent 2,122,543

(Flexible impervious lining for barrels, drums and cans.)

Ester Gum	65
Japan Wax	11
Petrolatum	24

Apply hot.

Sealing Wax

Formula No. 1

Shellac	33
Wax I. G. (O. P.)	5
Venice Turpentine	20
Talc	10
Pigment	25
Tricresyl Phosphate	5
Balsam	2

No. 2

Carnauba Wax	40
Paraffin Wax	20
Magnesia	15
Bronze Powder	25

No. 3

Carnauba Wax	30
Beeswax	20
Paraffin Wax	20
Whiting	4
Barium Carbonate	10
Pigment	16

No. 4

Rosin	30
Venice Turpentine	22
Paraffin Wax	6
Whiting	12
Barium Carbonate	12
Pigment	18

No. 5

Montan Wax	40
Japan Wax	10
Paraffin Wax	15
Whiting	9
Barium Carbonate	10
Pigment	16

No. 6

Paraffin Wax	70
Beeswax	10
Japan Wax	17
Aniline Dye	3

No. 7

Montan Wax	40
Japan Wax	10
Paraffin Wax	15
Whiting	9
Barium Carbonate	10
Pigment	16

No. 8

Rosin	34
Venice Turpentine	24
Paraffin Wax	6
Whiting	10
Barium Carbonate	10
Pigment	16

No. 9

Montan Wax	8
Japan Wax	20
Paraffin Wax	52
Pigment	20

No. 10

Rosin	30
Venice Turpentine	22
Paraffin Wax	6
Whiting	12
Barium Carbonate	12
Pigment	18

Adhesive, Mask

Beeswax	52
Lanolin	24
Venice Turpentine	15
Castor Oil	9

Adhesive for Wigs

Dammar	20
Rosin	20
Beeswax	40
Venice Turpentine	20

Heat to 90° C. and stir until uniform; cast in sticks.

Fusible Adhesive Cement

U. S. Patent 1,945,803

Chlorinated Naphthalene (Solid)	50
Ester Gum	50
Rubber Latex	5

Adhesive Wax

Rosin	100
Paraffin Wax	10
Thin Mineral Oil	88

Sticky Wax

Rosin	100
Talc	16
Lanolin	60
Paraffin	8
Saponified Wax	2

Melt together and while stirring rapidly, add slowly a boiling caustic soda solution (10° Bé.). Stir until uniform.

Waterproof Adhesive

U. S. Patent 1,965,778

Formula No. 1

Casein	100
Water	225
*Wax Solution	3

No. 2

Vegetable Protein Glue	100
Water	325
*Wax Solution	3

* Consists of:

Carbon Bisulphide	8
Carbon Tetrachloride	8
Paraffin Wax	1

Vacuum Holding Wax Adhesive

Beeswax	10
Rosin	10

AGRICULTURAL SPECIALTIES

Fly Catcher Composition

Formula No. 1

a. Crepe Rubber	8
Benzol, Benzine. Add some Dichlorethylene.	
b. Rosin	50
Mineral Oil (Sp. Gr. 0.923) (Viscosity 3½° E., 50° C.)	40
Lanolin	7
Beeswax	2
Castor Oil	2

Make rubber solution *a* and add it to the adhesive *b*.

No. 2

a. Rosin, Medium Dark or Light	6.6
b. Beeswax, Yellow	0.3
c. Crude Rubber	5.0
Spindle Oil	4.75

Melt *a*, add *b* and stir until it has melted up and mixed in—avoid overheating.

Meanwhile, prepare *c* by heating the oil to 100° C., and adding the rubber in small portions, until all of it has completely dispersed. Add this rubber solution to the melted *a* and *b*.

No. 3

Yellow Beeswax	2
Rosin	60
Rapeseed Oil	38

No. 4

Pine Resin, Refined	735
Ceresin	10
Non-Drying Fatty Oil or Mineral Oil	255

Perfume: Wax odor, honey odor or apple odor.

No. 5

Rosin	400
Pitch	200
Beeswax, Yellow	20
Rapeseed Oil	250

Bug Catcher

Colophony	60
Castor Oil	35
Ceresin	5

Tree-Bands, Insect

Rolls of corrugated paper are saturated with following and wrapped around trees.

Mineral Oil	1½ lb
Alpha Naphthylamine	1 lb
Paraffin Wax	4 oz

Caterpillar Catching Bands

Formula No. 1

a. Caoutchouc, Smoked Sheets	3
Rapeseed Oil	17
Spindle Oil	40
b. Rosin	35
Crude Montan Wax	5

Soak and peptize the rubber in the oils *a,* heat the solution and dissolve *b* in it. Stir till heavy and apply.

No. 2

a. Rosin	350
Beeswax, Yellow	10
Pitch	60
Linseed Oil	25
b. Heavy Turpentine	15

Melt *a* and thin with *b* in the absence of open flames.

No. 3

Rosin	30
Linseed Oil* Varnish	20
Beeswax, Yellow	2

The melted and well-mixed glue is put on the bark of the tree; over it put a ring of cloth, fastened with wire, then put over that again a layer of glue, all around the stock.

* Or rapeseed oil, or wool fat, when a longer catching period is desired.

Grafting Adhesives

The following formulas are for protecting the cuts made by grafting, from the action of air, sun and humidity. The adhesives used hot are more economical than those used cold but somewhat more difficult to apply.

Formula No. 1

Black Pitch	125
Rosin	500
Yellow Wax	120
Tallow	110
Sifted Wood Ash	Sufficient

No. 2

This does not flow in the sun and can be applied in all weathers.

Black Pitch	50
Yellow Wax	10
Linseed Oil	20

No. 3

Wool Fat, Neutral	22
Rosin	40
Ceresin (58–60° C.)	10
Beeswax	10
Rosin Oil	18

No. 4

Yellow Wax	12
Tallow	56
Rosin	12
Chalk	20
Castor Oil	Sufficient

Melt the wax, tallow, and rosin; stir in the chalk, and thin down with castor oil to the required consistency.

No. 5

Rosin	25
Japan Wax	10
Beeswax	25
Tallow	15
Turpentine, Venice	25

No. 6

a. Colophony	350
Beeswax	10
Pitch	60
Linseed Oil	25
Turpentine, Venice	15
b. Methanol	85

Melt up *a*, then stir until cool, add *b*.

No. 7

a. Linseed Oil	1
Turpentine Oil	4
Beeswax	3
Colophony	9
b. Methanol	1

Dissolve *a* cautiously, thin with *b*.

No. 8

Castor Oil	¼
Rosin	5
Beeswax	1
Charcoal	¾
Glyceryl Monostearate	1

Melt and apply with brush. This excludes air and fungi; prevents drying out and does not injure live tissues.

No. 9

Beeswax	1 lb
Linseed Oil	¼ pt
Rosin	5 lb
Powdered Charcoal	½ lb

No. 10

Beeswax	1 lb
Linseed Oil	½ pt
Rosin	5 lb
Fuller's Earth	½ lb

No. 11

Lanolin	22
Rosin	44
Ceresin	13
Beeswax	8
Japan Wax	2
Rozolin	9
Pine Oil	1

No. 12

Abietic Acid	5 lb
Beeswax, Crude	1 lb
Linseed Oil	¼ pt
Charcoal, Powdered	½ lb

No. 13

Rosin	5 lb
Beeswax, Crude	1 lb
Linseed Oil	¼ pt
Charcoal, Powdered	½ lb

Melt together and mix until uniform.

Wax Coating for Fruits

U. S. Patent 1,943,468

Formula No. 1

65 parts of carnauba wax and 20 parts of oleic acid are heated to 95–100° C., and, when the wax is melted, the mass is thoroughly agitated or stirred to thoroughly mix the acid into the molten wax. In another vessel 10 parts of triethanolamine and 30 parts of water are mixed and heated to 95–100° C. With both

mixtures at this temperature, the triethanolamine solution is added to the wax-oleic acid solution with rapid enough stirring to thoroughly mix the mass. As the last of the water solution is added the mass will thicken slightly and have the appearance of a clear jelly. Stirring is continued for 15 to 20 minutes, keeping the temperature at about 90–95° C. Then 35 pounds of paraffin wax, broken into small lumps, are added, and the mixture stirred for one-half hour, or until the paraffin is entirely melted and mixed through the jelly. Water heated to 90–95° C. is then added slowly with constant stirring; this clear transparent jelly dissolves in the hot water and produces an emulsion which has a decidedly bluish-white opalescence. Water is added until the total weight of the emulsion is 640 parts. The emulsion is then cooled rapidly.

This emulsion is better adapted for use in coating bananas, pineapples, and certain other fruits than for coating citrus fruits.

No. 2
U. S. Patent 2,153,487

Caustic Soda	6
Triethanolamine	20
Stearic Acid	42
Paraffin Wax	165
Carnauba Wax	55
Shellac	100
Water	2,000

Dilute above before use.

No. 3
U. S. Patent 2,275,659

Carnauba Wax	30.0
Soap	6.5
Water	260.0
Bentonite	0.3–2.6

No. 4

Carnauba Wax	30.0 g
Oleic Acid	3.3 g
Caustic Soda	0.5 g
Triethanolamine	2.7 g
Borax Shellac Solution	60.0 cc
Water	260.0 g
Bentonite	0.3–2.6 g

No. 5

Carnauba Wax	30.0 g
Oleic Acid	3.3 g
Caustic Soda	0.5 g
Triethanolamine	2.7 g
Borax Shellac Solution	60.0 cc
Water	260.0 g
Gelatin	0.3–1.3 g

No. 6

Carnauba Wax	30.0 g
Oleic Acid	3.3 g
Caustic Soda	0.5 g
Triethanolamine	2.7 g
Borax Shellac Solution	60.0 cc
Water	260.0 g
Irish Moss, Bleached	0.2–0.65 g

No. 7

Paraffin Wax	168.0
Beeswax	42.0
Oleic Acid	22.0
Sodium Bicarbonate	6.6
Sodium Chloride	2.2
Water	599.2

It is necessary that the soap be formed simultaneously with the first stage of emulsification

by the addition of the alkali, in a minimum amount of water, to a wax. These emulsions will readily coat fruits and vegetables with non-waxy surfaces; but spreading agents are necessary when they are used for waxy fruits. Alkyl naphthalenesulfonates are suitable spreading agents and also inhibit breaking of the emulsions.

No. 8

U. S. Patent 2,019,758

Paraffin Wax	553
Carnauba Wax	68
Cottonseed Oil	98
Oleic Acid	183
Triethanolamine	98
Water (Containing Soda Ash)	To suit

It is necessary that the soap be formed simultaneously with the first stage of emulsification by the addition of the alkali, in a minimum amount of water, to a mixture of fatty materials.

No. 9

U. S. Patent 1,940,530

Fresh fruit (notably citrus) is improved in appearance and made less liable to wither if a thin film of molten wax is rubbed on to the surface (e.g., 5–15% of carnauba wax in paraffin wax at 77–105° C. rubbed on for 10–30 seconds). Advantageous results are obtained if an alkaline wash has preceded this treatment.

Plant Growth Accelerator

British Patent 506,910

Bentonite	3
Water	100
Ammonium Linoleate	3
Paraffin Wax	10

To the above which has been emulsified by heating with vigorous stirring add β-indolylacetic acid to give a concentration of 1 in 300,000 parts by weight.

Defeathering Poultry

U. S. Patent 2,017,648

Burgundy Pitch	15
Montan Wax	5
Paraffin Wax	10

The ingredients are melted, thoroughly mixed, and applied to the carcass, preferably after the bird has been scalded and the bulk of the feathers that can be removed hastily have been removed by hand.

After application, the defeathering compound is permitted to solidify by cooling and is then removed, taking with it epidermal excrescences such as feathers, down, pinfeathers and the like.

MATERIALS OF CONSTRUCTION

Wood Preservative

U. S. Patent 1,890,650

Rosin	96
Wax	64
Creosote .	32
Quicklime	10
Castor Oil	1

Melt together and impregnate wood hot. This will set hard and not sweat out.

Soapstone Table Preservative

Boiled Linseed Oil	1 gal
Turpentine	1 gal
Ceresin	4 oz

Apply hot.

Cement Preservative

Chinawood Fatty Acids	10 lb
Paraffin Wax	10 lb
Kerosene	40 gal

Waterproofing for Cement Floors

U. S. Patent 2,148,113

Coal Tar	76
Rosin	10
Carnauba Wax	1
Pine Tar Oil	1
Solvent Naphtha	4
Asbestos Fiber	8

Warm together and mix until uniform. Apply hot.

Masonry Waterproofing

British Patent 413,463

Spermaceti	4
Paraffin Wax	1
Rubber	1
Mineral Spirits	25–50
Trichloroethylene	25–50

Stir until dissolved..

Acid-Proofing Creamery Floors

Paraffin Wax (150° F.)	4
Turpentine	1
Toluol	16

Warm and stir until uniform. Pour into cans and allow to "set." Spread on floor and allow to penetrate for 24 hrs. At the end of this time the residual layer should be driven into the concrete by heat. A free flame should not be used due to fire hazards; hot irons will be found safe and effective in forcing the paraffin into the pores and capillaries of the finish for some distance below the surface.

After treatment, the floor should be given a good waxing with any standard floor wax suited for this purpose. As the wax film is worn away through use, it is replaced by a fresh coating with the use of a polishing machine. This method of acid-proofing creamery floors will not change the color of the finish appreciably.

Impermeable Wall, Floor and Road Covering

British Patent 451,199

Lime	70
Rosin	15
Carnauba Wax	10
Mineral Oil	3½
Mineral Color	1½

Melt together and mix until uniform; apply hot.

Ground Wood Flooring

British Patent 521,404

Finely ground waste wood (1 l) is impregnated with paraffin wax (100–200 g) and then kneaded with 50% casein solution (300 cc) before application. An optional addition is kaolin (100–200 g) and rubber latex (600 cc).

Coating for Sand Molds for Light Metal Casting

U. S. Patent 2,045,913

Paraffin Wax	0.5–4 lb
Talc	0.5–4 lb
Carbon Tetrachloride	1 gal

Mix vigorously just before use to get a uniform suspension.

Foundry Mold (Casting) Powder

a. Limestone, Finest Powder	25	kg
b. Montan Wax, Crude, Powdered	750	g
Sudan Yellow, Oil Soluble	12.5	g
Limestone Powder	200	g

Heat *a* and *b* to 140° C. in an iron kettle until homogeneous.

Cool, grind thoroughly. Sift as fine as possible, e.g., through miller gauze.

Plaster Casting Mold

U. S. Patent 2,048,808

Japan Wax	½
Polymerized Vinyl Chloride	1
Tricresyl Phosphate	7

PROTECTIVE AND DECORATIVE COATINGS

Moistureproofing Compositions

Canadian Patent 352,183

Moistureproofing compositions consist of: Formula No. 1, paraffin 85, refined carnauba wax 10, rubber 5; (No. 2) paraffin 65, rubber 5, candelilla wax 30; (No. 3) paraffin 75, rubber 5, gum damar 20; (No. 4) paraffin 40, rubber 5, carnauba wax 40, ester gum 15; (No. 5) paraffin 60, rubber 5, carnauba wax 20, gum damar 15; and (No. 6) paraffin 55, rubber 4, candelilla wax 25, hydrogenated castor oil 16 parts.

Waterproofing Composition

Formula No. 1

Belgian Patent 400,446

Carbon tetrachloride or carbon disulphide 200 cc, paraffin 150 g, rubber 8 g, and naphthalene 50 g per liter.

No. 2

U. S. Patent 2,022,405

Refined Paraffin Wax	4
Paracoumarone Resin	2
White Beeswax	1
Aluminum Palmitate	4

The above ingredients being blended together and dissolved in a composite solvent of xylol and carbon tetrachloride in the

proportions of about three parts by volume of xylol to one part by volume of carbon tetrachloride, and the amount of solvent being such that about 2¾ ounces of the above composition is contained in each gallon of solution.

No. 3

Walls can be waterproofed by applying a coat of solution made by dissolving 1¾ lb of paraffin in each gal of mineral spirits used as a solvent. Use steam to melt rather than a free flame.

No. 4

U. S. Patent 1,894,059

(a)

100 pounds of montan wax are melted and 8 pounds of sodium silicate are added in 120 pounds of water; this solution is heated to about 10° above the melting point of montan wax; the mixture of melted montan wax and the solution of sodium silicate is then rapidly stirred and 4½ pounds of magnesium sulphate dissolved in 40 pounds of water are added. An encysting gel is immediately formed about the particles of montan wax, keeping them from coalescing together when the mixture cools.

(b)

Paraffin Wax	33.0
Silicate of Soda—(plus 65% of the total water)	4.0
Alum—(plus 35% of the total water)	2.0
Glue—(Added to silicate of soda)	1.0
Water	60.0

The silicate of soda is added to the melted wax in a disintegrator and the alum is added after thorough agitation. Working temperature 170° F.

No. 5

Rosin	27
Isobutylene Polymers	13
Casein	3
Ammonia	5
Water	55

Dissolve casein in water and ammonia, heating to 80° C. Melt the rosin and polymers and add latter slowly with good stirring until cool.

Acrawax C	10
Primal F32	2
Water	50

No. 6

Paraffin Wax	20
Acrawax C	4
Ester Gum	8

No. 7

Gelowax	17
Carbon Tetrachloride	10
Ethylene Dichloride	10
Benzol or Naphtha	60

Digest until dissolved.

No. 8

Petroleum Jelly	33
Rosin	11
Beeswax	56

No. 9

U. S. Patent 2,290,563

Ethyl Cellulose, Low Viscosity	18–25%
Paraffin Wax	50–60%
*Resin, to make	100%

* Compatible resins are Super Beckacite 2000, Durez 570, Beckacite 1101, Amberol B/S-1, cumar, Neville R. 9, Bakelite resin 302, Rezyl 880-1, ester gum, rosin, dammar or other naphtha-soluble resins.

No. 10

Waterproofing Shoes

Natural Wool Grease	8
Dark Petrolatum	4
Paraffin Wax	4

Melt the ingredients together by warming them carefully and stirring thoroughly. Apply grease when it is warm but never hotter than the hand can bear.

No. 11

Waterproofing Leather

British Patent 532,306

Leather is immersed at 50–55° C. for ½–1 min and brushed or sprayed with

Paraffin Wax	1
Stearin	1
Benzine	8

Rubberless Raincoat Coating

	Primer Coat XE-5131	Alternate Top Coats XE-5132	XE-5133
VINYLITE Resin XYNC (Dry Basis)	15.0	5.0	8.8
BAKELITE Resin Solution XJ-16320 (Wet Basis)	—	42.0	21.0
Spirit-soluble Black	1.0	—	—
Carbon Black	1.0	—	—
Iron Oxide Black	—	3.2	3.2
Iron Oxide Yellow	—	2.3	2.3
Lead Titanate	—	1.9	1.9
Whiting	—	7.6	7.6
"Acrawax" C	—	*	*
Raw Castor Oil, Cold-pressed	15.0	10.0	10.0
"Flexol" Plasticizer 3GO	15.0	2.5	2.5
Oleic Acid	—	0.6	0.6
Butanol	—	12.5	12.5
"Synasol" Solvent	38.0	6.8	20.6
Hydrogenated Petroleum Naphtha ("Solvesso" Solvent No. 1)	15.0	5.6	9.0
Total parts by Weight	100.0	100.0	100.0

* Approximately 2/100 of 1 per cent (2 to 3 oz per 1000 lb solution) of "Acrawax" C mixed pigments before grinding.

Paraffin Coating for Balloons and Airships

From one to two pounds of paraffin wax, depending upon the weight of coating, and the condition of the surface to which it is to be applied, is melted over a steam bath or upon a large electric plate to prevent overheating.

The melted paraffin is allowed to come to a temperature 5 to 10° C. above its melting point, when it is mixed with one gallon of solvent which has been previously heated to the same tem-

perature. Care should be taken that the paraffin and solvent are the same temperature, as the addition of hot paraffin will cause the solvent to boil violently.

The solvent should never be heated over an open flame due to the fire risk.

The air shall be between 50 and 75% relative humidity at approximately 70° F. as there is danger of fire due to the building up of static charges from the evaporation of the solvent which will be dissipated if the humidity is in excess of 50%, while if the humidity is over 75% there is a tendency to precipitate moisture. The application of paraffin should not be accomplished on days when there is an approaching thunderstorm or the surrounding temperature is under high electrical tension.

The envelope shall not be inflated and coated from the inside.

The envelope shall be opened at the mid-section above ⅓ of the circumference when about 20% inflated, and reversed by rolling the envelope on the air in the interior of the envelope. After removing the original tape, a tape approximately four inches wide shall be applied at the opened seam on both sides. This will prevent the application of paraffin at this point, which would cause a poor union when the envelope is reassembled. The tape should not be removed after paraffining until the envelope is turned and ready to be reassembled.

The paraffin shall be applied with a standard sweeping broom in a uniform coating so that it flows smoothly over the fabric, leaving no broom marks on the surface. Insofar as practicable, the surface to which the solution is to be applied should be flat in order that a uniform coating may be applied.

The increase in weight due to the application of the solution shall be approximately 0.5 ounce per square yard.

The envelope shall be required to dry for at least 48 hours to permit complete evaporation of the solvent from the paraffined surface before being rolled up.

It is very necessary to thoroughly ventilate the room in which the operation is being performed. Care should be exercised to prevent the formation of pockets of gas from the solvent, especially around the ballonet. When a section of the envelope has been doped it should be allowed to dry thoroughly before being turned over.

After the paraffin solution has been applied to the inside surface, the envelope should be inflated about 20% and returned to its original position. The tape shall then be removed from the

seams and a careful inspection made to determine if paraffin is on the cemented surface. If there is any paraffin on the cemented surface, it shall be removed by scraping, buffing and washing with the solvent before any cement is applied. The seams shall then be cemented, sewed and re-taped in accordance with standard practice.

Paperboard Proofing

The proofing of paperboard is of great importance, particularly those types which are used in the manufacture of food containers. In most instances, the proofing must be directed against both grease and moisture and in some instances serve also to retain the moisture in the packaged product.

Proofing of this type has not as yet found wide application due to the fact that the coating must be absolutely odorless. The odor of rubber while not pronounced ordinarily is readily absorbed by many substances particularly if allowed to remain at something above ordinary room temperatures.

For mixtures of this type, somewhat different compositions are employed than in the case of adhesives. Emulsified waxes may be used to good advantage with sodium silicate to give the desired surface effect.

A typical mixture of this kind may be prepared as follows:

Paraffin Wax Emulsion	800 g
60% Latex	300 g
Sodium Silicate (Water Glass)	100 g

The paraffin wax emulsion is prepared by emulsifying 150 g of paraffin in 650 g of water with the aid of heat, stirring, and emulsifying agents. When cool, the sodium silicate is stirred in the emulsion, made slightly alkaline with ammonia, and the latex then added with mild stirring.

A coating of the above type has a consistency not much greater than that of water but may be readily applied to the paper on an inclined bed coating machine or any other machine of a similar character.

In some instances, however, if the coating is to be applied by means of a doctor blade, the solution may be thickened by the addition of bentonite or similar substances.

Translucent Waterproofing for Paper and Leather

U. S. Patent 2,073,630

Hydrogenated Fish Oil	7½
Rubber	2½
Petroleum Solvent, Light	90

Moisture Proof Coating for "Cellophane"

Formula No. 1

U. S. Patent 2,073,310

Cellulose Acetate Stearate	10
Glyceryl Tristearate	3
Ester Gum	10
Butyl Acetate	400

No. 2

Canadian Patent 364,301

Paraffin Wax	7.5
Pyroxylin	2.5
Hydrogenated Rosin	1.0
Amyl Acetate	123.5
Alcohol	20.0
Toluol	47.5

Moisture Proof Paper Lacquer

British Patent 412,687

Ozokerite	1–2
Dibutyl Phthalate	25–50
Nitrocellulose	50–75
Lacquer Solvent	To suit

Straw Lacquer Waterproofing

Italian Patent 267,765

Cellulose Nitrate	10
Butyl Acetate	20
Benzol	48
Butyl Alcohol	7
Paraffin Wax	2
Camphor Oil	8
Butyl Ether	5

Transparent Waterproof Coating

U. S. Patent 2,094,771

Paraffin Wax (60–62° C.)	7½
Pyroxylin	2½
Hydrogenated Rosin	1
Amyl Acetate	123½
Alcohol	20
Toluol	47½

After coating, drying should take place at about 65° C.

Straw Hat Coating

Ethyl Cellulose (Low Viscosity)	20
Japan Wax	5
Toluol	60
Ethyl Alcohol	15

This solution may be applied by means of a pressure spray gun or with a brush. It renders the straw hat completely water resistant and rainproof, and will not yellow on standing.

Moisture Proof Coating for Wood

U. S. Patent 2,066,295

Linseed Oil	313 gal
China-Wood Oil	94 gal
Solution Containing 60% Limed Rosin and 40% Varnish Makers and Painters' Naphtha	130 gal
Paraffin Wax	724 lb
Zinc Stearate	50 lb
Varnish Makers and Painters' Naphtha	365 gal

Wood or Metal Container Coating

U. S. Patent 2,122,543

Ester Gum	65
Japan Wax	11
Petrolatum	24

Melt together and apply hot or from a hydrocarbon solvent.

Coating for Wood and Iron

Indian Patent 23,417

a.	Cumarone Resin	12,000 g
	Asphalt	12,000 g
	Montan Wax	100 g
b.	Water	1,400 g
	Methyl Cellulose Dispersion	800 g
c.	Latex	3,600 g
	Soda Ash Solution (3.25%)	100 cc

Protective Coating for Aluminum Castings and Zinc and Tin Plated Parts

An emulsion is made with the following formula:

Diglycol Stearate	1
Ozokerite	2
Paraffin Wax	4
Water	40

Melt the three waxes together and keep at a temperature of about 65 to 70° C. Heat the water up to about the same temperature or a little above, and add slowly with high speed agitation to the melted waxes.

Filler, Marking and Coating Composition

U. S. Patent 2,046,557

Shellac Wax	2

Heat at 60–175° C. and add with thorough mixing

Aluminum Powder	1

Porcelain Enamel Patching

White Rosin	40
Carnauba Wax	20
Titanium Dioxide	40

Melt first two ingredients and sift into it the titanium dioxide. Mix well.

Protective Coating for Beer Cans

Formula No. 1

British Patent 490,851

The metal is made the anode in following dispersion:

Beeswax, White	47	g
Ceresin	453	g
Sodium Aluminate	5.65	g
Sodium Silicate	9.35	g
Water	2	l

Current density 30–50 amp/sq ft at start, then reduce to 8 amp/sq ft. After this treatment heat can to coalesce wax particles.

No. 2

Asphalt	100
Montan Wax	10
Cumarone Resin	½–2

Thin to suit with a mixture of equal parts of toluol and carbon tetrachloride.

Wax "Lacquer"

a.	Orange Shellac	14
	Alcohol	60
b.	Carnauba Wax	2
	Paraffin, 50/52° C.	1
	Turpentine	23

Heat *a* to 50° C. on steam-bath, *b* to 60° C. separately.

Add *b* to *a* with thorough stirring; agitate until cold.

Water and Ink Resistant Lacquers

A 5% solution of Flexo Wax C in toluol can be incorporated into nitro-cellulose lacquer mixtures, giving excellent water and ink resistance. It also exhibits marked anti-block effects.

Moisture-Vapor-Proof Lacquers for Paper

Chlorinated Rubber	50
Diamyl Phthalate	20
Pale East India Chips	30
Paraffin Wax	10
Toluol	165

Mix the ingredients by cold cutting.

The mixture is cloudy. Its

coating on paper imparts excellent moistureproofness and is odorless, tasteless and nontoxic.

"Lacquer" for Glassine Paper

U. S. Patent 2,096,662

Chlorinated Rubber	100
Cumarone Resin	10–50
Paraffin Wax	3
Magnesium Oxide	3
Hexamethylenetetramine	3

Mix together in a heated mill.

Black Tire Finish

Gilsonite	20
Acrawax B	20
Paraffin Wax	40
Candelilla Wax	20
Carbon Black	6
Twitchell Base	5
Varnolene	190

Moistureproofing Varnish

Sorbitol Alkyd Resins	1.50
Colorless Paraffin Oil	0.21
Paraffin Wax	0.42

Dissolve in 1 gal Toluol

This mixture gives a coating which, when dried, is odorless. It may be used for coating glassine paper, etc.

Raw Rosin Carnauba Varnish

No. 1736

Raw M. Rosin	100 lb
China Wood Oil	20 gal
Soya Bean Oil	4 gal
Carnauba Wax	1 lb
Kerosene 62°	4 gal
Naphtha 54°	48 gal
Concentrated Varnish Drier No. 1007	1 gal

Melt the rosin in the china wood oil; run to 570° F. and pull from the fire.

Allow to stand until the temperature registers 580° F. then chill back with the 4 gal of cold soya bean oil and stir well.

The soya bean oil should be added all at once and the stirring continued until the temperature begins to fall.

When the temperature has dropped 20° add the carnauba wax, stir until dissolved, then allow to stand with frequent stirring, until cooled to 500° F. at which point thin with the kerosene.

After the kerosene is in, stir frequently while cooling to 330° F. then thin with the naphtha and finally add the concentrated varnish drier.

This varnish is fairly pale in color; has a good luster; dries in about 8 hours; and is extremely waterproof.

It is not neutral; consequently it must not be used with lead and zinc pigments.

It is designed especially for refrigerator cars; bath room wall and kitchen wood work, but it is not long enough in oil for a floor varnish.

Overprint Varnishes

Formula No. 1

Batavia Dammar A/E	5850	lb
China Wood Oil	520	gal
KPO "B" Linseed Oil	115.5	gal

Kerosene	397	gal
Cobalt Drier Solution (6%)	675	lb
Paraffin Wax (High M.P.)	71	lb
Oil Length Gallons	8.9	
Drying Time (Hours)	4	
Gloss	High	

No. 2

Batavia Dammar A/E	6300	lb
China Wood Oil	930	gal
Kerosene	497	gal
Cobalt Drier Solution (6%)	472	lb
Paraffin Wax (High M.P.)	157	lb
Oil Length Gallons	14.8	
Drying Time (Hours)	4	
Gloss	Good	

Heat the resin and oil to 450° F. Add the kerosene, then the drier, and then the paraffin wax.

These varnishes dry to water white, flexible films with maximum marproofness.

Disinfectant "Paint"

Italian Patent 288,514

Beeswax	70 g
Japan Wax	44 g
Montan Wax	25 g
Shellac	10 g
Potassium Carbonate	30 g
Water	730 cc

Boil together and mix well until emulsified. Cool and add with stirring

Alcohol	40 g
Trioxymethylene	50 g

Anti-Rust Waterproof Oil

Raw M. Rosin	100 lb
Red Lead	16 lb
Manganese Dioxide	4 lb
China Wood Oil	32 gal
Menhaden Fish Oil	8 gal
Beeswax	1 lb
Kerosene 46°	16 gal
Wood Turpentine	32 gal
Heavy Naphtha 48°	16 gal

Melt the rosin to about 320° F., pull the kettle from the fire and sprinkle in the driers, previously mixed together, well stirred in to the melted rosin. When the red lead and black oxide are all in, put the kettle back on the fire and cook at 350° F., to 400° F. for 15 minutes, or until a sample on glass shows a transparent amber color.

As soon as the drying salts are taken up pull the kettle from the fire and heat quickly to 575° F. stirring frequently and beating down the foam if necessary. *As soon* as the temperature reaches 575° F. pull from the fire and immediately "chill back" with the 8 gal of fish oil. Stir very frequently while the mixture is cooling to 480° F. at which point, add the beeswax, in small pieces, and stir until dissolved.

When the wax has dissolved, thin first with the kerosene then follow with the turpentine and heavy naphtha.

This waterproof oil is of a medium amber color; has a good luster, and dries in 8–10 hours.

It contains 35.71% oil. The oil is used as an anti-rust, waterproof varnish on metals and as a paint grinding oil.

Submarine Grinding Oil No. 887

Menhaden Fish Oil	32 gal
Manganese Dioxide	6 lb
China Wood Oil	16 gal
Litharge	24 lb
H. Rosin (Raw)	50 lb
Japan Wax	2 lb
Kerosene 46°	48 gal

Put the manganese dioxide in the cold menhaden oil, stir well, then raise the heat slowly to 560° F.

At about 320° F. the manganese dioxide will begin to give off oxygen, and at 420–480° F. the mixture will froth strongly, therefore, proceed cautiously.

When a temperature of 560° F. has been reached, usually in 2–3 hours, pull from the fire and add the cold wood oil, stir until thoroughly mixed, by which time the heat will have dropped to 460 or 440° F.

Now begin adding the litharge, about 2 lb at a time, sprinkling it on the surface of the oil, allowing it to remain for ½ minute, then stir for a minute.

Whip down the foam if necessary, before adding more litharge, then continue the additions until all of the litharge is in.

Put the kettle back on the fire, raise the heat to 480° F., pull from the fire and add the 50 lb of rosin, a little at a time, stirring constantly until the rosin is in solution. The addition of rosin will cause some foaming as all of the litharge will not have been taken up.

When frothing ceases, put the kettle back on the fire, heat to 480° F. and cook at 480–520° F. until the litharge is taken up, then pull from the fire, add the Japan wax, stir for 2 or 3 minutes and thin with kerosene.

This dark-colored, waterproof oil is used in roof paints, freight car and smokestack paints.

Greaseproof, Waterproof Coating

An excellent greaseproof coating with good waterproof properties is obtained by the application of a 1/1,000 inch film of a special wax mixture, using a modified waxing machine. The formula is as follows:

Glyco Wax A	400
Flexo Wax C	100

The waxes are melted together with intermittent slow stirring until clear. This may be done in the reservoir of the waxing machine, directly before required, since it will keep indefinitely. The approximate coverage is 30,000 square feet. In actual practice, a 15 point board thus requires somewhat more than 200 lb of the wax mixture, which gives a reasonable net cost. Being stable to

heat, the waxes will tolerate, without difficulty, the prolonged heating required in their application. Good flexibility is maintained even at low temperatures, and the melting point, approximately 135° F., is sufficient for the maximum temperatures to which containers made from the coated board are subjected.

This wax mixture is entirely non-toxic and will not support or induce bacterial or mold growth. The coated board will withstand 7 days' continuous contact with lard before being penetrated; its resistance to mineral or vegetable oils and greases is, in some cases, higher.

Oil and Moisture Proofing Coating

U. S. Patent 2,082,278

Hydrogenated Fish Oil	86
Rubber	14

Protective Coating for Hydrofluoric Acid Containers

Beeswax	1
Paraffin Wax	4

Inside Coating for Wood Barrels

a. Yellow Wax	40
Colophony	200
b. Iron Oxide	40
c. Gypsum (Molding)	10

Melt up *a*, then stir in *b*, finally *c*. Apply liquid, hot mixture with a brush.

Paint Remover

Paraffin Wax	3
Wood Spirit	30
Acetone	25
Benzol	20
Carbon Tetrachloride	15
Xylol	10

The paraffin wax is dissolved in the benzol-carbon tetrachloride-xylol mixture and the wood spirit-acetone mixture added. This precipitates the wax and forms a paste when it is set.

Paint and Varnish Remover

Formula No. 1

Amylene Dichloride	80
Alcohol	40
Naphtha	20
Diglycol Stearate	2

No. 2

Benzol	50
Methanol	25
Acetone	15
Gasoline	10
Paraffin Wax	2½

Varnish and Lacquer Remover

Formula No. 1

Canadian Patent 367,059

Ethylene Dichloride	77.5
Alcohol	10.0
Toluol	2.5
Benzene	2.5
Cellulose Acetate	2.5
Paraffin Wax	5.0

No. 2

Acetone	40
Benzene	20
Solvent Naphtha	10
Alcohol	30

By addition of paraffin to this solvent mixture, a cleansing ma-

terial of pasty consistency can be obtained.

Remover for Lacquers of Oil Chlorinated Rubber and Oil Paints

Formula No. 1

Scale Paraffin Wax (40/42° C.)	15
Benzol	45
Toluol	40

No. 2

Scale Paraffin Wax (40/42° C.)	20
Benzol	60
Hexalin	20

Paint Remover

a. Paraffin Wax, High Melting	5
Trichlorethylene	95
b. Aluminum Naphthenate	5
Trichlorethylene	95

Make solutions *a* and *b*, let stand for 24 hours separately, mix.

Tarnish and Corrosion Prevention

Ozokerite	20
Paraffin Wax	40
Diglycol Stearate	10

The waxes are dispersed in hot water in proportions of 7 parts of wax to 40 parts of water, giving an emulsion which is applied preferably by spraying, leaving a thin, transparent, adhesive and flexible film. Protection is obtained from tarnish or corrosion of ferrous as well as non-ferrous metal surfaces. For instance, the flat ground steel surfaces and the nickeled intaglio portion of candy molds are both protected effectively. The coating tolerates extremes of high room temperature and very low freezing temperature. A recent report indicates that waxy coatings on steel machinery and parts are much better than grease slushing because waxy coatings apparently seek out the spots particularly susceptible to corrosion or which have already begun to corrode. Greases do not always inhibit the electrochemical action resulting in corrosion, whereas waxes do. Where the coating must be removed, boiling water, hot water and soap, or solvents may be used.

Rubbing Compound

(For Paint, Lacquers, etc.)

1. Carnauba Wax	42 lb
2. Beeswax	18 lb
3. Ceresin	18 lb
4. Varnolene	3 gal
5. Water	3 gal
6. Triethanolamine	8 oz
7. Stearic Acid	2 lb
8. Tripoli	24 lb
9. Pumice	15 lb

Melt 1, 2, 3, 7 with 4. Heat 5 and 6 to 90° C., add to wax mixture and stir till emulsified. Then add 8 and 9 and stir till cool.

Alberene Stone Top Dressing

Paraffin Wax	1,000 g
Kerosene	700 cc
Gasoline	600 cc

Melt paraffin over a water bath and cool to about 65° C. Pour in kerosene slowly with vigorous stirring. Allow to cool to about 50° C. and add gasoline. Thoroughly mix. Keep in stoppered bottle, away from flame.

The above mixture should be heated over a water bath until it becomes a liquid, and applied to the stone by means of a cloth. The surface of the stone must not be moist and not too cool. After the thin layer of the dressing has set, polish with dry soft cloth.

Wood Filler for Ground Polishing

German Patent 607,521

Shellac Wax	10
Carnauba Wax	5
Pumice Meal	100
Sandarac	100
Blown Castor Oil	10

Melt together until uniform and powder after cooling.

Coloring Meerschaum Pipe Bowls

Beeswax	50
Olive Oil	50
Triethanolamine	15

The Meerschaum pipes are immersed in the above which is slowly heated to boiling and maintained at this temperature for 15 to 30 minutes. Pipes so treated will color very rapidly.

Glass Etching Resist

U. S. Patent 2,089,571

Rosin	2
Beeswax	6–7
Paraffin Wax	7–8
Asphalt	10
Chrome Yellow	16
Varnish	3
Turpentine	3
Tallow	3
Japan Drier	To suit

Etch Resist

In etching glass it is necessary at times to block off portions which one desires to keep unetched. A solution for this purpose is composed of the following:

Asphaltum	12½
Beeswax	4½
Ceresin Wax	58
Stearic Acid	25

Etching Filler

A filler for etched lines in metal to make them more distinctive has the following formula:

White Beeswax	10
French Chalk	5

Melt together.

Electric Insulation

Formula No. 1

Electric insulating coating compounds are prepared on a base of urea-CH_2O resin, mixed with materials with which solid solutions are formed. Example: 33 parts of a 46% solution of urea-CH_2O resin in n-BuOH are mixed with a solution of nitrocellulose 15, blown castor

oil 30, and rosin 6 parts in AcOBu 25, EtOH 75 and PhMe 75 parts, by wt. Coatings of this compound are very adherent, elastic and durable after drying for 8 hrs at 75°. They are resistant to mineral acids and to the action of transformer oils at high temperatures.

No. 2

British Patent 389,816

A composition, particularly for coating insulating tapes, comprises a wax having a melting point such as that of montan or carnauba wax or ozokerite 40–50, colophony or a derivative thereof, e.g., an ester gum, 32–40 and a non-drying oil, e.g., castor oil, 10–28 parts.

No. 3

Carnauba Wax	1 lb 14 oz
Yellow Beeswax	4 oz
Venice Turpentine	6 oz
Gum Obsidian	6 oz
Sulphur	2 lb 8 oz

Cook until thoroughly uniform.

This wax should have a melting point of 285° F. and a flash point of 499° F.

No. 4

Reclaim Rubber	40.0
Smoked Sheets	10.0
Whiting	34.3
Mineral Rubber	10.0
Zinc Oxide	2.5
Paraffin Wax	1.5
Stearic Acid	0.5
Sulphur	1.0
Captax	0.2

No. 5

British Patent 538,411

Hydrogenated Castor Oil	80
Paraffin Wax	20

Electrical Arc Resistant Insulation

U. S. Patent 2,049,370

A material suitable for panels consists of asbestos board carrying throughout its surface and interior a mixture of carnauba wax 2 and paraffin wax 1 part.

Fixed Electrical Condenser Wax

U. S. Patent 2,083,007

Chlorinated Naphthalene	25–40
Gilsonite	20–30
Montan Wax	30–35

This gives a product of minimum shrinkage.

STENCIL PAPER AND INK

Solid Stencil Ink

This ink is waterproof and will not rub off nor blur when the marking is exposed to wet or rain.

Black

Black Rosin	20
Shellac	16
Bone Black	14
Rosin Spirit	2
Japan Wax	2
Tallow	1¾
Hard Yellow Soap	¾

Melt the rosin, shellac, and rosin spirit, add the tallow and wax, stir well, add bone black and soap (sliced), stir until all dissolve and incorporate, then turn out into the molds to set hard.

Stencil and Marking Ink

U. S. Patent 2,002,939

Shellac Solution (4 lb per gal)	32	oz
Turpentine	5.3–6	oz
Beeswax	2.0–2.3	oz
Lampblack or Chrome Yellow	5.7–8	oz
Alcohol	80–167	fl oz

Engraver's Black Stenciling Ink

Paraffin Wax	¾ lb
Pigment Black	10 oz
Kerosene	½ gal
Nitrobenzol	½ oz

Melt the wax. Stir in the pigment black until well dispersed and then add the kerosene and nitrobenzol to the cooling wax.

Stencil Paper

U. S. Patent 1,916,203

A mixture of aluminum stearate 2 parts, 45% phenol-formaldehyde resin solution 16 parts, chlorinated naphthalene (Halowax) 14 parts, and maize oil 13 parts, is applied to a fabric backing and the sheet is heated to harden the resin.

Duplicating Machine Stencils

The wax-composition used should not be brittle and hard, but must be tough and elastic.

The paper used is a very fine, thin, fibrous, but tough tissue-paper.

Impregnation: Very thin.

Suggested Mixture:

Beeswax	20
Soft Ozokerite (60/62° C.)	15
Paraffin Wax (50/52° C.)	30

Melt together; mix; apply hot.

Heat-Resisting Stencil Sheet

U. S. Patent 2,242,313

Flexible "Cellophane" is coated with the following mixture:

Mineral Black	5
Castor or Cottonseed Oil	12
Carnauba Wax	49
Aluminum Powder	34

CARBON PAPER, INKS AND CRAYONS

Tranfer Ink

Formula N. 1

1. Ultramarine Blue	50
2. Gum Mastic	30
3. Beeswax	10
4. Petrolatum	10

Melt (3) and (4), work in (1) and mix with melted (2).

No. 2

U. S. Patent 1,990,193

Carnauba Wax	3
Boiled Linseed Oil	2
Caustic Soda	3/7
Pigment	To suit

No. 3
(Emulsifiable)

Diglycol Stearate	20
Ethyl Cellulose	5
Sodium Abietate	10
Pigment	10

No. 4

Nitrocellulose (½ sec.)	15
Phenol-Formaldehyde Resin	25
Beeswax	50
Acetone	50

Photolitho Transfer Ink

For inking up images on photolithographic transfer paper, the following is recommended:

Palm Oil	1
Beeswax	1
Asphaltum	2
Burgundy Pitch	2
Black Litho Ink	8
Litho Varnish	2½

The ink is applied with a composition roller, and, if desired, may be thinned with oil of turpentine.

Indelible Tranfer Ink

Formula No. 1

Asphalt Emulsion	200
*Para Cumarone Resin	20
Ozokerite	20
Carbon Black	20

Heat together till free from water.

* Varnish Grade.

No. 2

Amberol	150
Carnauba Wax	84
Ozokerite	32
No. 6 Litho Varnish	35
Blown Castor Oil	60
Cobalt Drier	1
Butyl Carbitol	10
Cadmium Red	215

Benday Ink

This is really a form of transfer ink, used in conjunction with shading mediums (stippling films) in the process known as "bendaying." Ink for this purpose may consist of:

Tallow	1
Wax	3
Shellac	4
Soap	2
Asphaltum	4
Canada Balsam	1
Carbon Black	1

For use, reduce with castor oil to a working consistency.

Color for "Blue Transfers"

Formula No. 1

Colophony	50
Rosin Oil	20
Montan Wax, Crude	10
Pigment	20

No. 2

Colophony	30
Rosin Oil	10
Montan Wax, Crude	10
Toluol or Xylol	35
Pigment	15

Transfer Composition

U. S. Patent 1,954,450

Formula No. 1

Amberol	10
Ozokerite	4
Blown Rapeseed Oil	2

All ingredients are fused and intermixed until the melted composition is then thoroughly homogeneous. Any suitable coloring material is then added to the composition with thorough intermixing, and the composition is then ready for use on the machines.

No. 2

Another useful composition can be made by melting together the following:

Cumar Varnish (Grade)	100
Ozokerite	12
Blown Rapeseed Oil	20
Lithographic Varnish (No. 6)	12
Butyl Carbitol	5
Cobalt Drier	2

When the ingredients of this composition have been thoroughly intermixed while the fusible ingredients thereof are in the molten condition, color is stirred in and the composition is then panned.

In place of the butyl carbitol in the above formula, the following may be used:

Pine Oil.

Diethyl Oxalate.

Mono-Butyl Tartrate.

Nitrobenzol.

Carbitol (Mono-Ethyl Ether of Diethylene Glycol).

Butyl Oxalate.

No. 3

Rosin	100
Beeswax	30
Gold Bronze or Pigment	30

No. 4

(Fugitive)

Rosin	100
Beeswax	10
Cobalt Drier	1
Gold Bronze	25

No. 5

(Water Fugitive)

Mutton Tallow	1
Cocoa Butter	1
Paraffin Wax	4
Rosin	6
Pigment	Sufficient

No. 6

U. S. Patent 1,941,697

Amberol (type F7)	150
Carnauba Wax	84
Ozokerite	32
No. 6 Litho Varnish	35
Blown Castor Oil	60
Cobalt Drier	1
Butyl Carbitol	10
Cadmium Selenide	215

In order to prepare this composition for printing on the transfer base, the fusible elements are first melted and intermixed and the oils are then added, and the mass is thoroughly intermixed. The butyl carbitol is diethylene glycol mono butyl ether and it has a boiling point of 220° C.

The temperature of the mixture is then lowered almost to the hardening point and the butyl carbitol is then added and the mass is again thoroughly mixed.

The cadmium selenide, which is the pigment utilized in the above-mentioned formula, is then added with thorough mixing.

The artificial resin above specified furnishes a base for the vehicle which is not easily fusible, and the addition of the carnauba wax and the ozokerite

renders the composition more fusible. The addition of the oils increases the fusibility of the composition so that it has a melting point between 80–120° C.

Photomechanical Inks

Autographic Transfer Ink

This is used for writing upon plain paper with a pen, said writing later transferred to a litho stone or metal plate:

Marseilles Soap	10 oz
Acetic Acid	1 lb
Glycerin	20 lb
Water	100 lb
Shellac	12 oz
Tallow	10 oz
Yellow Beeswax	12 oz
Mastic	5 oz
Asphaltum	4 oz
Lampblack	3 oz
Water	125 oz

Tusche

(Lithographic Drawing Material)

Yellow Beeswax	2
Mutton Tallow	2
Marseilles Soap	6
Shellac	3
Lampblack	1½

Heliograph Printing Ink

French Patent 806,594

Beeswax	15
Aluminum Stearate	10
Castor Oil	14
Nitrocellulose	15
Butyl Acetate	70
Toluene	30
Lampblack	15

Hard Etching Ink

As its name implies, this is a hard, strong ink, used where exceptional acid resistance is desired:

Litho Ink (Black)	1 lb
Beeswax	7 oz
Powdered Asphaltum	5 oz
Rosin	5 oz
Black Wax	3 oz

The *black wax* specified in the above formula consists of:

Asphaltum	2 oz
Beeswax	5 oz
Stearic Acid	5 oz
Spermaceti	10 oz

Or, equal quantities of beeswax, rosin and tar may be melted and thoroughly mixed, then used as a substitute for "black wax."

Soft Etching Ink

Preferred for delicate work and used in the French etching process (gillotage), this comprises:

Russian Tallow	6
Yellow Beeswax	5
Asphaltum	2
Black Litho Ink	1
Thin Litho Varnish	1

Finishing Ink

An ink sometimes used by etchers in cleaning up the plate (removal of shoulder) in the last stage of etching:

Black Litho Ink	2 lb
Beeswax	1 lb
Rosin	10 oz

Add sufficient turpentine to give the desired consistency. The ink is applied to the *warm* plate with a composition roller, which is manipulated over the plate in all directions until the surface of the etched relief de-

sign is thinly but thoroughly covered with ink.

Rolling Up Ink

Letterpress Ink	1 lb
Asphaltum	4 oz
Rosin	3 oz
Beeswax	3 oz
Turpentine	10 oz

Before application of the ink, heat the plate, and use a composition roller in applying a smooth film of ink to the plate.

Developing Ink

Good Letterpress Ink	1 lb
Beeswax	1 lb
Thin Litho Varnish	4 oz

Gloss Ink

a. Montan Wax, Crude	15
Colophony	2
Soft Paraffin 40/42° C.	3
Potash Carbonate	½
Marseilles Soap	4
Water	65
b. Shellac	20
Borax	7
Water	75
c. Nigrosine NTL	5½
Water	25

Make up separately *a*, *b*, and *c*, and mix these three components together.

Increased Slip, Spread and Anti-Blocking Effects

Ozowax is being used very successfully to replace ozokerite in the same proportions in ink vehicles. In this connection, it gives better spread, slip and anti-blocking effects.

Improving Printing Inks

Some waxes are used in certain printing inks because they cut down penetration, "length," stickiness and "offset" and increase lifting properties and hardness.

Carnauba wax is used to give luster, slip and hardness; Japan wax to prevent crystallization; beeswax to prevent offset and crystallization and to slow up evaporation in solvent inks; in offset and lithographic inks it lessens the tendency toward emulsification and "bleeding"; spermaceti lessens "offset."

Pigments, in printing inks, are "wetted" much more readily by the incorporation of 1% or less Acrawax. This wetting causes a great increase in viscosity of the ink. Thus thin inks can be thickened very readily.

Burnishing Ink

Formula No. 1

Montan Wax, Crude	6½
Rosin	1
Stearic Acid (Titer 53/54° C.)	½
Potassium Carbonate	1
Water	100
Nigrosine Solution (12% in water)	30

The wax, rosin, and stearic acid are melted together, and added to the boiling potash carbonate solution with stirring. The finished cooled emulsion is dyed with the nigrosine solution.

No. 2

a. Potash Carbonate	0.5
Rosin	2
Paraffin Wax	3
Marseilles Soap	4
Montan Wax, Crude	15
Water	65
b. Borax	7
Shellac	20
Water	75
c. Nigrosine Water Soluble	6
Water	25

Mix the three solutions after making them up separately.

Burnishing Wax

No. 3 North Country Carnauba Wax	9
Shellac Wax	4
Ozokerite Wax	1½
Montan Wax	1
Rosin	½
Paraffin Wax	½
Liquid Oil Black	3

Melt waxes and add liquid oil black and mold.

Carbon Paper Inks

Formula No. 1

Black Carbon

(Certified Public Accountant)

Carnauba Wax	40
Mineral Oil	40
Carbon Black	10
Iron Blue	10

No. 2

Black Carbon

Carnauba Wax	30
Methyl Violet Base	2
Oleic Acid	8
Beeswax	3
Carbon Black	15
Lard Oil	42

No. 3

Black Universal Carbon

Extra Heavy Mineral Oil	40
Oleic Acid	5
Carnauba Wax	37
Crystal Violet	3
Carbon Black	15

No. 4

Black Pencil Carbon

Mineral Oil	18
Oleic Acid	23
Rosin	7
Montan Wax	30
Lampblack	12
Milori Blue	10

No. 5

Blue Pencil Carbon

Carnauba Wax	30
Paraffin Wax	10
Milori Blue	25
Petrolatum	35

No. 6

Blue Pencil (Soluble Type)

Victoria Blue	10
Oleic Acid	30
Ceresin Wax	5
Carnauba Wax	25
Mineral Oil	30

No. 7

Hectograph Carbon

Crystal Violet	60
Carnauba Wax	9
Opal Wax or Acrawax B	10
Mineral Oil	20
Lecithin	1

No. 8

One-Time Ink

Montan Wax	30
Paraffin Wax	5
Methyl Violet	1
Lampblack	15
Mineral Oil	49

No. 9
French Patent 774,922

Cottonseed Oil	1
Prussian Blue	1
Carnauba Wax	2
Paraffin Wax	2
Ozokerite	½
Octadecyl Alcohol	1

No. 10

Carbon Black	20
Milori Blue	6
Violet Blue	5
Paraffin Oil	32
Montan Wax, Crude	15
Montan Wax, Double Bleached	3
Paraffin Wax (50/52° C.)	3

Violet

Methyl Violet-Base	5
Oleic Acid	10
Montan Wax, Crude	60
Petrolatum	90

No. 11
Black

75% of these materials in proportions suitable for grade desired.

Candelilla Wax
Beeswax
Crude Montan Wax
Mineral Oil

Toners (Oil Soluble)	10%
Peerless Carbon Black	15%

This is ground hot. It is a base formula which may be modified to suit conditions.

No. 12
Lead Pencil Carbon

Carbon Black	10
Mineral Oil	40

Grind together until smooth. Add

Nigrosine Base	1⅔

Dissolved in

Oleic Acid	3⅓

Mix well and add a hot solution of

Paraffin Wax	40
Mineral Oil	30

Grind again and spread on paper at temperature of 40–50° C.

No. 13
Pencil

Glyceryl Monostearate	6
Oleic Acid	20
Dye, Oil Soluble	10
Petrolatum	14
Kerosene	7
Paraffin Wax	85
Carnauba Wax	8
Montan Wax	30

No. 14
Typewriter

Oleic Acid	11
Diglycol Oleate	2
Dye, Oil Soluble	3
Pigment	17
Petrolatum	38
Carnauba Wax	30

No. 15
Black

Petroleum Jelly	21 lb
Japan Wax	6 lb
Drop Black (Ground in Turpentine)	4 lb
Ceylon Graphite	4 lb
Soft Soap	1 lb
Oil Black Dye	2 oz

Melt petroleum jelly, wax, and soap together, remove from the fire and stir in oil black when cooler, then grind to a fine paste with the others. The composition may be applied to the paper either hot or cold with a fairly stiff brush, then wipe off the superfluous paste and hang up papers with clips to dry.

No. 16

Raw Linseed Oil	2	gal
Tallow	8	lb
Lampblack	4	lb
Ceylon Graphite	2½	lb
Oil Black Dye	2½	oz

Warm the oil sufficiently to dissolve the tallow, stir in oil black and well mix with the others.

Austrian Patent 148,997

	No. 17	No. 18
Carnauba Wax	9	31
Montan Wax	6	24
Violet Dye	7	7
Mineral Oil	63	23
Lampblack	15	15

Magic Writing Pad

Cardboard is coated with the following composition and covered with a sheet of waxed or oiled paper or cellophane. When the latter is written on with a stylus or pencil the writing appears. When this sheet is lifted away from the coated cardboard the writing disappears.

Beeswax	4
Venice Turpentine	9
Lard	4
China Clay	3½
Carbon Black	1
Mineral Oil	2

The consistency may be varied by varying the proportions of liquid in the formula.

Duplicating Ink

Formula No. 1

Canadian Patent 382,180

Crystal Violet	11.0
Magenta	5.0
Brilliant Green	13.5
Chrysoidine	15.5

Grind together to fine powder and then disperse in following melted mixture.

Beeswax	4
Eleostearin	6
Mutton Tallow	26
Lard Oil	4

No. 2

Paraffin Wax, Hard	3
Montan Wax, Bleached, St.	3
Violet Blue	5
Milori Blue	6
Montan Wax, Crude	15
Lampblack	20
Mineral Oil	32

No. 3

Methyl Violet Base	5
Oleic Acid	10
Montan Wax, Bleached, St.	10
Montan Wax, Crude	60
Petrolatum	90

Must be ground in color mill.

Wax Offset Compound

1. Beeswax	22
2. Petrolatum Amber	20
3. Mutton Tallow	5
4. Paraffin Oil	22
5. Kerosene	10
6. Naphtha (High Flash)	4

Melt (1), (2), (3) and (4) and stir until dissolved. Turn off heat and work in (5) and (6).

Non-Offset Compound

No. 1 Lithographic Varnish	35
Soft Cup Grease	35
Paraffin Wax	10
Beeswax	20

Melt together; cool and run in mill.

Hard Wax Crayons, #1 Grade

Base:

Stearic Acid (Double Pressed)	65 lb
Paraffin Wax (138/140° F.)	35 lb

Add to 100 lb of base:

Color	Pigment	Quantity
Black	Carbon Black	6 lb 6 oz
Magenta	Poster Cerise	25 lb
Blue	C.P. Prussian Blue	7½ lb
Ultramarine Blue	C.P. Ultramarine Blue	25 lb
Orange	C.P. Chrome Orange	25 lb
White	Lithopone	33–35 lb
Yellow	Primrose Yellow	12½ lb
	Chrome Yellow Light	12½ lb
Brown	Burnt Umber	18¾ lb
	Burnt Umber	6¼ lb
Raw Umber	Raw Umber	25 lb
Burnt Sienna	Burnt Sienna	17 lb 10 oz
Indian Red	Indian Red	18¾ lb
	Pure Red Oxide	6¼ lb
Venetian Red	Red Oxide	12½ lb
Rose Pink	Process Red	4 lb
	Lithopone	10 lb
English Vermilion	American Vermilion	28 lb 3 oz
Flesh Tint	Vermilion	8 oz
	Lithopone	4 lb
Medium Yellow	Medium Chrome Yellow	25 lb
Golden Ochre	Mexican Yellow or Strong Yellow Oxide	8 lb 11 oz
Green	Green A or C.P. Milori Dark Green	12½ lb
Violet	Purple	12½ lb
Light Green	Extra Light Green	12½ lb
Cobalt Blue	Cobalt Blue	12½ lb
Dark Green	C.P. Peerless Green Dark	17 lb 10 oz
Olive Green	Chrome Yellow Medium	8 lb
	Black Lake	6 lb 5 oz
Red	Red #2097 (Lavenberg)	12½ lb

Munsel Type Wax Crayons

Base:

Stearic Acid (Double Pressed)	65 lb
Paraffin Wax (138/140° F.)	35 lb

Add to 100 lb of base:

Color	Pigment	Quantity
Middle Blue	Peacock Blue	17 lb
	C.P. Lincoln Toner	9½ oz
Maximum Purple-Blue	C.P. Milori Blue	8 lb 11 oz
Middle Purple-Blue	Ultramarine Blue	1 lb
Maximum Green	Green #8791 (Kohnstam)	8 lb 11 oz
Middle Red	Van Dyke Brown	2 lb 11 oz
	Para Red	1 lb 10 oz
	Lithopone	2 lb 2 oz
Middle Green	Green #8791 (Kohnstam)	5 lb 6 oz
	Black Lake	2 lb 2½ oz
Middle Yellow	Mexican Yellow	10 lb 2 oz
	Black Lake	1 lb 11 oz
Maximum Yellow-Red	Chrome Orange	25 lb 3 oz
	Permatone Orange (United)	1 lb 4 oz
Maximum Purple	Magenta	4 lb 12 oz
Maximum Red	Red #1897 (Lavenberg)	11 lb
Maximum Red-Purple	Red Purple Lake #2128 (Lavenberg)	3 lb 3½ oz
Maximum Yellow	Primrose Yellow	12½ lb
	Chrome Yellow Light	12½ lb
Maximum Blue	Salisbury Blue (United)	11 lb
Black	Carbon Black	6 lb 6 oz
Grey	Lampblack	2 lb 9 oz
	Lithopone	25 lb 13 oz
Maximum Green-Yellow	Light Chrome Green	11 lb
Middle Green-Yellow	Light Chrome Green	5 lb 6 oz
	Black Lake	2 lb 3 oz
Middle Yellow-Red	Persian Orange	2 lb 11 oz
	Black Lake	8½ oz
	Lithopone	5 lb 6½ oz
Middle Blue-Green	Peacock Blue	1 lb 8½ oz
	Green #10-7500 (United)	13 oz
	Black Lake	9 oz
Maximum Blue-Green	Peacock Blue	3 lb 2 oz
	Green #10-7500 (United)	1 lb 9 oz
Middle Purple	Purple Lake	4 oz
	Red Lake	2 oz
	Lithopone	7½ lb
Middle Red-Purple	Para Red	2 lb 3 oz
	Indian Red	1 lb 2 oz
	Black Lake	2 lb 3 oz
	Lithopone	5 lb 6 oz

Wax Drawing Pastels

Black

Hard Soap	80
Beeswax Crude	60
Spermaceti Crude	28
Carbon Black	14
Burnt Umber	5
Prussian Blue	4

Melt waxes and soap, mix in pigments and grind until smooth; pour hot in molds; and plunge into cold water to "set."

Red

Hard Soap	28
Saponified Japan Wax	28
Spermaceti	16
Carnauba Wax	2
Beeswax Crude	8
Orange Chrome Yellow	12

Method—as under Black.

Molded Drawing Crayon

Paraffin Wax	50
Mutton Tallow	40
Carnauba Wax	3
Pigment	7

Pressed Drawing Crayon

Clay	70
Glue Solution	10
Pigment	20

Knead and force through hydraulic press into desired shapes.

Impregnating Wax for Hard Pressed Crayon

Stearic Acid (Double Pressed)	10
Mutton Tallow	5
Japan Wax	10
Paraffin Wax, 138/140° F.	75

Soak crayons in above for 24 hours at 230/240° F.

Lithographic Crayon

Formula No. 1

Sod. Stearate	7
Beeswax	6
Carbon Black	1

No. 2

Beeswax	30
Tallow	25
Soap	20
Shellac	15
Lampblack	6

Heat in enamelled pot to melt together. Then heat strongly until vapor ignites. Allow to burn for a while and smother flame with cover of pot. Take out a sample and test for elasticity. If not satisfactory ignite again in same way.

Luminous Crayon

U. S. P. 2,317,159 (1943)

A luminous plastic writing stick is composed of 50 to 100 parts by weight of Japan wax, 25 to 75 parts of ozokerite, 50 to 300 parts of paraffin and 25 to 250 parts of petroleum jelly and a small amount of a luminous sulphide.

Hot Metal Crayon

Formula No. 1 (White)

Quick Lime	2
Zinc Oxide	4
Titanium Dioxide	70
Japan Wax	5
Stearic Acid	4
Paraffin Wax	15

No. 2

Chrome Green	75
Quick Lime	2
Zinc Oxide	4
Stearic Acid	4
Paraffin Wax	15

Heat to 85° C. and mix thoroughly while hot. Force into forms and allow to cool.

Shoe Repair Crayons

Formula No. 1

For Vici Kid

Broken Victrola Records	2½
Ozokerite	1¾
Yellow Beeswax	1¾
Lump Oil Black	1½

No. 2

Japan Wax	8
#2 Carnauba Wax	1
Color	To suit

No. 3

For Patent Leather

Broken Victrola Records	7¼
Ozokerite	2¼
Lump Oil Black	3

No. 4

For Gun Metal

#2 Carnauba Wax	5
Ozokerite	18
Yellow Beeswax	18
Japan Wax	2
Hard Paraffin Wax	14
Oil Black	1

No. 5

Candelilla Wax	15
Stearic Acid	60
Ceresin Wax	7½
Ozokerite Wax	7½

Melt the above together and stir until uniform. To 1½ oz of the above base (while melted) add ¼ oz lampblack.

Shoe Edge Ink

Montan Wax	14
Caustic Potash	2
Nigrosine	3
Water	81

The dye is dissolved in the water and the caustic also added and dissolved, the whole being added, while stirring, to the molten wax.

Bottom and Shank Blacking

No. 1 Carnauba Wax (Cut with 46 oz Castile Soap in 11½ Gallons Water)	23
Garnet Shellac (Cut with 100 oz Borax in 13 Gallons Water)	26
Nigrosine (In 10½ Gallons Water)	21

Mix the three solutions and add water to make 50 gallons.

Marking Crayon

Ceresin	40
Carnauba Wax	35
Paraffin Wax	20
Beeswax	5
Talc	50
Chrome Green or Other Pigment	15

Textile Marking Crayon (Washable)

Formula No. 1

Barium Carbonate	25
Diglycol Stearate	25

Melt at lowest possible temperature and stir until uniform; pour into molds. Other colors are obtained by using colored pigments.

No. 2

Paraffin Wax	649
Stearic Acid	125
Ultramarine Blue HM	24
Emulsifier S-489	91

Melt paraffin and stearic acid to about 158°; stir in the ultramarine blue. Turn off heat and add S-489, while stirring thoroughly. Continue stirring until it begins to solidify. Add to molds and chill as soon as possible.

Crayon, Tailors' Marking

Carnauba Wax	11
Stearic Acid	2
Ceraflux	76
Ozokerite	6
Terra Alba	5

Glass Marking Crayon

Mix while it is melted,

Paraffin Wax	98 g
Stearin	2 g

Then add 10–15 g of an oil-soluble dye in either red, blue, black, or yellow. Let the liquid cool slightly and before it sets to a hard mass, pour it into large paper soda straws, the ends of which have been closed at one end.

Marking of Uncured Rubber Mixes

For general use, where a stock is hot, a mixture of montan wax 3, beeswax 1, chrome yellow 3 is recommended. Where a stock receives no subsequent treatment and a mark which vanishes during vulcanization is desired, a mixture of montan wax 3, beeswax 1, zinc oxide 3, white lead (dry) 1 is recommended. For marking on wet stock a mixture of paraffin wax (m.p. 140° F.) 2, tallow 1, chrome yellow 2 is recommended. Glycerol is suitable for lubricating the wooden or metal molds in which the crayons are formed.

Cattle Marker

Paraffin Wax	40
Tallow	20
Woolfat	20
Ceresin (58/60° C.)	15
Oil-Soluble Color	1–2
Pigment (To Match Color)	As desired

COSMETICS AND MEDICAL PREPARATIONS

Cold Creams

Formula No. 1

1. Diglycol Stearate	14	lb
2. Paraffin Wax	2	lb
3. Mineral Oil	3¾	gal
4. Petrolatum (White)	6	lb
5. Water	6	gal
6. Perfume Oil	5½	fl oz

Method of manufacture:

a. Melt Nos. 1, 2, 3 and 4 at 170° F.

b. Heat 5 to 180° F.

c. Add *b* to *a* while mixing. Allow mixer to run until batch is completely emulsified.

d. Allow batch to cool to 125° F. and add 6 and mix at low speed.

e. Batch should be allowed to cool without stirring to 105° F. at which temperature it is poured into jars.

No. 2

The following cold cream formula gives a lustrous product both on the surface and beneath the surface, is of somewhat the same texture as a beeswax cream and can be made in the neighborhood of five cents per pound. It is somewhat softer than the beeswax cream.

a. Diglycol Stearate	7
Beeswax	3
Spermaceti	1
Paraffin Wax	1
Mineral Oil	30
b. Borax	1
Water	58

Melt *a* to 80° C., add *b* which has previously been heated to 80° C., to *a* slowly with constant stirring. When temperature has dropped to 50° C., add perfume with stirring and pour at 45° C. If a cream of greater consistency is desired, part of the mineral oil can be replaced with petrolatum.

No. 3

White Beeswax	12
White Petroleum Jelly	12
Peach Kernel Oil	50
Rose Water	25
Borax	1
Perfume	To suit

No. 4

Cetyl Alcohol	10
Paraffin, Liquid	10
Petrolatum, White	80
Water	60

Transparent, soft, white cream.

No. 5

Cetyl Alcohol	100
White Beeswax	150
Vegetable Oil	200
Mineral Oil	250
Cholesterin	5
Borax	10
Water	260
Perfume	25

No. 6

a. Ceresin, White	27
Spermaceti	25
Stearic Acid	21
Undecylic Acid	1
Mineral Oil, White	87
b. Borax	5
Water, Distilled	36

Melt *a* and add with agitation to the hot solution *b*. Stir until cold.

No. 7

1. Borax	2
Water	54
2. Glyco-Wax A	20
White Beeswax	26
White Mineral Oil	120
3. Perfume	1

1. Dissolve borax in water, heating this to 150° F.

2. Melt in another pot beeswax, Glyco-Wax A and white mineral oil and keep at about 150° F.; add with stirring 3/7 parts lily of the valley (or other perfume).

Add 2 to 1 slowly with thorough stirring; continue stirring until cool enough to pour.

Softer creams can be prepared by increasing the amounts of water in the above formula.

If creams are packed when too warm the finished products

will not look as well as if they are poured when cooler. The best time for packing is just before the cream begins to set.

No. 8

Stearic Acid	30
Lanolin (Anhydrous)	20
Beeswax (White)	16
Mineral Oil (White)	33
Triethanolamine	3.8
Carbitol	16
Water	95

Melt the stearic acid, lanolin and beeswax in the mineral oil and heat to about 70° C. Prepare in a separate kettle a boiling solution of the triethanolamine and water, and add to this the hot solution of waxes. Stir vigorously until a creamy emulsion is obtained and add the Carbitol to which the perfume has been added. Continue stirring until homogeneous and the product has reached the proper consistency. Pour into jars while still warm.

Cold Cream (Non-Greasy)

Formula No. 1

1. Glyceryl Monostearate	22
2. Petrolatum	16
3. Paraffin Wax	12
4. Mineral Oil	30
5. Water	98

Heat first four ingredients to 170° F. and stir together. Then slowly with stirring pour in the water which has been heated to the same temperature. Stir thoroughly and then allow to stand (hot) until air bubbles are gone. Add perfume and stir and pour at 110–130° F. Cover jars as soon as possible.

No. 2

Stearic Acid	16
Glycerin	48
Mineral Oil	12
Paraffin Wax	2
Stronger Ammonia Water	4
Water	64
Perfume	¾

Glycerin Cold Cream

a. Wax, White	80
Spermaceti	80
Peanut Oil	300
Petrolatum	300

Melt.

b. Glycerin	120
Water	120
Borax	10

Warm up to 90°; pour into melted *a.*

Add when cool:

Perfume Composition, Fresh Odor	20

Cleansing Cream

Formula No. 1

U.S.P. Flaked White Beeswax	10
Ceresin Wax (Melting Point 138° F.)	5
Mineral Oil (Viscosity 68/75)	65
Water	40
Borax	½
Perfume	Sufficient

This formula is stated in parts by weight.

The beeswax, ceresin and a portion of the mineral oil are placed in a steam-jacketed kettle and the temperature in melting the waxes should be at no time in excess of 80° C. (The

emulsifying power of beeswax is retarded or broken down when the temperature is above 80° C.) When the waxes have melted, the steam should be so regulated (this can be accomplished only by actual experiment on the part of the cream maker) that when the balance of the mineral oil is added cold, the temperature will be approximately 57° C. It will take a little experimenting to gain the knack of properly controlling the kettle temperature in order to speed production.

When the melted waxes and mineral oil are at a temperature of 57° C., the perfume oil should be added and the agitator started. The agitator should have only one propeller at the bottom, causing a complete vortex when agitating the melted waxes and oil, and forming only a slight vortex when all the water and borax have been added.

In another kettle, the water and borax should be kept at exactly the same temperature, 57° C. It is important that agitation be continued while the water and borax are being added and while the curds form until the cream begins to thin down and becomes a homogeneous mass. As soon as this occurs, stirring should be continued for a few minutes only. When the cream must stand before passing into the filling machine, it might be necessary to agitate it to destroy any crust caused by surface cooling.

No. 2

Sorbitol Mono-Oleate	5
Sorbitol Di-Stearate	10
Beeswax	7
Mineral Oil	32
Lanolin	3
Water	43

This combination gives a moderately firm cream with a fine-grained texture.

No. 3

Beeswax	6.00
Spermaceti	2.00
Petrolatum	5.00
Raisin Seed Oil	50.60
Mineral Oil	10.00
Rancidex (Preservative)	0.10
Water	25.00
Borax	0.60
Triethanolamine	0.20
Perfume	0.50

Melt fats and oils at 160° F. Water and borax in separate kettle at same temperature. Emulsify by adding water to oils at 160° F. with constant stirring. Add perfume oils at 115° F.

No. 4

1. Mineral Oil	80
2. Spermaceti	30
3. Glycosterin	24
4. Water	90
5. Glycerin	10
6. Perfume	To suit

Heat 1, 2 and 3 to 140° F. and stir into it slowly 4 and 5 heated to same temperature. Add perfume, at 105° F. stir slowly until cold after allowing

to stand for 5 minutes stir until smooth and pack.

No. 5

White Mineral Oil	280
Spermaceti	80
Glycosterin	80
Diglycol Laurate (Neutral)	20
Water	360
Carbitol	40
Perfume	5

No. 6

1. Mineral Oil	78
White Wax	5
Spermaceti	28
Trihydroxyethylamine Stearate (Special)	20
2. Perfume	1
3. Glycerin	4
Water	92

Heat Nos. 1 and 3 separately to 200° F.; then add Nos. 1 to 2 slowly, stirring thoroughly. When the cream begins to set, the perfume is added and stirred in. Allow to stand overnight. Stir thoroughly the next morning and package. This cream will not sweat oil during hot weather.

Liquid Cleansing Cream (Non-Greasy)

1. Beeswax	1.5
2. Spermaceti	6.5
3. Cherry Kernel Oil	6.0
4. Glycosterin	4.0
5. Water	122.0
6. Alcohol	3.0
7. Galagum	1.0
8. Borax	3.0
9. Perfume	3.0
10. Glycerin	4.0

Melt together 1, 2 and 3. Heat while stirring 4, 5, 7 and 8 together until uniform. Mix these two solutions, stirring until uniform. Stir in 6, 9 and 10 and mix until uniform.

Liquefying Cream

Formula No. 1

Mineral Oil	7
Ceraflux	3
Petrolatum	2

Melt together at 220° F. and stir at room temperature until cold, add perfume; pour into jars while liquid but at lowest possible temperature. This cream will not sweat oil during hot weather.

No. 2

Medium Translucent

Mineral Oil (Light or Medium)	50
Paraffin	18
Petrolatum (White)	23
Spermaceti	9

No. 3

Hard Type (for Hot Climates)

Spermaceti	5 lb
Petrolatum, White	8 lb
Ozokerite	5 lb
Petrolatum, Liquid	1½ gal

Proceed as in Medium Type above.

Night Cream (Greasy)

a. Paraffin Oil, White	2500
Wax, Scale	500
Beeswax, Bleached	500
Adeps Lanae, Anhydrous	500
b. Distilled Water	3000
Triethanolamine	75
Borax	35

Melt *a* together at 75° C.; add *b* which is at same temperature, to *a*. Stir until cold.

Neutral Cleansing Cream

1. Mineral Oil	80
2. Spermaceti	30
3. Glyceryl Monostearate	24
4. Water	90
5. Glycerin	10
6. Perfume	To suit

Heat 1, 2 and 3 to 140° F. and stir into it slowly 4 and 5 heated to same temperature. Add perfume, at 105° F., stir slowly until cold; after allowing to stand for 5 minutes stir until smooth and pack.

A four-purpose cream that cleans, nourishes, stimulates and acts as a powder base is made as follows:

Mineral Oil	3 pt
Petrolatum (White) (Heat to 140° F.)	½ lb
Water	4½ pt
Glycerin	5 oz
Preservative	½ oz

Heat to 140° F. and add slowly with stirring to oil mixture. As the temperature falls, a gelatinous mass forms at 120° F. 1 oz. perfume oil is added while stirring and the gelatinous mass changes to a white cream. Slow stirring is continued until cold. This cream may be packed either in tubes or jars.

This cream can be modified by various coloring agents and perfume as under cold cream to obtain specialty creams. Since it is neutral there may be incorporated in it viosterol, or gland or hormone extracts.

Avocado Oil Cleansing Cream

Part 1.	
Hydrogenated Oil (Cosmetic Grade)	11.0
Beeswax U.S.P. White	5.0
Stearic Acid Triple Pressed	0.5
Sesame Seed Oil	60.0
Avocado Oil	7.0
Antioxident & Preservative	0.1
Part 2.	
Distilled Water	15.3
Borax U.S.P.	0.5
Part 3.	
Perfume	0.6

Melt Part 1 at 80° C., Heat Part 2 to 75° C.

When Part 1 has cooled to 75° C. add Part 2 with constant stirring. Add Part 3 at 60° C. Pour between 55–50° C.

This cream is of the quick liquefying type. It does not melt or run in the jar even under extremely hot weather conditions. The quick liquefying property is mechanical not thermal.

Nourishing Cream

Formula No. 1

1. Beeswax	15
Mineral Oil	45
Lanolin (Anhydrous)	12
Glyco-Wax A	15
2. Water	25
Borax	1¼
Benzoate of Soda	½
3. Perfume	½

Heat Nos. 1 and 2 separately to 200° F., then add 1 to 2

slowly with stirring in an emulsifier or beater. When the cream begins to set, add the perfume. Allow to stand overnight; stir the next morning and package.

This cream possesses exceptional penetrating powers and is absorbed very readily by the skin.

No. 2

Cetyl Alcohol	50
Lanolin	50
Cocoa Butter	50
Cholesterin	10
White Beeswax	50
Arachis Oil	100
Mineral Oil	150
Petrolatum, White	240
Water	280
Perfume	20

No. 3

White Beeswax	9
Spermaceti	3
White Petroleum Jelly	35
Benzoated Lard	18
Lanolin	4
Liquid Paraffin	9
Distilled Water	21
Borax	1

Vegetable Vanishing Cream

Hydrogenated Cottonseed Oil	10
Sesame Oil	50
Water	30
Beeswax	8
Lanolin	2

To this formula 1–3% sorbitol (83%) with or without 0.2% borax may be added to give a firm, fine-grained stable cream. The oil constituents are melted together at 170° F., and the water-soluble parts are then mixed with the oil at the same temperature and mixing continued while cooling.

Foundation Cream

Stearic Acid	18.0
Cetyl Alcohol	0.5
Cocoa Butter	0.7
Glycerin	8.0
Potassium Hydroxide	1.0
Titanium Dioxide	2.0
Perfume	0.5
Water	69.0

Tissue Cream (Soft) with Cholesterin Base

Absorption Base	30
Lanolin	5
Water	55
Beeswax, White	10

Melt the wax and lanolin, add the base and stir in the water (warm).

(Note: Consistency in the foregoing formula can be adjusted by changing the wax content to suit.)

Avocado Tissue Cream

Avocado Oil	20
Lanolin Absorption Base	10
Stearic Acid	5
Cetyl Alcohol	5
Beeswax	5
Almond Oil	25
Preservative	0.2
Perfume	0.8
Borax	1
Distilled Water	28

The water and borax are brought to a temperature of 165° F. and are then added to

the molten fats, oils and waxes. Careful heating and constant stirring are essential, the perfume being added when the temperature has dropped to about 120° F.

Massage Cream

Spermaceti	10
Solid Paraffin	15
Mineral Oil	45
Lecithin	1.5
Cholesterin	0.5
Borax	1
Water	30
Perfume	As required

The solution of lecithin and cholesterin is accomplished best in the liquid or melted fats and waxy constituents. The melted mass is permitted to be cooled at say 40° C. and the hot solution of borax in water is poured first in small portions and then in larger portions into the fused mass while stirring thoroughly. Then it is stirred cold.

In the case of vanishing cream, it is somewhat more difficult to work in the lecithin. The simplest way is to dissolve the lecithin in the melted stearic acid (overheating should be prevented) and to mix the potash solution into it by stirring in the usual way. On the other hand saponification and emulsification might be affected by the lecithin. If any oil is permitted in the vanishing cream, lecithin is ground fine with warm mineral oil (1 part of lecithin to say ½–1 part of mineral oil), so that a mass is produced that can be distributed. As soon as the cream has been mixed and while it is still warm, the warm lecithin oil is stirred thoroughly into it. The whole of it is stirred cold.

Peanut Oil Massage Cream

This product is excellent for undernourished parts, cold feet, stiff joints, and as an aid to any flabby parts of the body.

White Beeswax	20
Spermaceti	20
Peanut Oil	45
Lanolin	12
Water	45
Borax	3
Camphor	1

Melt the wax over a water bath, add the lanolin and oil, and heat to 80° C. The camphor is dissolved in the oil with gentle heat, the borax is dissolved in the water and heated to 80° C. At this temperature the water is added to the wax oil mixure at the same temperature with vigorous stirring; best done with a motor stirrer.

Massage Skin "Food" (Liquefying)

Lanolin	4
Cocoa Butter	4
Almond Oil	4
Coconut Oil	8
Yellow Soft Paraffin Wax	12
Hard Paraffin Wax	4
Perfume	As desired

Salt Containing Cosmetic Cream

Polymerized Glycol Stearate	10
Stearic Acid	10
Paraffin Wax	15
Mineral Oil	15
Petrolatum	10
Sodium Chloride	6
Water	To make 100

Aluminum Chloride Cream

Polymerized Glycol Stearate	15
Spermaceti	5
Glycerin	3
Aluminum Chloride, Hydrated Crystals	12
Water	To make 100

Antiseptic Cream

Emulgor A (Polymerized Glycol Ester)	10.0
Stearic Acid	10.0
Paraffin Wax	15.0
Mineral Oil	15.0
Petrolatum	10.0
Oxy-Quinoline Sulfate	0.2
Water	To make 100

Acid Creams

Formula No. 1

Glycol Distearate, Pure	14.0
Mineral Oil	3.0
White Beeswax	2.0
Ceresin	1.0
Lanolin	1.0
Sodium Lauryl Sulfate	1.0
Citrus Pectin	0.5
Perfume	0.5
Citric Acid	2.0
Glycerin	6.0
Distilled Water	69.0

No. 2

Wool Wax	3.0
Lanolin	8.0
Stearyl Alcohol	2.0
Petrolatum	37.0
Glycerin	4.0
Lactic Acid	1.5
Distilled Water	44.5

Alum Cream

Petrolatum, White	9
Paraffin Wax (52° C.)	6.5
Mineral Oil	14
Acimul	12
"Carbitol"	3
Alum Solution, Saturated	5.5
Rose Water	50

Melt the oil and waxes at 70° C. Add them to water, alum solution and Carbitol of the same temperature with good stirring. Stir until cold enough to be just about pourable (50° C.). Perfume at 55° C.

Bleaching Cream

a. Petrolatum (White)	9
Paraffin Wax	6.5
Mineral Oil	14
Acimul	12
b. Carbitol	3
* Lemon Juice	5.5
Water	50

a is melted, *b* is mixed heated to 70–75° C. and poured slowly into *a*, with stirring. Perfume is added at 55° C. Pour at 50° C.

* Lemon juice can be replaced by citric or lactic acid, etc., in proportionate amounts.

Peroxide Cream

a. Paraffin Wax	4
Mineral Oil	10
Lanolin	6
Acimul	15

b. Hydrogen Peroxide (100 volume)	5
c. Water	60

Heat *a* to 70° C. and stir till completely clear. Heat *c* to 70° C. and add *a* to *c* slowly, stirring in one direction only. At 55° C. add *b* and perfume. Stir and pour at 50° C.

If 5 parts of the water are replaced by 5 parts "Carbitol" the cream can be poured at 45° C.

Almond Cream, Liquid

Oil Sweet Almonds	1 lb
Spermaceti	2 lb
Beeswax	2 lb
Castile Soap Powdered	3 lb
Borax	2 lb
Quince Jelly	1 lb
Alcohol	1 pt
Water	4 pt

Melt the spermaceti and wax together. Dissolve the soap and borax in hot water. Mix these together and add balance of ingredients. Stir and filter through cloth.

Skin Protectives

Beeswax	5.0
Glyceryl Monostearate	12.5
Hydrous Wool Fat	5.0
Sodium Silicate	5.0
Ammonium Hydroxide (10% sol.)	0.5
Petrolatum	72.5

The ammonium hydroxide is incorporated to prevent the precipitation of the sodium silicate. The above formula with 5% latex gives a product which produces a rubber-like film on the skin. The base is melted, the latex added with stirring and the mixture stirred constantly until it congeals.

Translucent Jelly Cream

Stearic Acid	6
Spermaceti	15
White Petrolatum	30
Mineral Oil	49
Perfume Oil	To suit

Melt the stearic acid and the spermaceti, add the petrolatum and when melted stir in the mineral oil which has first been heated. When almost set stir in perfume.

Pore or Blackhead Cream

For the removal of blackheads and cleansing of the pores, a "pore cream" or "blackhead cream" is used. Applied over areas of large pores after the face has been moistened with warm water, it is left on for a few minutes and then washed off with warm water. The face is then rinsed with ice cold water and an astringent lotion applied with cotton.

Salicylic Acid	2.5
Starch	25.0
Zinc Oxide	35.0
Castor Oil	7.5
Soft White Paraffin Wax	30.0

The precautions necessary in compounding this preparation lie in a thorough grinding of the three powders, then slightly warmed paraffin added to the oil and powders after they are triturated, in a warmed mortar.

All Purpose Cream

Sorbitol Distearate	10
Mineral Oil	20
Lanolin	3
Glycerin	5
Beeswax	4
Ceresin Wax	10
Water	48

Make-Up Remover

Ceraflux	2½
Mineral Oil	8
Petrolatum, White	10
	No perfume

Sports Cream

Glycosterin	12
Mineral Oil	10
Cetyl Alcohol	3
Water	100

Heat to 60° C. and mix vigorously till emulsified.

Sun Tan Cream

Ceresin Wax	15.0
Beeswax	8.0
Lanolin	10.0
Petrolatum	10.0
Mineral Oil	56.5
Perfume	0.5
Color	Sufficient

Melt the waxes; add the lanolin and petrolatum. Mix, strain and perfume. Then add a sufficient quantity of brown.

Absorption Bases

	Formula No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7
Cetyl Alcohol	10	15	12	4	—	—	—
Lanolin, Anhydrous	5	10	5	24	—	7	—
Petrolatum, White	75	45	—	—	95	84	58
Mineral Oil, White	15	30	63	17.5	—	—	12
Paraffin Wax	—	—	20	14.5	—	4	22
Cholesterol	—	—	—	—	5	5	8

Hand Lotion

Spermaceti	2.00
White Beeswax	0.25
Glycerin	6.00
Soap	3.00
Borax	0.50
Sodium Benzoate	0.20
Quince Seed	3.40
Alcohol	4.00
Water	80.00
Perfume	0.50
Preservative	0.15

Add the quince seed to two-thirds of the water in which the preservative has first been dissolved. Allow to soak for 24 hours and strain. Add the glycerin, borax and sodium benzoate to the remainder of the water and stir until dissolved. Melt and add the spermaceti and white wax, stir rapidly for one or two hours then add the soap. Add the mucilage next and finally add the perfume dissolved in the alcohol, in a very thin stream.

Industrial Hand Protection Creams

Formula No. 1

Stearic acid, 2½ oz; white beeswax, 1 oz; white soft paraffin, 2½ oz; liquid paraffin, 1½ fl oz. These are melted

and emulsified with heated triethanolamine, 4 fl drms, and boiling water to 24 fl oz; with this is incorporated magnesium stearate, 2 oz. This preparation is slightly alkaline which is probably not a drawback in its use since normal perspiration is slightly acid.

No. 2

The following preparation has a pH of 5.4 and is therefore recommended where there is prolonged contact of the hands with soapy water:

Beeswax	10.0
Lanolin	5.0
Glyceryl Monostearate	12.5
Stearic Acid	2.0
Petrolatum	75.5

No. 3

The following preparation to waterproof the skin is recommended where there is prolonged contact with water:

Beeswax	10.0
Lanolin	5.0
Sulphonated Olive Oil (75%)	10.0
Petrolatum	75.0

No. 4

Glyceryl Monostearate	12.0
Beeswax	12.0
Anhydrous Lanolin	6.0
Cholesterol	1.0
Sodium Silicate	5.0
Ammonium Hydroxide, 10% Solution	0.5
Water	To suit

Melt wax, glyceryl monostearate, lanolin and cholesterol in one pot. Add sodium silicate solution and ammonium hydroxide solution to water previously heated in another pot Stir aqueous solution into the wax mixture.

Formula 4 is a clean, nongreasy preparation that dries on the skin and does not rub off. Its use is indicated, therefore, in dry work, as a protection against dust-borne irritants, or when soiling materials by the protectives must be avoided. Formula 2 is smeared on the skin, while 3 and 4 are liquids and are applied with a brush or swab.

No. 5

Beeswax	5.0
Glyceryl Monostearate	12.5
Lanolin	5.0
Sodium Silicate	5.0
Ammonium Hydroxide (10%)	0.5
Petrolatum	72.5

No. 6

Glyceryl Monostearate	8
Magnesium Stearate	14
Beeswax	3
Petrolatum	10
Mineral Oil, White	5
Water	60

No. 7

Hard Paraffin Wax	50
Petrolatum, Yellow	400
Peanut Oil	200
Beeswax, Yellow	100
Lanolin, Anhydrous	60
Rosin, Pale	40
Water	140
Borax	10

No. 8

Lanolin	2
Glycosterin	19
Dextrin	4
Glycol Bori-Borate	3
Water	72

Dissolve last four ingredients by warming to 60° C. with stirring. Melt first two materials together and add first solution, stirring slowly but well. A little perfume may now be added and stirred in.

This gives an excellent cream to smear on hands to protect them while working with greases, lacquers, etc.

Milkers' Hand Lubricant

Formula No. 1

Paraffin, Hard	320
Ceresin	280
Mineral Oil, White	400

No. 2

Mineral Oil, White	600
Ceresin, White	200
Lanolin, Anhydrous	200

No. 3

White Mineral Oil, High Viscosity	60
White Ozokerite (60/62° C.)	20
Woolfat, Neutral	20

Melt the ingredients on a water-bath, mix thoroughly, pour into containers near the filter point of the "fat."

Deodorant Cream

Formula No. 1

Acimul	15
Glycerin	3
Spermaceti	5
Water	60
Titanium Dioxide	2
Aluminum Sulphate	15

Make up cream omitting the aluminum salts. When cream is cold, add salts stirring until smooth. Mill if convenient.

No. 2

Paraffin Wax	10
Mineral Oil	10
Deomul	15
Petrolatum	5
Aluminum Sulphate	10
Water	50

Heat waxes and oils to 70° C., add 30 parts water. Cool to 45° C., and stir in salt dissolved in 20 parts water.

No. 3

1. Glyceryl Monostearate	15
2. Spermaceti	3
3. Glycerin	5
4. Titanium Dioxide	2
5. Methenamine	5
6. Mineral Oil	3
7. Water	67
8. Perfume	To suit

No. 4

1. Acimul	15
2. Aluminum Chloride	10
3. Spermaceti	5
4. Glycerin	3
5. Water	67
6. Perfume	To suit

Dissolve 2 in about 20 or 25 parts of 5, and warm to about 50° C. Place 1, 3, 4 and remainder of 5 in one kettle, and bring to about 90° C. Remove

from fire, place on mixer, make emulsion by stirring rapidly at first, and more slowly until product temperature drops to about 50° C., at which temperature increase agitation speed and add aluminum chloride solution a little at a time until all is added. Continue stirring, add perfume at about 45° C. It may be necessary to homogenize or mill this cream if it is grainy or lumpy. If a white cream is wanted, titanium dioxide can be added. From 2 to 5% is sufficient.

No. 5

Beeswax	8 oz
Liquid Petrolatum	24 oz
Sodium Borate	100 gr
Benzoic Acid	20 gr
Salicylic Acid	400 gr
Hot Water	16 oz

Melt the wax and oil and heat to about 160° F. Dissolve the other materials in the water, heat to the same temperatures as the wax solution, and pour it into the latter, beating briskly until the cream is formed. Here a comparatively high temperature of the solutions, plus a small amount of stirring, results in a glossy cream.

Perspiration Inhibiting Cream

U. S. Patent 2,087,162

22.5 g of aluminum chloride, hydrated, 12.0 g of candelilla wax and 16.0 g of stearic acid are boiled under a reflux condenser with an alcoholic menstruum consisting of 108 cc of anhydrous ethyl alcohol, denatured according to U. S. Government formula, and 108 cc of isopropyl alcohol (98% by volume). When solution of the solid ingredients has been effected, 0.7 cc of perfume base is added and the mixture is run off into small containers. When cold it forms a solid mass of smooth salve-like consistency, small portions of which can be removed in discrete quantities from the container, by means of the fingers, and applied to the human skin, as under the arms, to control or deodorize perspiration.

Deodorant Pencil

Formula No. 1

Zinc Phenolsulfonate	5.00
Zinc Oleate	10.00
Aluminum Palmitate	7.50
Parachol	20.00
Glyco Wax	40.00

No. 2

Zinc Phenolsulfonate	10.00
Zinc Oleate	10.00
Aluminum Palmitate	7.50
Parachol	30.00
Glyco Wax	30.00
Titanium Dioxide	15.00

Rub first three ingredients to fine powder and add to liquefied wax the Parachol mixture. Stir until just before solidification and pour into molds.

Lipsticks

Formula No. 1

Cetyl Alcohol	240
White Petrolatum	370
Ceresin	240
Colored Lakes	120
Perfume	30

No. 2

(The Color Develops on Application)

a. Stearic Acid	9
Eosin	1
b. Stearic Acid	30
Beeswax, White	40
Paraffin Wax (50/52° C.)	20
Ceresin Wax, White	20
Mineral Oil	60
Lanolin, Anhydrous	5
c. Lanolin, Anhydrous	15
Ceresin Wax, White	50
Spermaceti	5
Mineral Oil	60

To the wax-composition *b* or *c*, 2 parts of the eosin stearate are added, mix well, and a bit of alcohol is used to disperse the dye better. The alcohol evaporates quickly.

No. 3

Petrolatum	15 oz
Beeswax	10 oz
Spermaceti	400 gr
Carmine	6 dr
Perfume	To suit

Melt and stir. Allow to cool before adding perfume. Pour into molds.

No. 4

Indelible

Stearoricinol	28
Mineral Oil	4
Lanolin (Anhydrous)	2
Petrolatum	2
Paraffin Wax	8
Beeswax	8
Bromo "Acid"	1
Lake Colors	5
Perfume Oil	1

By varying the colors correspondingly different shades may be obtained.

No. 5

For Theatrical Use

Petrolatum	4 lb
Paraffin Wax	2 lb
Mineral Oil	1 lb
Carnauba Wax	6 oz
Lanolin	8 oz
Lake Colors	1 lb
Perfume	As desired

The same lake color mixtures as are used in the greasy cream rouges are suggested to secure the various shades. The procedure is the same.

Liquid Lip Make-Up

a. Triethanolamine Oleate	15
Glycerin	10
Water	10
b. Beeswax	10
Mineral Oil, White	40
Scarlet, Oil-Soluble	2½
c. Perfume (Eau de Cologne Oil, Rose, Fougère)	As desired

Emulsify by adding *b* to *a* at 50–60°. Stir till cold, and add perfume.

Lip Pomade

Mineral Oil	1 gal
Petrolatum, White	2 lb
Ozokerite, White	5 lb
Beeswax, White	2 lb
Perfume	1 oz
Color	To suit

Lipsticks (and Eyebrow Pencils)

Paraffin	2
Vaseline Oil, White	3
Beeswax, White	1
Ozokerite Ceresin	3
Titanium Dioxide	1
Colors: For 100 parts use:	
Fixation Red (Fixierrot) I No. 46	3.5
Medium Red (Mittelrot) No. 28	22

Other red dyes used: Carmine, Nakarat, Fixierrot, Cherry Red, Orient Red.

Rouge

Hydrogenated Castor Oil	56
Beeswax	16
Mineral Oil	8
Lanolin, Anhydrous	4
Petrolatum, White	4
Lake Colors	10
Eosin	2

Solid Perfume

Paraffin Wax	500
Melt on water-bath and add	
Perfume Oil	50
Menthol	½

Mix well and pour into containers at 160° F.

Cuticle Creams

Formula No. 1

White Petroleum Oil	87.75
Paraffin Wax (M.P. 125° F.)	9.00
Menthol	3.00
Thymol	0.025
Color (Oil Soluble Red)	To suit

No. 2

Anhydrous Lanolin	12.0
Distilled Water	12.0
Lecithin	0.5
Petrolatum (Cream or Lily White)	55.5
Light Mineral Oil	20.0
Perfume	To suit

Since the two types of cuticle cream above are essentially hydrocarbon oils which are difficult to rinse off thoroughly their use should be directed after, not before, the application of liquid polish. Thus any impairment of luster and adhesion of the subsequently applied polish will be avoided.

No. 3

Petroleum Jelly (Pale Yellow)	1½	oz
Deodorized Coconut Oil	1	oz
Hard Paraffin	1	dr
Stearic Acid	2	dr
Lanolin, Hydrous	1	dr
Water	2	dr
Borax	5	gr

Nail Cream

a.	Beeswax, White	15.0
	Ozokerite, White	2.5
	Montan Wax, Bleached	2.5
	Mineral Oil	60.0
	Cetyl Alcohol	2.0
b.	Water	23.5
	Borax	1.5
c.	Aluminum Stearate	20.0
d.	Fish Silver Paste (10% Dispersed in Amyl Acetate)	5.0

Melt *a*, add *b* of about 70° C. Stir thoroughly, add *c*. Stir until the emulsion is almost cold, add *d*.

Brittle Finger-Nail Cream

The following preparation is recommended for brittle finger-nails:

Almond Oil	25
Soft Paraffin	20
Water	35
Glycerin	5
Stearic Acid	5
Triethanolamine	4

This is applied at night and allowed to dry. In the morning the nails are rubbed (polished) with the following powder: Tin oxide 7, talc 2, zinc oxide 1.

Nail Polish (Paste)

Formula No. 1

A good formula for a nail polish in paste form contains 100 parts of light colored rosin, 60 parts of stearin, 60 parts of yellow beeswax and 200 parts of ceresin wax. These ingredients are melted together on water-bath and then 300 parts of white petrolatum are mixed in. Then a well mixed mixture of 200 parts of washed kieselguhr, 140 parts of zinc oxide and 100 parts of tin oxide is mixed with the waxy base. Before mixture is removed from water-bath, coloring matter is added, for example, alkanna pink, as well as 15 to 20 parts of perfume. These ingredients must be added shortly before mass becomes solid and is poured into containers.

No. 2

Paste

Ceresin	6
Olein	44
Precipitated Chalk	50

Color and perfume to suit.

Eyebrow Pencils

Apart from those methods which serve to preserve the eye region in good physical condition, actual beauty treatment is now practiced on a very considerable scale. Coloring of the eyebrows, painting of the eyelashes and shading of the eyelids are now important components of face cosmetics, the greatest attention being devoted to the first operation. Coloring of the eyebrows or their simulation after complete shaving is effected with colored wax pencils. Ordinary pure charcoal pencils tend to cause falling-out and drying of the hair.

Ingredients used in preparing the wax pencils are white wax, benzoated tallow, cocoa butter, petroleum oil and olive oil. The pigments are lampblack, umber, and ochre. Large manufacturers find it economical to use pigment grinding machines and other equipment of the most modern design, but small concerns can nevertheless cope with the production of these cosmetics. The base comprises a composition made up from 110 g fine petroleum oil, 60 g white ceresin, 15 g white wax, 240 g

benzoated tallow, and 1 g coumarin. The fatty base is thoroughly ground with the pigments, the molten base being gradually stirred into the very finely powdered pigment contained in a mortar. After thorough trituration the mixture is again warmed, digested for about half an hour on a water-bath, and again allowed to cool. As soon as the mass begins to thicken, it is again vigorously stirred and forced through a fine-mesh sieve by applying powerful pressure with the pestle. Lumps and impurities are retained upon the sieve. The preparation which passes through the mesh is then again thoroughly mixed, with gentle heating before casting. The mass should be neither too hot nor too fluid when being cast, since settlement of the insoluble pigment will result in lack of uniform coloration. Oil-soluble dyestuffs will certainly only enter into consideration in exceptional cases. According to another process, the melt is prepared from 2 parts cocoa butter, 2 parts ceresin, and 1 part olive oil. Into this is stirred 0.6 part dyestuffs (i.e., about 10% of the total gross weight), which has previously been ground up with a little olive oil.

As soon as the mass has reached the state when it can just be cast, it is emptied into metal molds. As a rule these impart the required taper to the pencils, but if this is not the case they are tapered after removing from the molds and wrapped in thick metal foil while leaving the points exposed.

Eyebrow Pencils

Formula No. 1

Mineral Oil	100
Ozokerite (60/62° C.), White	55
Beeswax	15
Tallow, Benzoated	240
Coumarin	1

The color for this is, for 1,000 parts of the base:

Medium Brown:	
Umber	225
Mahogany	150
Dark Brown:	
Umber	150
Mahogany	150
Kassel Brown	50
Blue-Black:	
Zinc Oxide	150
Dark Ultramarine Blue	145
Lampblack	5

No. 2
(Brown)

Burnt Sienna	80
Burnt Umber	100
Hard Paraffin	420
Soft Paraffin, Yellow	400

Eyelid Pencils

The production of shading tones on eyelids can be effected with pencils, the composition of which is very similar to that of the eyebrow pencils. The mass consists of the fatty base de-

tailed above with the addition of about 20% ceresin. The color scale is somewhat more varied in the case of these pencils, since a wider range of tones can be induced in the usual brown and bluish-black shades. Chestnut is obtained by mixing 225 g pale umber and 150 g mahogany brown with 1000 g of the molten wax mass. For dark brown tones mix with the same quantity of wax 300 g of a brun foncé; black shades require for the same wax quantity 100 g zinc white, 120 g ultramarine, and 4 g lampblack.

Regarding the perfuming of these preparations, this should generally be of a very refined character. About 5 to 10 g of perfume are required for each kilogram of mass. In cases where a fancy perfume is desired, preference should be given to one with a fresh natural odor.

Eye Shadow

Mineral Oil	5 lb
Lanolin	2 lb
Petrolatum	1 lb
Beeswax	1 lb
Paraffin	2 lb
Perfume Oil	4 oz

Color with any of following combinations:

Blue	
Ultramarine Blue	2 lb
Zinc Oxide	2 lb
Green, Light	
Zinc Oxide	3 lb
Green Lake	1 lb
Gray	
Ultramarine Blue	1 lb
Carbon Black	1 lb
Zinc Oxide	2 lb
Brown	
Burnt Umber	3 lb
Zinc Oxide	1 lb
Green, Dark	
Green Lake	3 lb
Zinc Oxide	1 lb
Violet	
Violet Lake	1 lb
Zinc Oxide	3 lb

Heat colors and wax mixture and grind in ointment mill; pack by pouring hot.

Mascara

Formula No. 1

Glyceryl Monostearate	10
Triethanolamine	5
Stearic Acid	15
White Petrolatum	20
Beeswax	25
Gelatin	2
Water	13
Carbon Black	10

Make a solution of the gelatin in water add the triethanolamine. Melt the wax, glyceryl monostearate, petrolatum and stearic acid, add the pigment and then the hot gelatin solution. Mill to get a uniform product.

No. 2

(Soapless Type—Poured)

Triethanolamine	14
Stearic Acid	20
Oleic Acid	5
Ricinoleic Acid	5
Carnauba Wax	30
Ozokerite	15

Shaving Cream, Brushless

Stearic Acid	12
White Mineral Oil	12
Paraffin Wax	5
Soap Flakes	3
Water	72

Hair Cream

White Wax	10
Liquid Paraffin	125
Borax	1
Distilled Water	14

Allow the wax to dissolve in 60 parts of liquid paraffin, then stir in the remainder of the liquid paraffin. Dissolve the borax in the distilled water, add to the previous solution, and stir the cream so formed very thoroughly.

Hair Pomade

Tallow	390
Ceresin, White	150
Beeswax, White	50
Rosin, Pale	200
Mineral Oil, White	200
Perfume	10

Moustache Pomade

Glycosterin	4
Gum Arabic	8
Water	31
Castile Soap	12
Beeswax	30
Diethylene Glycol	12
Perfume	To suit

Warm until wax has melted and mix vigorously until uniform.

Hair Pomade and Straightener

Yellow Petrolatum	6
Yellow Beeswax	1
Peanut Oil (Refined)	2
Perfume Oil	Sufficient

Melt the petrolatum in double boiler and add the other ingredients. The perfume should not be added until the mixture begins to solidify around the edges. This is an amber product. If a water-white product is desired use white petrolatum and white beeswax and substitute equal parts of deodorized castor oil and mineral oil for the peanut oil. By adding more wax and less of the oils a product can be obtained that will straighten the most unruly hair.

Hair Fixers or Straighteners

(Waxy)

Formula No. 1

Ceraflux	40
Glyco Wax A	10
Petrolatum, White or Yellow	100
Rosin	40

Melt together until clear and stir until uniform. Pour into jars while melted.

No. 2

Beeswax	10
Petrolatum, Yellow or White	100
Paraflux	40
Flexoresin B1	40

Method as given for formula 1. Formula 1 will give a very light colored product if white petrolatum, and FF rosin is used. Harder or softer product may be gotten by slight variation of the above.

No. 3

Beefsuet	16 oz
Yellow Beeswax	2 oz
Castor Oil	2 oz
Benzoic Acid	10 gr
Perfume	Sufficient

Melt the suet and wax, add the castor oil and acid, allow to cool, and add perfume.

Brilliantine

Formula No. 1
(Jelly)

Spermaceti	14
Beeswax	6
Mineral Oil	100
Perfume	1
Color	To suit

Melt the waxes in the mineral oil. Strain and allow to cool to about 115° F. Add perfume; stir until cold.

No. 2
(Solid for Hot Countries)

Ceresin Wax	2 lb
White Wax	0.1 lb
Mineral Oil (Light)	20.0 lb
Lemon Oil	0.32 oz
Geranium Oil	0.16 oz
Bergamot Oil	0.64 oz
Color	Sufficient

Depilatories

Formula No. 1
(Pulling)
Canadian Patent 382,241

Rosin	60
Paraffin Wax	2
Olive Oil	7

Melt together and mix well. Apply in a fluid state.

No. 2
U. S. Patent 2,202,829

Rosin	10
Beeswax	⅔
Mineral Oil	6

To this is added any suitable perfume. In preparing the product, the rosin is first melted in the oil and then the wax in small pieces is added gradually to the heated mixture. Upon cooling, the mass is of the consistency of a smooth paste, which, when not perfumed, is practically odorless. This paste does not harden nor become lumpy, but retains its consistency practically indefinitely.

In using the depilatory, it is spread in a thin layer over a piece of cloth of sufficient size to cover the area where the hair is to be removed. The cloth should be relatively thin and somewhat stiff, and preferably waterproof. The cloth is then firmly applied over the skin where the hair is to be removed, with the coated side of the cloth against the skin. A piece of ice is then held against the uncoated surface of the cloth, or rubbed over the surface. When the skin is thoroughly chilled, which usually takes one minute, one end of the cloth is grasped in the fingers and the cloth quickly pulled or ripped from the skin. This procedure cleanly pulls out all of the hair covered by the paste by the roots, without breaking, and without appreciable pain or irritation.

Under the influence of the ice, the paste has become sufficiently hard and tacky to grip the hairs firmly. When skin from which

the hair has been removed by this product is examined through a magnifying glass it is apparent that the shortest and finest hairs as well as the long coarse hairs have been pulled out and not merely broken at the surface of the skin.

If the ice or other chilling agent is placed in a metal drum, or other thermally conducting container, then it is not necessary that the cloth be waterproof.

No. 3

U. S. Patent 2,062,411

Rosin	5 lb
Beeswax	1 lb 4 oz
Musk Ambrette	7¾ gr
Labdanum Resin	7¾ gr
Oil Soluble Red Dye	¼ gr

Heat in double boiler until melted; mix until uniform. Pour into molds. Sticks of about 3/16 of an inch in diameter for removing hair from the eyebrows, 5/8 inch sticks for use on the upper lip, face and chin, and still larger sticks for melting down and applying on larger areas of the body for full leg or full arm treatment are used. Before application place a stick in hot water. When thoroughly softened apply to skin. The plastic mixture is to be allowed to remain in place for from 3 to 15 minutes. After this period the depilatory may be lifted away and will bring with it the hair which has been imbedded.

Plucking Depilatory

British Patent 478,176

Glucose	210
Flour	20
Beeswax	8

Boil together for 15 minutes with good stirring.

Suppository Base

Formula No. 1

Beeswax	1.5
Cocoa Butter	4.5
Cod Liver Oil	4.0

No. 2

Triethanolamine Stearate	4
Beeswax	3
Cod Liver Oil	20

No. 3

White Wax	2.50
Hard Paraffin Wax	5.00
Wool Fat	5.00
Spermaceti	35.00
Liquid Paraffin, to Make	100.00

No. 4

U. S. Patent 2,055,063

Propylene Glycol Stearate	82
Stearic Acid	½
Triethanolamine	2–3

Corn Plaster Base

a. Rosin Oil	30
Copaiba Balsam	40
Larch Turpentine	20
Rosin, Pale	40
Beeswax, Yellow	12
b. Ethyl Ether	100
c. Sheet Rubber	100
Ethyl Ether	500

Melt up *a* and stir until homogeneous. Strain through a fine-mesh cloth into a wide-mouth metal bottle, and add *b*.

Separately, digest the rubber solution *c* in a wide-mouth

glass bottle, and keep tightly closed. Shake daily, and use as soon as a homogeneous, and pourable solution has formed (this takes about 3 weeks). Add *c* to the wax-resin solution *a* and *b*, and add enough ether to make 800 g.

Use this for the

Salicylic Acid Corn Plaster

Salicylic Acid, Powdered	34
Violet Root, Finely Powdered	70
Sandarac, Powdered	20
Rosin Oil	22
Petroleum Ether	185
Plaster Base, as Above	800

Mix powders, wet with the rosin oil and the petroleum ether, and work in the plaster base.

Corn Salve

a. Pine Rosin, Refined	8
Glyceryl Monoricinoleate	2
Larch Turpentine	10
Beeswax, Yellow	16
b. Salicylic Acid	8
c. Peru Balsam	8

Melt *a*; dissolve *b* in the melted base, and add *c*. Stir until homogeneous, cool, and pour.

Ointment Base

Glyceryl Monostearate	15
Cetyl Alcohol	15
Glycerin	35
Diethylene Glycol	35

Emulsified Ointment Base

Sodium Lauryl Sulphate	0.5
Cetyl Alcohol	8.0
Cocoa Butter	6.5
Petrolatum, White	20.0
Water	65.0

Poison Gas Ointment

Boric Acid (Powdered)	44 gr
Eucalyptus Oil	15 min
Soft Paraffin Wax	to 1 oz

This should be spread on the smooth side of strips of white lint 10 in by 4, stored folded down across the middle to keep the business side of the dressing clean. These are opened out and laid on the skin with a slight overlap and kept in position with the lightest bandaging, changed, if possible, night and morning.

Frost Bite Prevention Creams

Formula No. 1

Lanolin	10
Cocoa Butter	15
Olive Oil	25
White Beeswax	22
Water	25
Borax	1½
Benzoic Acid	½
Perfume	1

Mix the fat, oil and wax at about 49° C., add the solution of borax and water which should be about 10 degrees warmer. The whole mixture should be stirred until the temperature has dropped to 45° C. The last ingredients are the perfume and the benzoic acid which should be dissolved in a little alcohol to make a more "elegant" preparation.

No. 2

Almond Oil	425
Lanolin	185
Beeswax	62
Borax	4½
Spermaceti	62
Distilled Water	300

Corpse Wound Filler

a. Yellow Beeswax	5
Paraffin	5
White Petrolatum	15
b. Soap Flakes	2
Water	5

Finishing Cream (Corpse)

Glycol Stearate	12
Glyceryl Tristearate	5
Rose Oil	2
Glycerin	3
Water	78
Titanium Dioxide	1

Cacao Butter Substitutes

Formula No. 1

Lanolin	6
Spermaceti	3
Olive Oil	1

No. 2

Paraffin Wax	1
Lanolin	1
Olive Oil	1

No. 3

Lanolin	9
Stearin	1
Triethanolamine Stearate	3

No. 4

Beeswax, Sunbleached	2½
Paraffin Wax, Hard	5
Lanolin	5
Spermaceti	35
Mineral Oil U.S.P.	100

Petroleum Jelly

Formula No. 1

Petrolatum (White)	20
Ceresin	3
Paraffin Wax	4
White Light Mineral Oil	73

No. 2

Petrolatum (White)	10
Paraffin Wax	6
Ceresin	3
Ozokerite	2
Cetyl Alcohol	6
White Heavy Mineral Oil	73

Mix all solid components. Heat until melted and dissolved. Heat oil in separate containers 5–10° above temperature needed to melt the solid components. Mix all components and stir well. Pour in containers and allow to solidify without stirring.

Ulcer Salve

Ethyl Aminobenzoate	3
Paraffin	10
Petrolatum	20

Spread on gauze and apply to ulcer.

Liniment or Rheumatic Cream

Formula No. 1

Raisin Seed Oil	9
Methyl Salicylate	15
Diglycol Stearate	15
Water	61

No. 2

Avocado Oil	10
Methyl Salicylate	15
Diglycol Stearate	22
Water	60

Heat diglycol stearate with oil at 70° C., until dissolved. While

mixing add warm methyl salicylate and then pour mixture slowly with rapid mixing into water heated to 70° C.

Cod Liver Oil Ointments

Formula No. 1

Beeswax	10
Spermaceti	10
Cod Liver Oil	80

No. 2

Beeswax, Yellow	20
Petrolatum	50
Cod Liver Oil	40

No. 3

Cod Liver Oil	100
Beeswax	20
Glycerin	20
Petrolatum	30
Lanolin	30
Water	50

No. 4

Beeswax, Yellow	10
Triethanolamine Stearate	10
Lanolin	25
Cod Liver Oil	75

Eczema Preparations

Ointments

Lanolin	200
Petrolatum	200
Beeswax	50
Phenol	5
Camphor	10
Oil Eucalyptus	50
Salicylic Acid	10
Perfume	To suit

Chest Rub

Camphor	15
Menthol	5
Methyl Salicylate	5
Eucalyptus Oil	5
Lanolin, Anhydrous	20
Paraffin Wax, Soft	100

Melt and stir until uniform; pour into jars or tins at lowest possible temperature.

Mentholated Adhesive Tape

Beeswax, Yellow	100
Rosin	750

Melt together; mix until uniform; cool until it thickens slightly and then mix in

Menthol	50

Apply to cloth or rubberized tape.

Non-Staining (Non-Leaking) Mineral Oil

Laxative

White Soft Paraffin Wax	2
Mineral Oil, U.S.P.	6

Warm together and stir until uniform.

Mosquito Repellent Cream

Formula No. 1

a. White Wax	50	g
Spermaceti	50	g
b. Borax	4	g
Ammonia (0.96)	40	g
c. Water	510	cc
Wheat Starch	1	g
Gelatin	4	g
Sodium Benzoate	½	g

Make up cream as usual pouring *b* into *a*, then add the solution *c* which is to be made up before (soak cold, then warm to clear solution, if necessary, pour through a fine sieve), stir thoroughly, stop heating, stir until cooled, and add

Eucalyptus Oil	50 cc

No. 2

White Mineral Oil	16	oz
Beeswax U.S.P.	4	oz
Spermaceti	1	oz
Distilled Water	8	oz
Borax	30	gr
Butyl Salicylate	1½	oz

Mosquito Cream

Glyceryl Monostearate	11.0
Cedar Leaf Oil	4.0
Pennyroyal Oil	4.0
Linalyl Acetate	3.0
Gasoline	5.0
Menthol	0.5
Phenol	2.0
Glycerin	5.0
Water	65.5

Put the glyceryl monostearate into the water, add the glycerin and bring the mixture to the boiling point with constant stirring. Keep stirring and when the temperature drops to about 45° C. add the rest of the ingredients which have been mixed together.

Insect Repellent Cream

Beeswax	3–4
Citronella Oil	15
Spirits of Camphor	8
Cedar Wood Oil	8
White Petrolatum	60

Melt petrolatum and beeswax, then add other constituents and stir until smooth.

Moth Protection Tablets

Naphthalene	225
Camphor	75
Ceresin	50

Melt together and then add

Hexachlorethane	50
Pine Needle Oil	5

Dip cardboards into the above while fluid.

Mineral Jelly

Technical White Oil	45
Ceresin	15
Refined Paraffin (135° F.m.p.)	20
Snow-White Petrolatum	20

Artificial Petroleum Jelly

Ceresin or Paraffin	15–20
White Mineral Oil	85–80

Camphor Ice

Castor Oil	25	oz
White Beeswax	15	oz
Spermaceti	49	oz
Camphor Powder	10	oz
Ethyl Amino Benzoate	1	oz
Carbolic Acid	20	gr

Melt castor oil, beeswax and spermaceti together and add camphor and ethyl amino benzoate. Stir until dissolved. Then add carbolic acid and pour into molds.

Toothache Gum

Yellow Beeswax	60
Venice Turpentine	10
Gum Mastic Powder	10
Ethyl Amino Benzoate	5
Dragon Blood Powder	10
Clove Oil	5

Melt beeswax and Venice turpentine together and add gum mastic. Stir until dissolved. Then add ethyl amino benzoate and, when dissolved, dragon blood. Stir until cooled to about 50° C. then add clove oil and mold into sticks.

Migraine Pencil

Stearic Acid	70
Menthol	30

Melt together on water bath and cast in molds.

Cream, Catarrh

Menthol	2
Eucalyptol	3
Pumilio Pine Oil	3
White Beeswax	1
Hard Paraffin Wax	6
White Soft Paraffin Wax	85

The beeswax and white soft paraffin are melted together and stirred until nearly cold, and the medicaments, previously mixed, are incorporated while the mass is still soft. Some form of closed mixer is desirable, as otherwise there is considerable loss of menthol. The directions on the tube and its carton recommend the frequent use of the cream until the troublesome symptoms are relieved.

"Chest Rub" Salve

Petrolatum brown, 1 pound; paraffin wax, 1 ounce; oil eucalyptus, 2 ounces; menthol crystals, ½ ounce; oil cassia, ⅛ ounce; turpentine, ½ ounce; carbolic acid, ⅛ ounce. Melt the petrolatum and paraffin wax together, then add the menthol crystals and stir till dissolved. Remove from fire, and while cooling add the oils, turpentine and acid. Pour into one-ounce tin boxes when it begins to thicken.

Stick Salve

A base for producing salves in pencil form is as follows: 10 parts coconut oil, 30 parts white beeswax, 22 parts lard and 35 parts lanolin. The base should be carefully melted and agitated and the pulverized medicament thoroughly mixed in the melted mass before it congeals.

Metol Dermatitis Ointment

Many photographers show an idiosyncrasy to metol, which causes dermatitis of their fingers. Other organic chemicals used in photography may cause this, and the following ointment is recommended:

Lanolin	10
Soft Paraffin Wax	15
Ichthyol	5
Boric Acid	15

Rubber gloves should be worn if at all practicable.

Haemorrhoid Ointment (Pile Ointment)

Yellow Petrolatum	53
Lanolin Anhydrous	30
Yellow Beeswax	5
Ethyl Amino Benzoate	5
Bismuth Subgallate	5
Thymol Iodide	2

Melt yellow petrolatum, lanolin and beeswax together and allow to cool. Mix the three powders and triturate with a portion of the ointment base until smooth. Then add gradually the remainder of the base and mix until ointment is homogeneous. Note: This ointment must not come in contact with iron as discoloration will result so only porcelain or wooden utensils should be used.

Agar and Paraffin Confection

Alkanna Root	8	gr
White Soft Paraffin Wax	5	oz
Agar	2½	oz
Citric Acid	40	gr
Lemon Oil	16	min
Sucrose	to 8	oz

Digest the alkanna root in the melted soft paraffin on a water-bath for fifteen minutes, strain on to the agar, citric acid, and sucrose, previously powdered and mixed in a mortar. When cold add the oil of lemon.

Dose: 1 to 4 drams.

Moorhaf's Bone Wax

Iodoform	20
Spermaceti	40
Sesame Oil	40

Heat the ingredients slowly to 100° C. and allow the mixture to cool while stirring. For use as a bone plug it is heated to 50° C.

Antiseptic Cream

Carbolic Acid	5	gr
Camphor	10	gr
Lanolin (Anhydrous)	1	oz
Paraffin Wax (Soft)	1½	oz
Cocoa Butter	½	oz

Melt the lanolin, paraffin, and cocoa butter together. Rub together the carbolic acid and camphor, and when they are liquid, add to the first mixture. Stir until cold.

Healing Plaster

Take two parts of beeswax, four parts of pine tar, and four parts of rosin. Melt these materials together, when almost cool mold into sticks.

In its use, it is found best to heat the wax and apply a thin coat on a piece of muslin and place over the injury.

Polishing of Pharmaceutical Tablets, Pills, etc.

Pharmaceutical tablets are generally polished by tumbling with a carnauba wax-beeswax mixture in a suitable solvent such as acetone. This mixture of natural waxes can be replaced by glyceryl tristearate which will not spot or discolor colored or black coatings. It also effects a considerable economy because of lower cost. In this connection anhydrous ethyl acetate or deodorized naphtha is suggested as solvents.

EMULSIONS

Paraffin Wax Emulsion

Formula No. 1

Paraffin Wax	120 g
Stearic Acid	12 g

Melt together and while stirring vigorously add following heated to 55° C.

Ammonia (26° Bé.)	6 cc
Water	182 cc

Stir until uniform.

No. 2

Glyceryl Monostearate	5 g
Water	150 cc

Heat and stir vigorously until uniform. Pour into this slowly while stirring strongly:

Paraffin Wax (melted)	40 g

No. 3

a. Diglycol Stearate	10
Paraffin Wax	40
b. Water	250
Granulated Sugar	½
Ammonia (26° Bé.)	1

Melt *a* and add *b* (warmed to 40° C.) with vigorous stirring.

No. 4

a. Paraffin Wax	12
b. Stearic Acid	5
c. Trigamine	3
d. Water	80

Melt *a* and *b* at 65–70° C. and add *c* and *d* at same temperature, slowly, while mixing with a high-speed agitator.

No. 5
(Non-Alkaline)

Paraffin Wax	25
Glycol Stearate	5

Melt together and while stirring vigorously add

Water (Boiling)	175

Paraffin Rosin Emulsions

U. S. Patent 1,940,432

In producing paraffin dispersions, various proportions of paraffin and rosin may be used, for instance, from as high as 85% paraffin and as low as 15% rosin to as low as 15% paraffin and as high as 85% rosin. Assuming that a mixture of about 50% paraffin and about 50% rosin is employed, the mixture is melted and heated to about 220° F., which temperature is materially above the melting point of the paraffin (130° F.) and above the melting point of the rosin (about 180° F.). The heat-liquefied thermoplastic mixture is then commingled as a regulated stream flowing, say, at the rate of 15 pounds per minute with a regulated stream of 5% caustic soda solution at 110° F., flowing, say, at the rate of 20 pounds per minute. Under these conditions, an aqueous dispersion of a solids content of about 45% and at a temperature of about 155° F. is produced, which when suddenly chilled to a temperature below 130° F. to prevent coalescence of dispersed particles, is of a creamy consistency. In producing asphalt dispersions, at least about 35% rosin, based on the total weight of thermoplastic material, should be used in order to produce a stable dispersion of fine particle size. Assuming that a mixture of about 50% asphalt having a melting point of about 150° F. and about 50% rosin is employed, the mixture should be heated to about 300° F., whereupon it is brought in contact with a caustic soda solution under practically the same conditions as in the case of the paraffin dispersion, except that

the solution should be at 150 to 160° F. The resulting dispersion has a temperature of about 200° F., and when permitted to cool, is of a smooth, soft, paste-like consistency.

Montan Wax Emulsion

Montan Wax	20
Oleic Acid	5

Heat to 100° C. and add the following heated to 95–100° C. slowly with good mixing:

Triethanolamine	8
Borax	2
Water	185

Opal Wax Emulsion

a. Opal Wax	15
Aminostearin	5
b. Water	75
Sulfatate	5

Heat *a* to 100–105° C. and add to it slowly while mixing with high-speed mixer *b* heated to 95° C. A smooth emulsion results that may be used for a furniture polish.

Ouricuri Wax Emulsion

Ouricuri Wax	13.2
Diglycol Oleate	2.5
Triethanolamine	2.2
Borax	1.0
Water	80.0

Melt wax and diglycol oleate at 80° C., and make solution of other ingredients at same temperature. Add latter to former slowly while mixing vigorously with electric stirrer.

Halowax Emulsions

Formula No. 1

Water	3 lb
Halowax	1 lb
Stearic Acid	53 g
Triethanolamine	27 g

No. 2

Water	3 lb
Halowax	3 lb
Stearic Acid	108 g
Triethanolamine	54 g

No. 3

Water	3 lb
Halowax	13 oz
Halowax Oil No. 1000	3 oz
Stearic Acid	108 g
Triethanolamine	54 g

Melt the wax and stearic acid together and stir. Heat the water and triethanolamine until they start to boil. Add the wax to the water and stir with an electric stirrer and then run through the colloid mill. A good emulsion is obtained if it is cooled quickly after coming from the colloid mill.

Japan Wax Emulsion

a. Japan Wax	36 g
Trihydroxyethylamine Stearate	4 g
b. Water, Boiling	360 cc

Warm *a* to 65° C. and add *b* to it slowly with vigorous stir ring.

Ozokerite Emulsion

Ozokerite	90
Ammonium Linoleate S	14
Water	400

Ceresin Wax Emulsion

1. Ceresin Wax	16
2. Aminostearin	4
3. Water	80

Heat *1* and *2* to 85° C., and add slowly with vigorous mixing to the water at 90–100° C.

Beeswax Emulsion

Beeswax	90
Ammonium Linoleate S	12
Water	500

Esparto Wax Emulsion

a. Esparto Wax	15
Triethanolamine	3
Red Oil	1⅞
b. Borax	1¼
Water	10
c. Water	32½

Heat *d* to 95–100° C. and mix well; run into *b* heated to 95–100° C., beating vigorously; when smooth gel is formed add *c* heated to 95–100° C. and beat vigorously until cool.

Candelilla Wax Emulsions

Formula No. 1

Candelilla Wax	60
Myristic Acid	15
Emulsifier S489	19
Water	To make 375

This gives a very translucent, almost clear emulsion which dries to a transparent film.

No. 2

Candelilla Wax	60
Myristic Acid	13
Morpholine	10
Water	To make 375

This produces a very thin emulsion which is translucent and dries to a transparent film.

No. 3

Refined Candelilla Wax	60
Myristic Acid	13
Emulsifier S489	10
Water	To make 375

This gives a dark but very translucent, thin emulsion with high wax content, which dries to a transparent film.

No. 4

Candelilla Wax	60
Oleic Acid	16
Morpholine	8
Water	To make 375

Very thin, translucent and dries to a transparent film.

No. 5

Candelilla Wax	40 g
Abietic Acid	8 g
Isopropanol	10 cc
Ammonia	15 g
Borax	1 g
Water	To make 400 cc

This gives a thin, amber emulsion, translucent, which dries to a transparent film.

No. 6

Candelilla Wax	30
Flexo Wax C	10
Oleic Acid	8
Ammonia	15
Butanol	10
Water	To make 400

This gives a translucent, thin emulsion which dries to a transparent film.

No. 7

Candelilla Wax	20
Flexo Wax C	10
Oleic Acid	11
Morpholine	4
Water	To make 225

No. 8

a. Candelilla Wax	20 g
Oleic Acid	3 g

Heat to 95–100° C. and then run in the following heated to 95–100° C., mixing with a high-speed stirrer:

b. Triethanolamine	4 g
Borax	2 g
Water	185 cc

No. 9

a. Candelilla Wax	20 g
Oleic Acid	3 g

Use above method adding:

b. Triethanolamine	3 g
Borax	1½ g
Water	185 cc

No. 10

a. Candelilla Wax	30
Triethanolamine	7
Red Oil	5
b. Borax	2½
Water	20
c. Water	150

Method as in esparto wax emulsion.

No. 11

Candelilla Wax	23
Ammonium Linoleate S	3
Water	232
Ammonia	2

Melt wax at 100° C. The ammonium linoleate is thinned by working in 30 cc of water, a little at a time. The balance of water is heated to 95–100° C., and the ammonium linoleate solution is added to it. The whole is boiled and added to the melted wax, a little at a time, while stirring vigorously. Finally add the ammonia and stir until cooled to 50° C.

Carnauba Wax Emulsions

Formula No. 1

Carnauba Wax	60
Myristic Acid	16
Oleic Acid	4
Emulsifier S489	19
Water	To make 375

This gives a very clear, light colored emulsion, almost transparent and which dries to a transparent film.

No. 2

Carnauba Wax	60
Oleic Acid	16
Morpholine	11½
Water	To make 375

This makes a very light colored, translucent emulsion of low viscosity which dries to a transparent film with good gloss.

No. 3

Carnauba Wax	60
Linseed Oil Fatty Acids	13
Emulsifier S489	17
Water	To make 375

This gives a very thin, almost transparent emulsion which dries to a transparent film with good brightness.

No. 4

Carnauba Wax	260.00
Trihydroxyethylamine Oleate	48.50
Triethanolamine	28.00
Borax	11.11
Caustic Soda (50%)	2.22
Water	650.22

No. 5

Carnauba Wax	90
Ammonium Linoleate S	12
Water, Boiling	620

Acid Wax Emulsions

Formula No. 1

Polymerized Glycol Distearate	5
Candelilla Wax	20
Phosphoric Acid (85%)	5
Water (Boiling)	70

No. 2

Polymerized Glycol Distearate	15
Monostearate of Glycerin	15
Paraffin Wax	6
Hydrochloric Acid	9
Water	55

Resin-Wax Emulsions

Formula No. 1

Batavia Dammar	12.5
Beeswax	12.5
Morpholine	1.0
Stearic Acid	1.5
Water	100.0

Melt the beeswax and add the dammar, stirring until the mixture is homogeneous. Stir into this mixture the morpholine and the stearic acid. Add this mixture slowly with stirring to the water which has been heated to about 85–95° C.

This emulsion remains stable and is capable of infinite dilution with water without breaking.

No. 2

Batavia Dammar	25.0
Paraffin Wax	25.0
Oleic Acid	5.0
Morpholine	2.5
Water	250.0

Melt the wax and sift in the dammar. When all is melted, add the oleic acid and stir until the mixture is homogeneous. Do the same with the morpholine. Keeping the mixture hot and continuing the stirring, add the water slowly. The water should previously be heated to about 85–95° C.

No. 3

Batavia Dammar	37.5
Beeswax	37.5
Oleic Acid	8.0
Morpholine	4.0
Water	375.0

Melt the wax. Sift in the dammar. When all is melted, add the oleic acid and stir until the mixture is homogeneous. Do the same with the morpholine. Keeping the mixture hot and continuing the stirring, add the water slowly. The water should be previously heated to 85–95° C.

Santowax Emulsions

Formula No. 1

Santowax M	50.00
Stearic Acid	3.10
Turpentine	50.00
Triethanolamine	0.94
Water	400.00

Dissolve Santowax and stearic acid in turpentine, heating to about 85° C. Dissolve triethanolamine in 100 grams of soft water and heat to 85° C. Add the solution of triethanolamine to the hot turpentine solution with rapid mixing. Mix for about two minutes, then add 300 grams of soft water at room temperature. Continue to mix for ten minutes or more. This gives a smooth, fairly fluid, creamy-white suspension. Fol-

low the same procedure with the formula given below.

No. 2

Santowax M or Santowax 9523	50.00
Turpentine	50.00
Stearic Acid	2.00
Triethanolamine	1.23
Water	400.00

Synthetic Wax Emulsion

Acrawax	10
Ethanolamine Oleate	1
Water	84

Heat to 95–100° C. with vigorous mixing. Continue mixing until temperature drops to 75° C. Then add

Methyl Ethyl Ketone	5

Laundry Calendering Wax Emulsion

Mix 33 parts of paraffin wax with 3 parts of oleine, and pour this mixture into a solution of 0.6 part of strong ammonia in 63.4 parts of water, heated to 160° F.

Stearic Acid Emulsion

Stearic Acid	20
Gelatin	5
Tartaric Acid	3
Moldex (Preservative)	⅔
Water	172

Melt stearic acid at 80° C. and add slowly to other ingredients previously heated to 70° C. and dissolved.

Wax Emulsion Spray

Montan Wax	160
Ammonium Linoleate	40
Water	600

Dissolve the ammonium linoleate in the water and heat to 95–100° C.; pour the wax into this slowly while stirring vigorously. While still hot run through a colloid mill. A stable emulsion that sprays easily results.

Tar Emulsion

Austrian Patent 137,894

Crude Montan Wax	3
Crude Wool Fat	2
Tar	95

Heat to 80–90° C. and while mixing vigorously run into a 1% caustic soda solution heated to 60° C.

Triethanolamine-Wax Emulsions

The water method of emulsification has been developed for use particularly with waxes and other semi-solid materials, such as greases and asphalts, and for the preparation of the wax polishes. It gives very good results, however, in other emulsion problems and is a convenient method whenever stearic acid is preferable to liquid fatty acids.

The following tabulation presents suggestions for the formulae to be adopted for waxes. The proportions of the ingredients are given on a weight basis.

Water Method

Type of Wax	Wax	Stearic Acid	Tri-ethanol-amine	Water
Beeswax	88	9	3	300
Carnauba ...	87	9	4	400
Paraffin	88	9	3	300
Lanolin	80	15	5	200
Japan	85	12	3	400

In this method, the wax or oil is emulsified by means of a water solution of the soap which is made from the triethanolamine and stearic acid. The water is measured out into a container or kettle which can be heated. The triethanolamine is then stirred into this and then the stearic acid is added. On heating, the acid gradually melts and can be stirred into the water to give a smooth soap solution, and the temperature is raised to just below the boiling point. The wax is now melted in a separate container and its temperature brought to 85–95° C. This is then added to the water solution and the whole at once stirred vigorously to obtain a good emulsion. Stirring is then continued gently until the product has cooled.

Colored Liquid Wax-Emulsions

Formula No. 1

Black

Montan Wax, Crude	7
Rosin, Dark	1
Potash Carbonate	1
Water	120
Nigrosine, Water-Soluble	4
Water, 80–90° C.	12

No. 2

Carnauba Wax	10
Montan Wax, Bleached	5
Marseilles Soap	3
Potassium Carbonate	3
Water	160
Nigrosin, Water-Soluble	0.1– 0.4
English Red	15
Chrome Orange	6

Emulsify the melted waxes with the alkali (soap) solution; in the former case, the dye solution is added last. In the latter case, the dye is dissolved in the emulsification water. The pigments are then worked in on a pigment mill.

Emulsifying Wax

U. S. Patent 1,932,643

Melt together 65 parts of spermaceti with 25 parts of cetyl alcohol and 10 parts of stearic acid. This product has a fusing point of about 50° C. and in the molten state is capable of combining with as much as 600% of its own weight of a 2% sodium carbonate solution.

FOOD PRODUCTS

Chewing Gum Bases

U. S. Patent 2,137,746

Formula No. 1

Jelutong (Dry)	92
Paraffin Wax (M.P. 168° F.)	8

No. 2

Ester Gum	30
Coumarone Resin	45
Latex (Dry)	15
Paraffin Wax (M.P. 180° F.)	10

No. 3

Jelutong (Dry)	80
Gutta Siak	15
Paraffin Wax (M.P. 176° F.)	5

No. 4

Pontianac Gum	425
Gutta Katian	400
Gutta Soh	75
Candelilla Wax	60

No. 5
(Bubble Gum Base)

Washed Pontianac Gum	425
Washed Gutta Katian	400
Washed Gutta Soh	75
Candelilla Wax	10

The mixed gums and wax are heated until the total batch contains only 8–9% moisture.

Artificial Honey Combs

a. Beeswax, Yellow	45 kg
Paraffin Wax (52/54° C.)	40 kg
Ceresin	10 kg
Japan Wax	5 kg
b. Beeswax-Perfume	About 25 g
Honey-Perfume	Small amount

Melt *a* with steam, add *b* and mix thoroughly. Pour out into shallow dishes.

Rewarm on the water bath and roll to give it the honeycomb-shape.

Egg Preservative

British Patent 409,623

Eggs are coated with following:

Soft Yellow Paraffin Wax	75
Tallow	5
Boric Acid	20

Coating for Sausages

Paraffin Wax	35.0
Rosin	62.8
Whiting	2.2

Margarine

Formula No. 1

U. S. Patent 2,173,203

1. Glyceryl Monostearate	85 lb
2. Coconut Oil (76° F. Titer)	800 lb
3. Cotton Seed Oil, Winterized	125 lb
4. Cultured Milk	50–55 gal

Melt *1*, *2* and *3* and mix: churn with milk, temper, work and salt.

No. 2

U. S. Patent 2,089,470

Soya Bean Lecithin (60–65%)	100
Glyceryl Distearate	100
Melt together and mix in	
Water, Hot	100
Add and mix in	
Water, Warm	500

One pound of above is added to 100 lb plastic margarine.

Increasing Melting Point of Butter

Butter, for use in hot climates, is mixed with melted glyceryl tristearate (an edible product), in various amounts, to increase its melting point.

Wax Coatings for Cheese [1]

In the manufacture of cheese, the curd is pressed into the desired shape or size and allowed to remain exposed to the atmos-

[1] Parsons, U. S. Patent 2,322,198.

phere for a short period. During this exposure, the surface of the cheese curd dries out to form a rind on the block of cheese. In order to prevent excessive mold growth on the surface of the cheese during the aging period, the cheese, after the rind has formed, is generally dipped into molten paraffin. Since the surface of the cheese is somewhat moist or oily, the paraffin does not always adhere firmly to the surface.

During the aging or storage period, the cheese is generally subjected to temperatures below ordinary room temperatures. Since the paraffin is somewhat brittle, particularly at storage temperatures and since it does not adhere firmly to the cheese, the coating cracks and small pieces of paraffin will chip from the surface of the cheese. As a result, an excessive mold growth may develop along the lines of the cracks and wherever the coating has become chipped from the surface.

Formula No. 1

Green cheese directly from the molds and containing a substantial amount of moisture and oil on the surface is coated with a mixture of 85% of paraffin wax and 15% of a mixture of monoglycerides and diglycerides prepared by glycerinating partially hydrogenated cottonseed oil. The wax adheres firmly to the surface without chipping or cracking over a wide temperature range.

No. 2

Aged cheese is wiped to remove a portion of the oil, mold and slime on the surface and is then coated with a mixture of 85% of amorphous wax of melting point of about 135–145° F. and 15% of mono- and diglycerides similar to those of Formula 1. The coating adhered firmly to the surface and appears to absorb the moisture.

No. 3

U. S. Patent 2,299,951

Paraffin Wax	50
Rubber Hydrochloride	5–15
Microcrystalline Paraffin Wax	To make 100

No. 4

U. S. Patent 2,102,516

White Scale Wax (M.P. 50–55° C.)	50–85
Petroleum Wax (M.P. 55–60° C.)	50–15

In thin layers this wax is flexible at cold storage temperatures.

No. 5

Wash the cheese which should not be less than 10 days old, with warm water containing 1% of ordinary blue lime, dry thoroughly and dip in paraffin wax (M.P. 130–135° F.) heated to 300° F. and containing:

Amber Petrolatum	5.0–10.0
Petrolatum Ceresin	1.0– 2.5
Carmine Red Paint, Oil-Soluble	2.0– 3.0

LEATHER AND FURS

Leather Finishes

Formula No. 1

Castile Soap	15 lb
Carnauba Wax, No. 1 Yellow	5 lb
Candelilla Wax	5 lb

Dissolve the soap in 8 gallons of water by boiling for 1 hour, adding water as it is lost by evaporation, then add melted wax and continue boiling for two more hours, then add water enough to make a total of 10 gallons. Strain the mass through 4 layers of cheese-cloth.

No. 2

Carnauba Wax	300 lb
Dry Castile Soap	40 lb
Water	50 gal

Boil soap in water for 30 minutes: add wax and boil for 30 minutes. Add water to make 150 gallons. This is mixed with casein shellac solutions for leather finishes.

Waterproofing for Leather

Formula No. 1

U. S. Patent 2,026,453

Impregnate with following melted mixture:

Paraffin Wax	16 oz
Rosin	2 oz
Burgundy Pitch	1 oz
Neatsfoot Oil	1½ oz
Wood Alcohol	1 oz
Cod Oil	1 oz
Wintergreen Oil	5 drops

No. 2

French Patent 801,828

Rosin	100 g
Paraffin Wax	100 g
Petrolatum, Liquid	350 g
Turpentine	100 g
Beeswax	100 g
Neatsfoot Oil	200 g
Linseed Oil	50 g
Benzaldehyde	1 cc

No. 3

Impregnate leather with emulsion at 45° C.

Fish Oil	36.5–54.5
Alizarin Oil or Pine Oil	0– 4.0
Paraffin Wax	36.0–50.0
Diglycol Stearate	7.5–10.0
Ammonia	0.5– 2.0

No. 4

Gutta-Percha	2
Rape Seed Oil, Boiled	8
Yellow Wax	6
Pig Fat	25
Venetian Turpentine	60
Spermaceti	1

No. 5

Linseed Oil	100
Gutta-Percha	10
Copal Varnish	A little

Waterproof Boot Dressing

Spermaceti	3 oz
Raw India Rubber	6 dr
Tallow	8 oz
Lard	2 oz
Amber Varnish	5 oz

Leather Preservative

Swiss Patent 171,374

Linseed Oil	0.20
Beeswax	2.20
Naphtha	2.46
Turpentine	5.00

Weatherproofing Leather Harness

Formula No. 1

Beeswax	20
Paraffin Wax	5
Varnish	75

No. 2

Benzol	20
Paraffin Wax	5
Stearin	3
Color	To suit

Black Harness Oil

Ceresin	2
Ozokerite	2
Cod Oil	32
Herring Oil	26
Whale Oil	14
Pale Oil No. 100	22
Nigrosine Base	2

Mix all components, except dye, until melted and dissolved. Add dye; mix thoroughly and let it cool.

Leather Oiling and Finishing

Formula No. 1

Neutral Wool Grease	8
Dark Petrolatum	4
Paraffin Wax	4

No. 2

Petrolatum	16
Beeswax	2

Black Leather Fat

	Formula No. 1	No. 2	No. 3
Paraffin Wax	8	4	5.2
Wool Fat, Raw	2	1	—
Montan Wax, Crude	4	3	3.9
Carnauba Wax, Gray	2	—	—
Nigrosine, Fat-Soluble	1	0.3	0.39
Train Oil	8	4	5.4
Mineral Oil	60	28	32

Leather Grease

Scale Wax (50/52° C.)	8
Montan Wax, Bleached	7
Woolfat	10
Train Oil, Pale	50
Spindle Oil, Distilled	25
Oil-Soluble Dye	1–2

Belt Preserving Grease

Formula No. 1

Beef Tallow	50
Paraffin Wax (50/52° C.)	10
Turpentine	10
"Saturated-Steam-Cylinder Oil," Very Fluid	50
Rosin, Ground	10

Melt the first three ingredients on the steam-bath, add the oil, stir until cooled, and stir in the rosin.

No. 2

A liquid belt dressing formula contains beeswax 4 lb, pitch 5 lb, resin 3 lb, neatsfoot oil 13 lb. The beeswax is melted first and the other ingredients are added in the order named.

Belt Adhesion Compound

Formula No. 1

Rosin	25
Woolfat, Anhydrous	20
Rape Seed Oil, Blown	20
Tallow	25
Scale Wax (50/52° C.)	10

Melt all ingredients together and mix until uniform.

No. 2

Cumarone Resin	35–40
Montan Wax, Bleached, Nova	5–10
Train Oil	55

Government Harness Dressing

Neatsfoot Oil	1 gal
Bayberry Tallow	2 lb
Beeswax	2 lb
Beef Tallow	2 lb
Castor Oil	1 qt
Lampblack	1 oz

Leather Stuffing

Ozokerite	6
Paraffin Wax	8
Rosin Oil	40
Mineral Oil	48

Leather Stuffing Grease

Formula No. 1

Montan Wax, Crude	12
Ceresin	3
Woolfat, Neutral	5
Car Waste Oil	50
Birch Tar	3
Train Oil	27

No. 2

Yellow

Ozokerite-Ceresin, Yellow (58/60° C.)	17
Spindle Oil, Distilled	83

No. 3

Yellow

Scale Wax, Yellow (50/52° C.)	10
Montan Wax, Bleached	10
Rosin, Pale	5
Spindle Oil, Distilled	75

No. 4

Brown

Montan Wax, Crude	10
Rosin, Dark	10
Scale Wax	5
Spindle Oil, Distilled	75

No. 5

Black

Montan Wax, Crude	12
Rosin, Dark	10
Scale Wax	3
Spindle Oil, Distilled	73
Nigrosine, Oil-Soluble	2

No. 6

Black

Montan Wax, Crude	15
Ozokerite-Ceresin, Yellow	3
Woolfat, Crude	5
Black Leather Dye, Oil-Soluble	2
Spindle Oil, Distilled	75

No. 7

Ozokerite	3
Paraffin Wax	5
Woolfat, Neutral	10
Mineral Oil	22
Train Oil	60

Stuffing Fat-Liquors for Leather

Formula No. 1

Montan Wax, Bleached	10
Fish Train Oil	3
Paraffin Oil	35
Woolfat	25

No. 2

Montan Wax, Crude	10
Ceresin (64–70° C.)	16
Train Oil	30
Spindle Oil	44

Dubbing, Leather

Ceresin	9
Aluminum Stearate	1
Neatsfoot Oil	40
Tallow	50

Belt Dressing

Formula No. 1

Woolfat	50
Mineral Oil (0.885)	20
Paraffin Wax (56–58° C.)	10
Ceresin, Yellow (58–60° C.)	5
Castor Oil ("Second Pressing")	10
Degras	5

No. 2

Resin	40
Train Oil	10
Cotton Seed Oil or Sperm Oil, Blown	15
Paraffin Scale Wax (48–52° C.)	15
Mineral Oil (sp. gr. 0.905)	20

No. 3

a. Woolfat, Neutral	30
Tallow	20
b. Graphite, Amorphous	10
Castor Oil	10

Melt up the fats *a,* stir them into the fusion graphite, and castor oil. Press. The product is soft and like a salve.

No. 4

Rosin	65
Tallow	6
Stearic Acid	1
Scale Wax	20
Castor Oil	2.0
Rosin Oil	0.5
Lanolin	4.2

Old Leather Freshner

(Book Covers)

Beeswax	1
Cedarwood Oil	1
Lanolin (Anhydrous)	8
Naphtha, Dry Cleaners'	12

Melt wax and lanolin, add cleaning solvent (fire hazard!) and stir until cool. Add the oil of cedarwood while mixture is cooling and pour into bottles for storage.

Shake before using. Treat leather thoroughly, but do not allow mixture to reach the leaves of the books. Avoid use on calfskin, which is better handled with milk followed by petrolatum.

Neutral Shoe Cream

Carnauba Wax	6
Ceresin Wax	3
Candelilla Wax	3
Turpentine	5
Lemongrass Oil	½
Light Mineral Oil	1
Diglycol Stearate	5

Heat together below 90° C. and stir till clear. Pour slowly while stirring with high speed stirrer into

Water (Boiling)	100

Stir until temperature falls to 70° C. The finished product is snow-white, applies easily and rubs to a high gloss.

Paste Shoe Polish

Carnauba Wax	25 g
Ceresin	10 g
Triethanolamine	1 cc

Melt together and stir; add following slowly:

Turpentine	30 cc
Deodorized Kerosene	5 cc
Gasoline	30 cc

For black polish add 1% oil black dye.

For brown polish add brown iron oxide sufficient to color.

The above mix is poured into cans at 35° C. and allowed to set.

Calf Leather Cleaner and Polish

Water	20	gal
Potassium Oleate	7½	lb
Trisodium Phosphate	½	lb
Yellow Beeswax	6	lb
Yellow Carnauba Wax	6	lb
White Spirits, Turpentine, or Benzol	4½	gal
Pine Oil	½	gal
Terpineol	1	qt

Dissolve first three materials and bring to a boil; other materials are melted together and run into first solution while stirring vigorously.

Hardener for Shoe Soles

Formula No. 1

British Patent 433,207

Sodium Silicate	7
Iron Oxide	1
Soap	1
Carnauba Wax	7
Gum Arabic	1
Sodium Carbonate	1

Yields a plastic mass which is aplied between outer and inner soles.

No. 2

Beeswax	12.50
Turpentine	12.50
Castor Oil	12.50
Wood Tar	3.25
Linseed Oil	125.00

Heat up the mixture to get a homogeneous oil.

Apply hot on dry soles.

No. 3

a. Asphalt	60
Ceresin	40
Train Oil	200
Linseed Oil	700
b. Rubber, 10% in Benzene	30

Dissolve *a* hot. Cool. Add *b*. Mix.

No. 4

Tallow	500
Beeswax	500
Rosin	30
Linseed Oil	15

Apply hot.

No. 5

Beeswax	25
Ozokerite or High Melting Petrolatum	40
Rosin	35

Shoe Sole Paint

Formula No. 1

Brown

Montan Wax, Double Bleached	25
Beeswax	25
Paraffin	25
Linseed Oil	2
Iron Oxide Red or Brown	22
Brown Dye, Oil-Soluble	1

No. 2

Venetian Red	1 lb 4 oz
Fast Brown	2 lb 8 oz
Gum Arabic	2 lb 12 oz
Water	43 lb 12 oz

A mucilage is made with the gum, and then, using water, a paste is made with the pigment, and then thinned down, using more water. Make a solution of the dyestuff, mix the pigment-water mixture with the mucilage then add balance of water.

	No. 3	No. 4	No. 5
Red Iron Oxide	2.0	4.0	16.0
China Clay	13.5	13.5	13.5
Yellow Ochre	11.0	12.0	—
Middle Chrome Yellow	3.0	—	—
Gum Arabic	9.5	9.5	5.0
Water	61.0	61.0	61.0

Conservation of Shoe Soles

Melt up:

Linseed Oil	50–60
Paraffin	40–50

Heat 80° C.

Treat soles with this mixture after thorough cleaning, 2 or 3 times in 4–6 weeks.

Shoe Bottom Dressing

Montan Wax, Bleached	10
Paraffin (or Scales), White (50–52° C.)	10
Anilin Dyestuff (Oil-Soluble)	2
Turpentine Oil (or Substitute)	54

Liquid Burnishing Wax for Shoe Soles

Carnauba Wax	20.0
Turpentine	20.0
Black Dye (Oil-Soluble)	3.0
Duponol W.E. or Lohrinol	5.0
Ferric Acetate	6.0
Glacial Acetic Acid	0.2
Water	45.8

Reduce the ferric acetate to a powder and dissolve same in the acetic acid and water mixture. Dissolve the Duponol W. E. in the above solution and heat to about 170° F. Melt the carnauba wax and pour into the turpentine which has been previously heated to about 180° F., dissolve the black dye in this mixture, and then add this latter solution to the former while agitating vigorously. Allow to cool with continued agitation.

Shoemaker's Polishing Wax

Carnauba Wax, Yellow	26–28
Olein (Low Titer)	10– 7
Abrasive (Tripoli, Bole, Clay, etc.)	64–65

Shoemaker's Brushing Wax

Carnauba Wax, Yellow to Tan	63
Lacquer Benzine (0.78–0.80)	37

Polishing Wax for Lacquered Heels

Paraffin Wax (50/52° C.)	27.5
Spindle Oil, Pale	13.5
Chalk, Finest Powder	59.0

Black Padding Wax

Carnauba Wax (North Country)	40
Ozokerite (Green)	2
Paraffin Wax	58
Rosin	2
Oil-Soluble Black Dye	7

Shoe Finishers' Black Stick Wax

Candelilla Wax	9
Rosin	1
Carnauba Wax (North Country)	32
Oil-Soluble Black Dye	6
Carbon Black	¼
Paraffin Wax	1

Shoemaker's Hard Wax

Rosin	8
Ester Gum	2
Montan Wax, Crude	30
Paraffin Wax	45
Stearin Pitch	10
Beeswax	5
Oil-Soluble Color	To suit

Shoemaker's Soft Wax

Rosin	5
Paraffin Wax	65
Japan Wax	5
Stearin Pitch	20
Beeswax	5
Oil-Soluble Color	To suit

Shoemaker's Thread Wax

Formula No. 1

Rosin	76.5
Tallow	8.5
Beeswax, Yellow	15.0

Melt and stir until uniform. Pour into containers at lowest possible temperature.

No. 2

Rosin	54 lb
Beeswax	6 lb

Melt and stir until uniform. Cool to 150° F. and add

Benzene	9½ gal

No. 3
(Sticky Wax)

Rosin (X Grade)	74
Glaurin (Plasticizer)	1
Petrolatum	20
Water	5

No. 4

Candelilla Wax	2
Rosin	55
Burgundy Pitch	20
Rosin Oil	4
Lard	3
Mineral Oil (Heavy)	1

No. 5

Ozokerite, Refined	70
Beeswax	30
Linseed Oil	5–10

Wax Stick to Cover Small Defects of Shoe Leather

Black

Montan Wax, Crude	28
Carnauba Wax, Gray	7½
Shellac Wax	7½
Beeswax	20
Paraffin	20
Linseed Oil	2
Nigrosine Stearate	15

Brown

Montan Wax, Double Bleached	25
Beeswax	25
Paraffin	25
Linseed Oil	2
Iron Oxide, Red or Brown	22
Brown Dye, Oil-Soluble	1

Shoe Wax Finish

Orange Shellac	14
Alcohol	60
Carnauba Wax	2
Paraffin (50/52° C.)	1
Turpentine	23

The shellac is dissolved in the alcohol either in the cold or with the aid of heat. The waxes are melted and thinned with the turpentine. The shellac solution is warmed to about 122° F. and the warm (140° F.) wax solution is slowly stirred into the alcohol solution. The mixture is allowed to cool under constant stirring. The mixture may be colored with suitable dyestuffs.

The wax stains are either solutions of wax in turpentine or emulsions of wax in water. The emulsions are stabilized with the aid of alkalies, such as ammonia or potash. They are colored with water-soluble dyes. The proper selection of waxes insures the desired gloss, harder waxes giving a higher gloss than so-called soft waxes. Such a stain may have the following composition:

Shoe Wax Stain

Carnauba Wax	4
Ozokerite, Refined	2
Paraffin (50/52° F.)	2
Sudan Yellow Dye	2
Thinner	90

When preparing a turpentine stain, the waxes are melted and thinned. The dye is best dissolved in the waxes before adding the ozokerite. The thinner should be warmed before adding it to the molten waxes. The mixture is allowed to cool while stirring constantly to avoid a separation of the components.

A water emulsion stain may have the following composition:

Shoe Emulsion Stain

Montan Wax, Double Bleached	7.0
Potassium Oleate	3.0
Potash, Caustic	0.8
Water-Soluble Dye	2.0
Water	87.2

The potash, the soap and the dye are dissolved in the boiling water. The boiling solution is then slowly poured into the wax melt adding it in small portions at a time. Care must be taken that a drop in temperature does not cause a separation. It is essential that the mixture be stirred constantly while cooling.

Softening and Flexibilizing Dyed Furs

Diglycol Stearate	10 lb
Water	12 gal

Boil together and mix until uniform. Cool to room temperature and add to it 107 gal of dye-bath solution. Dye in the usual way. If salts are present in the dye-bath, the addition of a wetting agent, such as Wetanol is necessary.

Glazing Furs

Formula No. 1

U. S. Patent 1,952,137

Add 10 parts of ammonium linoleate to 500 parts of water and to this mixture is added 50 parts of melted carnauba wax.

The liquid used for treating furs is made by adding 4 ounces of the above wax emulsion to a gallon of water and in some cases add to the emulsions so employed 2 ounces of a mordant, such as aluminum acetate for each gallon of water used. The complete mixture will therefore consist of 1 gallon of water, 2 ounces of aluminum acetate and 4 ounces of wax emulsion prepared as above described.

The furs are immersed in this luke-warm emulsion for approximately 15 to 20 minutes, after which time the superfluous liquid is drained off by centrifuging or otherwise. The furs are then dried, drummed with sawdust and finished in the usual way by which operations a slight protective film of waterproof wax is left upon the surface of the fur and skin.

It should be noted that instead of immersing the furs in this luke-warm emulsion, the

hair of the furs can be brushed or sprayed with the same liquid above described, the subsequent processes of drying and drumming with sand or sawdust or similar material and finishing being the same as now generally employed.

No. 2

Dissolve 3 to 6 oz of paraffin wax in 1 gal petroleum cleaning solvent.

Approved cleaning solvent is preferable because of its safety during ordinary handling.

Precaution: Paraffin separates from the petroleum solvent at temperatures below 70° F. At —15° F. it is completely chilled out of the solvent.

This finish is used for the saturation of dry-cleaned furs to replace any oils removed and to make them water-repellent. It is also sponged or sprayed on materials that are lifeless or lusterless after cleaning and dying to produce high gloss.

METAL TREATMENT

Abrasive for Polishing Hard Metals

U. S. Patent 2,129,377

Silica, Powdered	1250
Alumina	750
Tripoli	250
Petroleum Jelly	250
Ceresin Wax	25–250
Tar or Asphalt	25–250

Melt last three materials and stir in powders and mix until uniform.

Tripoli Buffing Stick

Double-Pressed Stearic Acid	30
Edible Tallow	25
Paraffin Wax	25
Tripoli Flour	20

A buffing or polishing paste may be made, using the above formula with the addition of a small amount of turpentine and of water, to bring to the consistency desired.

Anti-Rust Compound

Paraffin Wax	6
Asphaltic Still Residue (About 1000 visc. at 210° F.)	94

Cream for Preventing Silver Tarnish

U. S. Patent 2,144,642

Carnauba Wax	4½ lb
Stearic Acid	18 oz

Melt together at 100° C. and to this add slowly, with vigorous stirring the following boiling mixture:

Triethanolamine	5 fl oz
Water	4 gal

Apply on silver and wipe off leaving a very thin film.

Metal Etching Stop-Off

Formula No. 1

Wax	4
Rosin	2
Pitch	1

This coating is used as a general stop-off material and is made by melting the above mentioned quantities of materials in a kettle, after which are added 4 oz of finely powdered asphalt. The following stop-off is also recommended particularly as being very hard and possessing good resistance to strongly acid etching solutions:

No. 2

Black Pitch	1
Japan Wax	2
Rosin	1
Dammar, Gum	1

To the above mentioned quantities, melted together in a kettle, is added 1 oz of turpentine.

For etching, an entire series of etchants are available but usually dilute solutions of nitric acid are used on metals other than gold or platinum. Strong acids are not suitable because of the lifting of the stop-off material by the evolution of gas resulting in non-uniform and dull etching.

Gum for Parting Punch from Die

Beeswax	1
Rosin	½
Venice Turpentine	¼

Soldering Paste

Formula No. 1

Ceresin	10
Stearic Acid	30
Rosin	22
Zinc Chloride, Anhydrous	38

The first three components are melted in a steam-heated kettle and when liquid the zinc chloride is stirred in. It will result in a granular structure.

No. 2

Ammonium Chloride	29
Sulphur (Powder)	33
Rosin	2
Paraffin Wax	9
Tallow	21
Salt	5
Balsam	1

The paraffin and tallow are melted in a steam-heated kettle and while molten the other solids are stirred in; the balsam is added after the mixture has been removed from the heat.

Aluminum Protection

As a protective coating for aluminum casting against corrosion, particularly where such parts are to be used at low temperatures causing condensation of liquid water or at temperatures below 32° F.; with frequent cycles of condensation and subsequent freezing or frost or ice, and then defrosting, a blend of Flexo Wax C, diglycol stearate S and paraffin, (cf article) has proven to be most effective.

Diglycol Stearate S	10
Flexo Wax C	20
Paraffin Wax	40

The waxes are melted together until a uniform blend is obtained. Seven parts of this blend are then dispersed in forty parts of water heated to 200° F.,

and stirred until cool. The castings can then be dipped into the dispersion. The use of this aqueous dispersion has eliminated fire hazard and cost of maintaining high temperatures, both of which were entailed in the previous method used where hot paraffin was dipped or sprayed onto the metal.

For ferrous and non-ferrous metals use of the above wax blend has replaced with equal satisfaction the use of solvent-oil-grease slushes as a protective coating on ferrous as well as non-ferrous metals. It enables replacement of hazardous solvents with water thus also effecting worth-while economies. In addition to giving a firm, flexible film as the protective coating that will not "smear" off or collect dirt and grime, this was blend dispersion tends to inhibit electrochemical action resulting in corrosion whereas all greases do not. It is of interest to note that a wax will seek out rust, whereas oils seem to flow around corroded areas and thereby fail at points where they are most needed.

Aluminum Lubrication

Aluminum anti-seize compounds of particular interest in the lubrication of delicate airplane parts and mechanisms that must remain freemoving under varying conditions of temperature, can be made by using diglycol stearate S as a base wax. Typical formulae are listed below:

		Temperature Limits °C.
Diglycol Stearate S-125	80	
(Glyceryl Monoricinolcate), or		–35 to 70
Dibutyl Phthalate, or	20	–55 to 70
Tricresyl Phosphate		–20 to 70

The wax and the plasticizer are heated together until complete solution is obtained. A 35% alcohol solution is made of the resultant blend which can then be brushed, sprayed or wiped on to the metal parts. This gives a thin flexible film having high lubricity that will not flake at the lower temperatures, nor flow off or volatize at the higher temperature limits. By varying the amount and type of plasticizer a wide range of lubricants, having other interesting properties, is possible.

Metal Stamping Lubricant

Enameled or lacquered metal can be stamped without chipping or fracturing of the coating by the use of diglycol stearate S dispersed in water.

Diglycol Stearate S	1
Water	100

The wax is dispersed by

means of heat in the water and is stirred until cool. The dispersion can be sprayed on the lacquered metal sheets or in semi-automatic operations, brushing or spraying is satisfactory. This operation, carried out prior to stamping, is a considerable improvement over the old hot paraffin wax method by eliminating "spotting" and a greasy surface to the finished lacquered stampings, as well as effecting considerable reduction in operating and material costs.

Metal Powder Molding Lubricant

Sintered bearings made with metallic powders can now be very readily released from their molds by the use of a new lubricant, Acrawax C.

The method of procedure for use as a mold lubricant is to blend 15% of Acrawax C and 85% of stearic acid, by melting them together. Then 2–4% of this wax mixture, based on the weight of the metallic powder, is added to the metallic powder and the whole heated above the melting point of the wax mixture and tumbled in the usual way. The metallic powder, after pressure forming, will release very readily from the mold.

Lubricant

Grease (Drop Point 70° C.)

Caustic Soda, Technical (38° Bé.)	3
Montan Wax, Crude	15
Mineral Oil, Dark	82

Graphite Grease

Ceresin	70
Tallow	70

Heat together to 80° C. and work in

Graphite	30

Air Seal Grease for Glass Joint

Melt together beeswax and castor oil in proportions to suit use—should be tacky but not too stiff.

Grease for Pressure Lubricants

Refined Montan Wax	22
Oleic Acid	5
Engine Oil (6–7° E. at 50° C.)	67
Lime Hydrate	3

Hot-Bearing Grease

(For heavily loaded, hot bearings)

Formula No. 1

Tallow Fatty Acid	14.0
Montan Wax, Refined	3.0
Engine Oil (6–7 E. at 50° C.)	79.5
Lime Hydrate	1.5
Caustic Soda (40° Bé.)	3.0

Ball Bearing Grease

Paraffin Wax (40–42° C.)	16
Ozokerite, Refined	4
Spindle Oil, Containing Paraffin (Visc. 2 E. at 50° C.)	80

Cock Valve Grease

(For Benzine, Gas, Organic Solvents, below 180° C.)

Tallow	700
Paraffin Wax	80
Sodium Hydroxide, Solid	110
Potassium Hydroxide, Solid	20
Aluminum Sulphate	20
Calcium Oxide	30
Magnesium Chloride	30

Cup Grease

a. Montan Wax, Bleached	20
Mineral Oil, Pale	33
b. Caustic Potash (24° Bé.)	8½
c. Mineral Oil, Pale	42

Melt *a*, and add *b* in thin jet with vigorous stirring, keeping the mass at boiling.

Carriage Greases

Formula No. 1

Yellow

a. Montan Wax, Bleached	20
Rosin	5
b. Mineral Oil, Pale	30
c. Caustic Soda (24° Bé.)	5½
d. Mineral Oil, Pale	42

Melt *a*, dilute with *b*, saponify with *c*, dilute with *d*.

No. 2

Natural Color

a. Montan Wax, Crude	18
Rosin	3
b. Paraffin Oil, Dark	30
c. Caustic Soda (36° Bé.)	5
d. Mineral Oil	46

Lubricating Grease

Formula No. 1

(Light-Colored)

Lime Hydrate, Powdered	5
Oleic Acid	10
Montan Wax, Doubly Bleached, St.	25
Spindle Oil, Pale	80

No. 2

(Dark)

Rapeseed Oil or Deodorized Train Oil	5
Caustic Soda, 10%, Technical	10
Crude Montan Wax	25
Mineral Oil (sp. gr. 0.910)	260

Dry Brittle Lubricant

U. S. Patent 2,089,506

Petroleum Jelly	18
Mineral Oil	18
Mica, Flaked	5
Paraffin Wax	59

Greaseless Lubricating Pencil

Formula No. 1

For lubricating hinges, automobile doors, etc., the following is useful as it will not run off and produce stains.

Beeswax	100
Graphite Powder	50–100

Melt together and stir until a little above room temperature. Pour into molds and allow to cool.

No. 2

Beeswax	80
Diglycol Stearate	20
Graphite Powder	100–200

Melt together and stir until just cold enough to pour. Pour into molds and allow to set.

No. 3

Petrolatum	10
Paraffin Wax	10

Melt together, mix well and pour into cardboard molds.

Die Member Lubricant

U. S. Patent 2,276,453

Stearic Acid	20–30
Spermaceti	4–6
Lanolin	4–6
Borax	1–3
Water	To make a good emulsion

Porcelain Mold Oil

Stearic Acid	24
Ozokerite	1
Paraffin Wax	3
Heavy Mineral Oil	82

Plastic Mold Lubricant

Bright Drying Carnauba Wax Emulsion	2 oz
Pine Oil	5 drops

The above is sprayed into mold, before use, and permits easy ejection of molded articles.

Lubricating Compound for Tin Stamping

Diglycol Stearate S	1
Water	100

The Diglycol Stearate S is dispersed by heating while stirring in the water. This is applied prior to stamping and is considerably cheaper than the old wax lubrication method. It permits stamping of lacquered metal without fracturing the coating.

Cogwheel Lubricant

Formula No. 1

Ceresin, Talc, Boiled Linseed Oil, Blown Rape Oil	5 lb each
Woolfat, Crude	40 lb
Graphite	40 lb

No. 2

(Liquid, leaving a tacky, solid mass on the wheel after cooling)

Ozokerite	7
Colza Oil, Blown	10
Tallow	20
Woolfat, Neutral	15
Carbon Tetrachloride or Other Solvent	8
Graphite (Flakes)	40

Graphite Lubricants

Formula No. 1

(Stick Form)

Ozokerite	30
Beeswax	13
Rosin	10
Castor Oil	5
Graphite	33
Carbon Black	9

The rosin and castor oil mixture is stirred over direct heat until a clear liquid results, which is poured into the waxes which have been melted by hot water or steam heat. The pigments are stirred in, heating is continued, and when a smooth cream results the heating is stopped and cooling allowed to proceed until viscous. Then it can be poured into cold molds of the hinge type.

No. 2
(Paste)

Paraffin Wax	10
Candelilla Wax	10
Graphite	20
Naphtha (Varnoline)	59
Lavender Oil	1

The waxes are melted by hot water or steam and poured into the naphtha, which has been heated to the same temperature as the wax and in a similar manner.

The graphite and perfume oil are stirred into this and kept hot until a smooth slurry results, when heating can be stopped. When cooling has proceeded to the point where stirring is difficult, the mixture, still plastic, can be poured into tin cans to cool and set.

No. 3
(Liquid)

Asphalt (By-Product)	11
Asphalt (Gilsonite)	6
Paraffin Wax	10
Naphtha (Varnoline)	25
Graphite	20
Carbon Tetrachloride	25
Nigrosine (Oil-Soluble)	3

The natural asphalt is first crushed and heated until it can be stirred; then the by-product asphalt is poured in and heating continued until a homogeneous liquid results. The paraffin is then added, and after it has melted, the container is removed from the flame and the naphtha stirred in. When it is homogeneous the black liquid is passed through a screen to remove coarse minerals always present in gilsonite. In the meantime, the graphite and nigrosine are soaking in the carbon tetrachloride, and when both containers are at room temperature, the contents are mixed and are ready for packaging. In view of the fact that graphite forms aggregates or lumps in mixtures, where water is absent, it might settle to the bottom upon long standing and not be redispersed with vigorous shaking. However, the paraffins present in this mixture have a thickening effect and offset settling.

No. 4

Rosin	7
Montan Wax (Crude)	2
Naphtha (Varnoline)	2
Caustic Soda	1
Water	70
Nigrosine	3
Graphite	12
Lamp Black	3

Stopcock Grease

Formula No. 1

Petrolatum	16
Pure Gum Rubber	8
Paraffin	1

This formula is stated in parts by weight.

Stir while warming gently until all are dissolved.

Laboratory Stopcock Lubricants

No. 2

Standard Viscous Oil (#24 or #32)	80
Beeswax	20

Heat the oil to about 100–120° C., add the beeswax and mix thoroughly. Use of oil #24 gives a lubricant of medium body, #32 gives a very, very firm, viscous product. This formula is useful where one does not care to take the time needed for preparation of rubber products. Standard Viscous Oil is manufactured by the Standard Oil Company of California, Richmond, Calif.

No. 3

Petroleum Jelly (Petrolatum)	100
Beeswax	10
High-Grade Red Rubber Tubing (Small Pieces)	20

Heat together for several hours at 150°, until the mixture is homogeneous. Pour into wide-mouthed jars.

No. 4

White Petrolatum	77.5
Paraffin Wax	15 0
Pale Rubber Latex	7.5

Heat on an oil bath for 6 hours at 130°.

Chain Lubricant

Formula No. 1

Stearin	85
Beeswax	5
Carnauba Wax	5
Japan Wax	5

No. 2

Stearin	85
Beeswax	2½
Carnauba Wax	5
Japan Wax	5

Pour at lowest possible temperature and allow to cool slowly and undisturbed.

Ammunition Lubricant

Carbon Tetrachloride	90
Ceresin Wax (Melting Point 176° F.)	9
Aluminum Stearate	1

In proceeding to make the mixture the aluminum stearate is first dissolved in the wax at a temperature of approximately 260° F. with thorough stirring. The wax is then cooled and dissolved in the solvent at somewhat elevated temperatures, approximately 130° F.

In applying the lubricant the lubricating bath is maintained at a temperature of approximately 120° F.

Dynamo Brush Lubricant

Ceresin	20
Tallow, Acid-Free	10
Woolfat, Neutral	10
Castor Oil	10
Petrolatum Oil	50

Melt together and add enough organic solvent (heavy benzoline, naphtha or tetralin).

Wire-Drawing Lubricant

U. S. Patent 2,126,128

Stearic Acid	65
Mineral Oil	35

Melt together, mix well and allow to cool. Apply melted and wash off with hot dilute caustic soda solution.

Lubricating Compound for Drawing Aluminum

Formula No. 1

Diglycol Stearate S	6
Glycowax A	2
Water	56

The entire mass is heated to about 180° F. and then stirred at moderate speed until uniformly dispersed. Small parts, such as collapsible tube blanks are dipped into the hot dispersion while in a wire basket and then centrifuged to remove excess lubricant. If a microscopic protective film is not required on the finished work, the Glycowax A may be replaced by additional diglycol stearate S.

No. 2

1. Diglycol Stearate	10
2. Paraffin Wax (145° F.)	60
3. Water, Boiling	400

Melt *1* and *2* and to it add *3* slowly, with vigorous mixing.

Collector Lubricant

(for Electric Motors)

Formula No. 1

Paraffin Wax (56/58° C.)	19
Tallow, Neutral	14
Woolfat, Neutral	40
Graphite, Flocks, Finest	31

Put only a thin layer of the mixture on the collectors, after removing the brushes and using a dry woolen rag.

No. 2

a. Tallow	24
Mineral Oil	66
Castor Oil	6
Ceresin	18
b. Graphite, Finest	6
Copper Powder, Finest	½

Melt *a*, and disperse *b*.

Rod Lubricant

a. Ceresin, Yellow	25
Sperm Oil	25
Tallow	50

Melt together.

or

b. Ceresin, Yellow	1
Spindle Oil, Refined	3-8

Melt at low temperature.

Wood and Fiber Lubricant

Wood and non-metallic surfaces of the type of synthetic fibers are difficultly lubricated, since the lubricant usually causes swelling or remains entirely on the surface. This is true even when the friction is against metal. A suitable lubricant for this purpose can be prepared from 1 oz camphor, sufficient castor oil to make a thin paste, and 2.5 lb of finely shaved paraffin wax. The camphor is first dissolved in the castor oil, with slight heating if necessary; the paraffin wax is then added and the whole well mixed until solution is complete (eventually with further heating). The mixture is cooled and stored in air-tight containers.

POLISHES AND ABRASIVES

Automobile Polish

Formula No. 1

Carnauba Wax	9
Beeswax	4
Ceresin Wax	4
Naphtha	75
Stearic Acid	7
Triethanolamine	2½
Water	75
Abrasive	25 to 60

No. 2

Sulphonated Olive Oil (30%)	10
Mineral Oil	30
Pumice Powder	5
Amyl Alcohol	10
Carnauba Wax (Powdered)	5
Water	40

Mix the oils, wax and alcohol; add the water slowly with good stirring; mix in other ingredients.

No. 3

1. Carnauba Wax (N.C.)	500
Paraffin Wax (50/52° C.)	200
Beeswax	100
Colophony	150
2. Turpentine Oil	4000
Tetralin	800
Methyl Hexalin	800
3. Potash Carbonate	100
Soft Soap	50
Water	5000
4. Neuburger Chalk	600
Methanol	100

Melt 1, with stirring, add 2 (which is warmed up to 55° C), cool for a while, add 3, and finally 4.

No. 4

Carnauba, or I. G. Wax O	12
Montan Wax, Bleached	4
Beeswax	3
Ozokerite-Ceresin (56–58° C.)	6

Of this melted mixture of waxes take (changing with the season)

Waxes	6–8
Heavy Benzoline, or Turpentine	80
Petroleum	12–14

The cooled finished product should be a stiff-liquid jelly.

No. 5

a. Carnauba Wax, Gray	15
Beeswax or Japan Wax	5
Glycowax	5
b. Kaolin or Floated Chalk	30–35
c. Solvent (Turpentine, White Spirit, or a Mixture of Both and 10 Parts of Kerosene)	30
d. Black Soap	1
Water	7–10

Melt *a*, stir in *b* very thoroughly; add slowly *c*, with continuous agitation.

Add hot *d* and stir until a paste forms on cooling.

No. 6

a. Montan Wax, Bleached	3.0
Carnauba Wax Residues	4.0
Yellow Beeswax	1.5
Japan Wax	1.5
Glycowax	1.0

b. Potash Carbonate	0.2
Borax	0.3
Black Soap	0.5
Water	35.0
c. Kerosene	10.0
Turpentine	10.0

Melt *a* at about 100° C., and add *b*, of equal temperature, to it with very good agitation. Watch closely to prevent from foaming over (carbon dioxide formed!) and keep boiling until the saponification is finished and add *c*. Stir until cold.

No. 7

a. Carnauba Wax	500
Paraffin Wax (50/52° C.)	200
Beeswax	200
Rosin	150
b. Turpentine Substitute	4000
"Tetralin" or Methylhexalin	600–800

No. 8

Ceresin	6
Paraffin Wax, Hard	10
Montan Wax, Doubly Bleached, A.	12
Turpentine or Substitute	72

No. 9

Paraffin Wax	8
Carnauba Wax	24
Turpentine	68

No. 10

Mineral Oil, White	35
Beeswax	5
Carbon Tetrachloride	10
Kieselguhr	3
Oleic Acid	3
Potash Carbonate	½
Ammonia	½
Water	43

No. 11
U. S. Patent 1,979,787
(Wax Base)

Carnauba Wax	66.5
Petrolatum Wax (160 to 165° F. Melting Point)	26.6
Petrolatum (140° F. Melting Point)	6.3
Rosin	0.6
Wax Base (Prepared as Above Described)	9.0
Refined Mineral Oil (Narrow Cut)	41.0
Starch	0.5
Water	49.5

The refined oil is a distillate having an initial boiling point of about 350° F. and an end point of about 475° F. Although it is not necessary that these precise limits be maintained, it is important that a narrow cut be used of about this range. The so-called "W.W. 150" (water white kerosene), with a boiling range of about 373 to 504° F. evaporates too slowly, while oleum spirits, with a boiling range of about 300 to 425° F. evaporates too rapidly to give best results. The narrow boiling range of the refined oil is of particular importance in a "set" or solid emulsion of this type. It is also of particular importance that the oil be highly refined (treated with sulphuric acid for the removal of unsaturateds and other impurities) because untreated light petroleum distillates may be injurious to the skin.

In preparing the finished product melt the base stock with

the refined oil and heat the mixture to a temperature of about 175 to 200° F. Then boil a 1% starch solution and make an oil-in-water emulsion in a colloid mill at a temperature above the melting point of the wax and below the boiling point of the water, usually at about 130 to 200° F. When the resulting emulsion cools, it sets to form a semi-hard, solidified emulsion which is extremely stable and which possesses entirely different structural properties from the ordinary liquid oil-in-water emulsions of the same concentrations. The product may be stored for an indefinite period of time without separation, and it may be easily handled and applied.

No. 12

a. Montan Wax, Bleached	8 g
Paraffin (40–42° C.)	8 g
Ozokerite, Refined	2 g
b. Infusorial Earth	35 g
Spindle Oil, Refined	13 cc
White Spirit	13 cc
c. Turpentine Oil or Substitute	21 cc

No. 13

a. Montan Wax, Bleached	8 g
Montan Wax, Double Bleached	5 g
Olein	2 cc
b. Potassium Carbonate	2 g
Glycerin (28° Bé.)	3 cc
Water, Boiling	40 cc
c. Yellow Clay or Bentonite	To suit
d. Turpentine Oil or White Spirit	22 cc

Melt *a*, add hot (boiling) *b*, then *c*; cool, add *d*.

No. 14
(Wax-Solvent Type)

Carnauba Wax	4.5
Ceresin Wax	5.5
Candelilla Wax	7.5
Paraffin Wax	12.0
Naphtha	60.5
Turpentine	10.0

	No. 15	No. 16
Carnauba Wax	4.0	3.0
Yellow Beeswax	2.0	2.0
Paraffin Wax	2.0	1.5
Tripoli	—	12.0
Bentonite	—	3.0
Kieselguhr	15.0	—
Naphtha	30.0	34.0
White Spirit	5.0	—
Kerosene	—	3.0
Olein	—	4.0
Triethanolamine Stearate	5.0	5.0
Water	37.0	36.0

No. 17

a. Carnauba Wax, Gray	10
Montan Wax, Bleached	3
Japan Wax	5
Scale Wax (50–52° C.)	2
b. Black Soap	1½
Water	10
c. Solvent (Turpentine, White Spirit, etc.)	60

Melt *a* at 95–100° C., prepare the hot soap solution *b*.

Add *c* with good agitation, and stir until it begins to go heavy (at about 48° C.).

No. 18

Carnauba Wax	5
Beeswax	5
Ceresin Wax	5
Stearic Acid	2
Soap	2
Varnolene	45
Water	10

No. 19

Paraffin Wax	55
Candelilla Wax	20
Rezo Wax B	25
Durocer	20
Turpentine	45
Mineral Spirits	205

Melt together at 90° C.

No. 20
(Powdered)

Mineral Oil	5
Kerosene	10
Diglycol Laurate	1
Silica Dust	½
Kieselguhr	4
Tripoli	1

Auto Polishes and Cleaners

Formula No. 1

Carnauba Wax	27	lb
Spermaceti	50½	lb
Ozokerite	44	lb
Kerosene or V.M.P. Naphtha	32	gal
Diatomaceous Silica (Finest)	65	lb
Cream Tripoli	131	lb
Bentonite	16	lb
Coloring Pigment or Dye	To suit	
Water	13¼	gal
Borax	3¼	lb
Trisodium Phosphate	3¼	lb
Soap Chips (Finest Grade)	16¼	lb
Water	13¼	gal

No. 2

Yellow Wax	10
Air-Floated Tripoli	18
White Spirit	19
Soft Soap	½
Water	2½

Melt the wax in a double pan and add the powder slowly; keep stirring while slowly adding the white spirit. Dissolve the soft soap in the water and add to the mix with constant stirring. On cooling this forms a soft paste.

No. 3

Kieselguhr	30
Tripoli	5
Paraffin Wax	4½
Carnauba Wax	½
Varnolene	30

Tint with iron oxide.

Automobile, Floor and Furniture Polish Paste

Formula No. 1

Albacer	61
Paraffin Wax	80
Candelilla Wax	5
Naphtha (V. M. & P.)	102
Tetralin	4
Hexalin	12

Melt the waxes together and stir until complete solution is obtained. Turn off the flame and add the mixed solvent slowly, stirring thoroughly. Pour at 25–30° C.

No. 2

Albacer	20
Paraffin Wax	30
Japan Wax	5
Diglycol Stearate S	4
Beeswax	5
Naphtha (V. M. & P.)	65
Turpentine	20

The procedure is the same as in preceding formula.

These pastes polish easily and give a high luster. For shoe polishes, etc., suitable oil-soluble colors can be dissolved in the waxes.

No. 3

Carnauba Wax	8
Montan Wax	5
Ceraflux	13
Naphtha	40
Turpentine	40

Warm on a water or steam bath until waxes have melted; stir until thick and pour into tight closing cans.

No. 4

Yellow Beeswax	6
Ceraflux	16
Carnauba Wax	27
Montan Wax	8
Naphtha or Varnolene	89
Turpentine	10
Pine Oil	3

Melt together and pour into cans. Do not disturb until solidified. This makes an excellent auto polish of great durability and luster. Variations can be made to suit individual requirements.

Furniture or Automobile Polish (Fluid)

Formula No. 1

1. Albacer	15
Trigamine Stearate	5
2. Water	75
Sulfatate	5

Melt 1 and heat 2 to 85° C. Add 1 to 2 slowly with rapid agitation. Continue stirring till cool. This gives a heavy bodied liquid emulsion.

If 3 parts of boiling water are added to 1 part of the above emulsion and stirred thoroughly, a fluid emulsion is obtained.

No. 2

Carnauba Wax	120
Kerosene	50
Stearic Acid	15
Oleic Acid	3
Benzaldehyde	6
Triethanolamine	8

Melt the carnauba wax, stearic acid and oleic acid. Remove from fire and add the kerosene and the benzaldehyde. Stir thoroughly. Now add a hot solution (80–85° C.) consisting of 240 parts of water and the amount of triethanolamine as given above. Stir well until a smooth emulsion is formed, then add sufficient hot water to make 825 parts. Continue stirring until nearly cool, then bottle. This polish will form a permanent emulsion which is stable at all temperatures.

Furniture Polish

Formula No. 1

Yellow Ceresin	3 lb
Japan Wax	1 lb
Beeswax	2 lb
Linseed Oil, Raw	4 gal
Turpentine	1 gal
Paraffin Oil	1 gal
Water	7 gal
Carbonate of Potash	3 oz
Soap Chips (Animal Fat Soap)	1 lb

Mix the above thoroughly.

No. 2

Carnauba Wax	30
Beeswax	15
Ceresin Wax	15
Turpentine	26
Naphtha	24
Stearic Acid	8
Triethanolamine	4
Water	65

No. 3

A. Carnauba Wax	60
Turpentine	60
Stearic Acid	2
B. Trihydroxyethylamine Stearate	12
Water	62

Heat (A) and (B) in separate vessels to 200° F. and run (B) into (A) slowly with vigorous stirring. Stop when homogeneous.

No. 4

Carnauba Wax	6
Paraffin Wax	9
Ceresin	2
Naphtha	43
Turpentine	4
Stearic Acid	1
Trihydroxyethylamine Stearate	4.5
Water	130

Procedure—as above.

No. 5

Carnauba Wax	10
Beeswax	4
Ceresin Wax	4
Naphtha	80
Stearic Acid	8
Triethanolamine	4½
Water	200

Melt the waxes and stearic acid and add the triethanolamine. Temperature should be about 90° C. Add the naphtha slowly so that a clear solution is maintained. Using a water or steam-jacketed kettle prevents overheating and also caking of the waxes on the sides of the container. Add the boiling water to the naphtha solution and stir vigorously until a good emulsion is obtained and then slowly until the emulsion is cold.

No. 6

a. Beeswax, Yellow	13 g
Ozokerite, Yellow	2 g
b. Thinner (White Spirit)	75 cc
c. Alkali Solution (Water : Ammonia (0.91) = 85 : 15)	10 cc

Melt up *a*, add the warmed *b* to clear solution, then add *c* in thin jet, stirring thoroughly.

No. 7

Carnauba Wax, Bleached	6
Japan Wax	3½
Paraffin Wax	1½
Turpentine	12
White Curd Soap	3
Rosin, Pale	2
Water	30
Clovel	Trace

No. 8

Light Mineral Oil	1 gal
Carnauba Wax	2½ oz

Heat until wax is dissolved.

Floor Polish

Formula No. 1

Carnauba Wax	2
Ceresin	2
Turpentine	3
Gasoline	3

Melt the waxes by heating in a vessel placed in hot water, add the turpentine and gasoline, and cool the mixture as rapidly as possible, while vigorously stirring to produce a smooth creamy wax.

No. 2

Turpentine	1 pt
Beeswax	4 oz
Aqua Ammonia (10%)	3 fl oz
Water	1 pt

Mix the beeswax and turpentine and heat them by placing the vessel in hot water until the beeswax dissolves. Remove the mixture from the source of heat, add the ammonia and the water, and stir vigorously until the mass becomes creamy.

No. 3

a. Carnauba Wax	15
Montan Wax	5
Rosin, Pale	5

Melt on water bath, put out fire. Add:

b. Turpentine Oil, or Substitute	20

At same time prepare:

c. Potassium Carbonate	5
Hard Soap	5
Water, Hot	45

and pour in thin jet into *a* plus *b*, stir. Keep temperature at 55–60° C. Stir continuously, add a yellow dye, then pour into cans.

	No. 4	No. 5	No. 6
Carnauba Wax	15	15	15
Cumarone Resin	6	10	4
Oleic Acid	4	5	5

Melt together and while hot add following mixture brought to a boil.

Triethanolamine	4	5	5
Borax	6	6	3
Water	25	25	185

The above dry dull but polish on rubbing to give a hard glossy finish.

No. 7

Esparto Wax	2¾ lb
Montan Wax, Bleached	1½ lb
Beeswax, Bleached	1¼ lb
Ceresin Wax, White	¾ lb
Paraffin Wax (M.P. 135–140° F.)	2 lb
Dyestuff	Trace
Turpentine	2 gal
Cassia Oil	4 oz

No. 8

a

Montan Wax, Double Bleached	8
Montan Wax, Bleached	3
Paraffin (50–52° C.)	19
Thinner	70

b

(Yellow or Orange)

Carnauba Wax, Fat-Gray*	4
Ozokerite, Yellow	2
Paraffin (48–50° C.), Yellow	24
Thinner	70

* Dye with 0.02% Sudan Yellow G.

No. 9

Melt:

Paraffin Wax (50–52° C.)	50
Ceresin (58–60° C.)	10
Carnauba Wax	40

and dissolve:

In summer, 7–9 parts in 93–91 parts of turpentine.

In winter, 6–7 parts in 94–93 parts of turpentine.

No. 10

Paraffin Wax (50–52° C.)	18 g
Carnauba Wax	5 g
Ceresin (58–60° C.)	2 g
Rosin, Pale	4 g
Stearin	1 g
Potassium Carbonate	2 g
Caustic Soda (38° Bé.)	0.5 cc
Water	66 cc

Boil and stir until smooth.

No. 11

Carnauba Wax	15
Paraffin Wax	26
Ceresin	32
Benzine	170–180

Color to suit with any oil-soluble color.

No. 12

Carnauba Wax	60
Paraffin Wax	104
Ceresin	128
Turpentine	600
Naphtha	100

No. 13

Carnauba Wax	30
Rosin	6

Heat above to 140° C., cool to 100° C. and add following with vigorous stirring which has been heated to 95–100° C.

Soap Flakes	10
Turpentine	1
Water	270

No. 14

Beeswax, Yellow	5 lb
Paraffin Wax	4 lb
Soap Chips	3 lb
Stearic Acid	3 lb
Turpentine	3 gal
Salts of Tartar	1½ lb
Water	3½ gal

Dissolve salts of tartar and soap in boiling water. Melt waxes in another container and heat to 200° F. when the boiling water soap solution is added slowly with vigorous stirring until homogeneous. Turn off heat and run turpentine in slowly with good stirring. Pack in cans when cold.

No. 15

Carnauba Wax	5 lb
Ozokerite	5 lb
Turpentine	1 gal
Gasoline	5 gal

Heat gently until wax completely dissolves. Cool quickly.

No. 16

Paraffin Wax	16000 g
Carnauba Wax	3000 g
Beeswax, Yellow	1000 g
Turpentine	46000 cc
"Yellow 1435" (Dye)	20 g

No. 17

Paraffin Wax	16000 g
Carnauba Wax	3000 g
Beeswax, Yellow	2000 g
Turpentine	25000 cc
"Yellow 1435" (Dye)	20 g

No. 18

Paraffin Wax	16000 g
Carnauba Wax	2500 g
Beeswax, Yellow	1500 g
Turpentine	30000 cc
"Yellow 1435" (Dye)	20 g
Amyl Acetate	100 cc

No. 19

Scale Wax, Powdered	20–30
Talcum	70–80
Ochre	To suit

Mix thoroughly, and sift.

No. 20

Stearic Acid, Powdered	80
Ceresin, Powdered	15
Hard Soap, Powdered	5

No. 21

A stable emulsified floor wax can be obtained with 40% of a mixture of 1 part of beeswax, 1 part of paraffin, 1% of soap, 0.33% of soda ash, and 2.6–2.7% of methyl cellulose. The

soap and soda ash are dissolved in boiling water, and an aqueous 5% solution of methyl cellulose added. This is warmed and the melted wax added. The product is then stirred while cooling to give a good emulsion.

No. 22

A wax which spreads well and is very resistant to wear is prepared according to the following formula: 63 parts of a 5% aqueous solution of methyl cellulose are mixed into 1 part of potassium carbonate and 3 parts of soap dissolved in 37 parts of boiling water. The mixture is cooled to 70° C. and 100 parts of a melted mixture containing 1 part of beeswax, 1 part of paraffin and 8 parts of ceresin added. Heating is continued for a half hour, the mixture is stirred well, the amount of water which has evaporated is replaced, and 96 parts of white spirit or turpentine substitute are gradually added. The whole is stirred until cool.

No. 23

Heavy Panoline Oil	165.0
Mineral Seal Oil	75.0
Paraffin Wax	13.5
Carnauba Wax	1.5
Varnolene	24.0

No. 24

Carnauba Wax	30
Beeswax	15
Ceresin Wax	15
Paraffin Wax	120
Varnolene	340

No. 25

Ozokerite	2.5
Paraffin Wax	25.0
Rezo Wax B	8.5
Turpentine	35.0
Mineral Spirits	35.0

Melt waxes on water bath and then add solvents slowly while stirring. Fill into containers and allow to stand undisturbed until gelled.

No. 26

Beeswax	25
Diglycol Stearate	10
Montan Wax, Bleached	25
Rosin	3
Ozokerite (60/62° C.)	17
Ammonia (0.91)	70
Water	850
Dye,* Water-Soluble	0.3–0.5%

* *Yellow*: Metanil Yellow, Extra X.
Orange: Orange II Concentrated.

No. 27

Turpentine	1 pt
Beeswax	1 lb

Melt the beeswax and work in the turpentine.

No. 28

Beeswax	500
Water	400
Calcium Carbonate	100
Water	4000

Boil the first three ingredients for a period. Thin with the water. To 3 kg of the resulting mixture add:

Kassel Brown (Dye)	125
Potash Carbonate	250
Water	500

Boil altogether with stirring. The product is applied when it is still warm, putting it on the furniture in a thin layer and polishing with a brush.

No. 29

Montan Wax, Double Bleached	5
Paraffin Wax (50/52° C.)	5
Diglycol Stearate	1
Water	67
Ammonia (0.910)	2
Alcohol	20

Soap and waxes are cut into small pieces and taken up to a boil in the water and the ammonia, stirring thoroughly. When the mass is homogeneous, cool with stirring, and add the alcohol when cooled sufficiently. Keep agitating until it goes heavy.

No. 30

Carnauba Wax	2
Montan Wax, Bleached	6
Beeswax	5
Paraffin Wax (52–54° C.)	14

Melt.

Add:

Linseed Oil (or Varnish)	3

And (when temperature is 43–45° C.) add:

Turpentine	70

Water-Resistant Emulsion Floor Polishes

Formula No. 1

a. Carnauba Wax	11.2
Oleic Acid	2.4
Morpholine	2.2
Water	67.0
b. Shellac	1.5
Morpholine	0.2
Water	15.5

Melt the carnauba wax carefully with the oleic acid and maintain the temperature closely at 90° C. Stir until well mixed, add the morpholine, and stir constantly until the whole mass is quite clear. In the meantime, the water should have been brought to a simmer in a separate kettle. Add it slowly to the hot wax mixture with steady stirring, making certain that each small portion is well incorporated before further addition. The mixture becomes increasingly viscous and should be of the appearance of petrolatum when two-thirds of the water have been added. After this stage has been reached, the mixture begins to thin out and the remainder of the water may be added rapidly. The total time for adding the water should be 30–40 minutes. A steam-jacketed kettle and a hand-operated paddle, or slow-speed, large-blade propeller are recommended for successful production.

Allow the mixture to cool. While slowly stirring, add the shellac solution. This has been made by warming together the morpholine, water and shellac indicated in *b* above and filtering if necessary.

Another morpholine dry-bright polish is formulated as follows, using paraffin as a substitute for part of the carnauba wax:

No. 2

Carnauba Wax	64.8
Paraffin Wax	7.2
Morpholine	14.4
Oleic Acid	15.3
Boiling Water	430.0
Cold Water	100.0

By observing great care in the gradual addition of boiling water up to the point of emulsion inversion (see above), a polish is prepared which is exceptionally translucent.

No. 3

Rosin	454.0
Oiticica Oil	760.0
Soybean Oil	18.0
Ouricuri Wax	4.5
Kerosene (62°)	152.0
Naphtha (54°)	182.4
Liquid Drier	1.5

Heat rosin and oiticica oil to 300° C. and remove from heat. Add soybean oil with good mixing. When temperature has fallen to 290° C. add the wax and stir well. Add the kerosene in portions while stirring until temperature has fallen to 165° C. Then add naphtha slowly with stirring and then the drier.

Bright Drying Floor Polish
(Non-Rubbing)

These polishes are composed of mixtures of aqueous Manila resin solutions with carnauba wax emulsions. The following resin solution is recommended:

Formula No. 1

Manila DBB or Loba C, Ground	240
Monoethanolamine	45–50
Water	2090

Dissolve the monoethanolamine in 700 parts of water, stir, and add the resin. Heating the mixture to 50–55° C. helps the resin to dissolve more rapidly. Finally, add the remainder of the water and allow to cool. Strain.

This resin solution is mixed with a carnauba wax emulsion to give the final product. Established wax emulsion formulae are satisfactory, but the following may be used if desired:

Carnauba Wax	240
Triethanolamine	28
Linoleic Acid	45
Borax	18
Water	2412

Melt the wax at 90–95° C.

In a separate container, dissolve the triethanolamine in 200 grams of water, stir at 90° C., and add the linoleic acid. Stir the mixture for five minutes at 85–90° C. and then add the resulting cloudy viscous solution to the wax. Stir the wax-soap mixture at 90–95° C. for five minutes.

Dissolve the borax in 50 grams of boiling water, add and stir until a hot drop off a spatula is clear (14–15 minutes). The remainder of the water is then added cautiously at a temperature of 95–100° C. When the mixture starts to thin out, the addition of the water may be made more rapidly. Allow to cool to room temperature and add water to compensate for evaporation loss.

The polish is made by mixing the resin solution and the wax emulsion in the desired proportions. The emulsion is stirred

and the resin solution is added. Stirring is continued in order to obtain a homogeneous mixture.

No. 2

Carnauba Wax, Refined	15.0
Durez 420 Resin	15.0
Oleic Acid	4.5

Heat to 300–325° F. until fluid. Cool to 210° F., add the following at boiling point:

2 Amino, 2 Methyl, 1 Propanol	1.0
Sodium Hydroxide	0.4
Water	5.0

Stir in until mixture is clear and jelly-like. Add the following slowly with good agitation:

Water, Hot	210.0

Cool rapidly and add:

Casein Solution 10%*	25.0

* Casein Solution

Casein	10.0
Borax	1 5
Pine Oil	0.2
Preservative	0 2
Water at 160° F.	15.0
Mix thoroughly and add	
Water at 160° F.	15.0
Mix thoroughly and add	
Ammonia in water, 7% of 28%	1.0
Water at 160° F.	70.0
Mix until smooth.	

No. 3

Carnauba Wax	18
Pine Oil	1½
Soap	1½
Hot Water	3

Cook till transparent.

Sodium Silicate	2¼
Hot Water	3

Cook 5 minutes. Make up to 4 quarts.

No. 4

Carnauba Wax	8½ lb
Candelilla Wax	16½ lb
Borax	2 lb
Duponol W.A. Paste	5½ lb
Dissolved in Water	2 gal

Cook till smooth. Make up to 50 gal with boiling water.

In a separate kettle, cook

Gum Loba C	30 lb
Water	30 gal
Ammonia (26°)	150 oz

until the gum is completely dissolved, and add to the wax emulsion. Make up the volume of the finished mixture to 100 gal.

No. 5

Candelilla Wax	64
Oleic Acid	24
2 Amino, 2 Methyl, 1 Propanol	11
Water, To make	500

Very translucent, thin emulsion which dries to a transparent, bright film.

No. 6

Water, Boiled	2½ gal
Shellac, Dry Bleached	6¼ lb
Borax	1¾ lb

Melt together:

Esparto Wax	5 lb
Emulsifier	2 lb

Stir 2 gal boiling water into molten wax, cool, and add shellac solution while stirring.

No. 7

1. Prepare a Carnauba Wax Emulsion as follows:

Carnauba Wax No. 1, Yellow	30
Water	210
Trigamine	5
Oleic Acid	3.5
Caustic Soda	0.25

Melt the wax and oleic acid together in a boiling water bath until a homogeneous, clear liquid is obtained. Stir in the trigamine.

Dissolve the caustic soda in 25 parts of water. Heat it to boiling. Add this solution slowly and with stirring to the above mixture still in the boiling water bath. A gel forms, at which time add the remainder of the water also pre-heated to boiling and also slowly and with stirring.

2. Prepare a Manila gum solution as follows:

Manila DBB Gum	30
Water	158
Ammonium Hydroxide (28–29% NH_3)	12

Powder the resin and mix it with the water and ammonia. Agitate the mixture until the resin has dissolved. Strain the solution.

3. Prepare the finished polish as follows:

Manila Resin Solution (2)	39
Carnauba Wax Emulsion (1)	34

Mix the two well, using high speed stirring. The polish dries to a hard, glossy, waterproof film.

No. 8

U. S. Patent 2,045,455

Carnauba Wax	10.0
Triethanolamine	1.4
Oleic Acid	1.4
Borax	1.0
Refined Shellac	1.4
Ammonium Hydroxide	0.2
Water	To make 100.0

Prepared by melting the carnauba wax and adding the oleic acid to same. To about one third of the above amount of water is added the triethanolamine, the ammonium hydroxide and the borax dissolved in this mixture. This is warmed and the shellac added and stirred until same is completely passed into solution. To this last solution, which is being agitated vigorously by means of an electric homogenizer, is added the carnauba wax oleic acid mixture which should be very close to the boiling point of water. For best results this emulsion should be passed through a colloid mill in order to keep its viscosity low, and prevent separation. All or a portion of the remainder of the water may be added.

No. 9

Carnauba Wax	13.2
Oleic Acid	1.5
Triethanolamine	2.1
Borax	1.0
Water	108.0
Shellac	2.2
Ammonia (28%)	0.32

Melt the wax and add the oleic acid. The temperature should not be above 90° C. Using a hot water or steam-jacketed kettle maintains a good temperature and prevents wax caking along the sides of the container. Add the triethanolamine slowly, stirring constantly. The solution should be *clear* at this point. Dissolve the borax in about a pint of boiling water and add to the wax solution to obtain a clear jelly-like mass. Stir for about 5 minutes. Add 92 pounds water, previously heated to boiling temperature, slowly with constant stirring. An opaque solution should be obtained. Cool. Add 16 pounds of water to the shellac and then the ammonia and heat until the shellac is in solution. Cool. Add this to the above wax solution and stir well to obtain an even mixture.

No. 10
(Non-Slippery)
U. S. Patent 2,088,795

Vulcanized Rubber Latex	5–30
Bright Drying Floor Wax Emulsion	95–70

No. 11

Carnauba Wax	11.9
Paraffin Wax	1.3
Oleic Acid	3.0
Triethanolamine	1.9
Water (Hot)	50.0
Water (Cold)	50.0

Melt the wax and add the oleic acid and triethanolamine. With the temperature at 95° C., add small (5-part) portions of boiling water, stirring between each addition and continuing them until a heavy translucent paste is formed. Add the remaining boiling water and stir until homogeneous. Add the cold water; cool the complete dispersion to room temperature. If desired, all of the water may be added at boiling temperature.

Due to the possible variation in the composition of some of the suggested ingredients and to the varying methods and conditions which may attend the compounding, modifications to meet individual requirements may be necessary.

No. 12

Carnauba Wax No. 2	120.0
Oleic Acid	13.7
Trigamine	19.0
Caustic Soda (47%)	3.5
Water	843.5

Melt the wax in the oleic acid, add Trigamine and heat to 90° C. Then add the caustic soda and 25 cc of water at about 95° C. Stir until jell is formed. Then add the rest of the water which must be boiling. Stir thoroughly till cool.

No. 13

Hydromalin	138
Carnauba Wax No. 1 or No. 2, Yellow	250

Heat to 120–140° C. half an hour.

Cool to 100–105° C.

Add to the above slowly with stirring.

Water (at 100° C.)	280

Stir to smooth paste then add slowly with good stirring.

Water (at 100° C.)	1500

Keep as close to 100° as possible for 15 minutes with rapid stirring. Then stir till cool.

No. 14

Aquamel	15
Carnauba Wax	25
Water	225

Heat the wax and Aquamel together till a clear jelly is obtained. Then add the water which must be as near boiling as possible. Stir thoroughly till cool.

No. 15

1. Make a carnauba wax emulsion as follows:

Carnauba Wax No. 1, Yellow	30
Water	210
Triethanolamine	3
Oleic Acid	5

Melt the wax and the oleic acid in boiling water bath. When the mixture is homogeneous, add the triethanolamine and stir until it is all uniformly incorporated.

Heat the water to boiling and add it slowly, portion by portion, permitting each addition to be well agitated before the next addition. As the first additions of water are made, the mixture thickens considerably and becomes gel-like in consistency. As more water is added, the mixture becomes like a cream. When still more water is added, it breaks into an emulsion and then becomes a watery product. During the gel and cream stage, it is very important that the addition of water be made carefully and efficient agitation be used in order to obtain a thoroughly homogeneous mass. It is just as detrimental to add the water too slowly as too fast. Equally as important as efficient agitation and careful addition of water is the maintenance of high temperatures during the process.

2. Make a Manila resin solution as follows:

Manila DBB	30
Water	158
Ammonium Hydroxide (28–29% NH_3)	12

Powder the resin and agitate it with water and the ammonia until all the resin is dissolved. Strain the solution.

3. Prepare the finished polish as follows:

Carnauba Wax Emulsion	34
Manila DBB Solution	39

Mix the two well, using stirring. A glossy, waterproof polish is obtained.

No. 16

Carnauba Wax No. 1, Yellow	30
Thermally Processed Congo	30
Sodium Hydroxide	0.5
Water	420
Triethanolamine	4
Oleic Acid	9

Melt the wax and add the Congo at about 125–150° C. Hold until the mixture is homogeneous. Put the mixture in a boiling water bath. Add the oleic acid slowly and with vigorous stirring. Do the same with the triethanolamine. Dissolve the sodium hydroxide in 25 parts of water. Heat the solution to its boiling point and add it slowly to the mixture still in the boiling water bath, using vigorous stirring. When the mixture is thoroughly homogeneous, add the remainder of the water (also at its boiling point, and also with vigorous stirring).

This polish dries quickly to a hard, glossy, waterproof film. It is especially valuable for polishing floors.

No. 17

a. Carnauba Wax	120
Oleic Acid	20
b. Trigamine	20
c. Caustic Soda (50%)	8
Water	32
d. Water	800

Semi Bright Drying Wax Emulsion Polishes

Formula No. 1

a. Carnauba Wax #2	10 g
Candelilla Wax	10 g
Oleic Acid	3 g

Use method given under Candelilla Wax Emulsions on this and others in this group.

b. Triethanolamine	4 g
Borax	2 g
Water	185 cc

No. 2

a. Carnauba Wax #2	10 g
Candelilla Wax	10 g
Oleic Acid	3 g
b. Triethanolamine	4 g
Borax	1½ g
Water	185 cc

Rubbing Type Paste Wax

Formula No. 1

Carnauba Wax	150
Paraffin Wax	166
Beeswax	76
Durez 420 Resin	34

Heat to approximately 300 to 325° F. to melt.

Add the following:

Mineral Spirits	1280
Turpentine	32

Stir and cool to 160° F. Dump into containers.

No. 2

Carnauba Wax	14.0
Beeswax	14.0
Paraffin Wax	14.0
Stearic Acid	5.0
Amino Methylpropanol	2.5
Water	80.0

The first four ingredients are melted together on a boiling water bath. The amino methylpropanol is stirred into the wax melt, the temperature of which should not exceed 100 to 105° C. at this point, and the boiling water is added with vigorous agitation.

No. 3

Glyco Wax A	10
Naphtha or Kerosene	30

Heat the wax with the naphtha or kerosene until dissolved. Cool and stir thoroughly when thickening begins. Color yellow

or orange with an oil-soluble dye. This may be made thicker or thinner by varying the amount of wax.

No. 4

Carnauba Wax	60 oz
Dry Castile Soap	15¼ oz
Oleic Acid	2¾ oz
Caustic Soda	1½ oz
Water	To make 4 gal

Heat the wax, soap, and acid to 100° C. and while stirring rapidly add the caustic dissolved in the water, heated to 80° C., slowly. A beautiful stable creamy emulsion results.

Liquid Floor Wax

Formula No. 1

Heat 10 lb of Glyco Wax B and 2 lb beeswax with 30 lb naphtha or kerosene until dissolved. Cool and stir thoroughly when thickening begins. Color yellow or orange with an oil-soluble dye. This may be made thicker or thinner by varying the amount of wax.

No. 2

Carnauba Wax	1 lb
Paraffin Wax	¼ lb
Raw Linseed Oil	½ pt
Turpentine	½ pt

Melt up together and heat to 85° C. Add a gasoline-kerosene mixture (1 : 2) or naphtha with thorough stirring to make a total volume of 2 gallons. Add 1 ounce of ammonium linoleate and stir thoroughly until cool. If the mix fails to emulsify, heat up again and stir well until cool.

No. 3
(Non-Slippery)

One pound candelilla or carnauba wax; one-half pound Japan wax melted together by heat.

When melted, add gradually by stirring one gallon of light gravity paraffin oil. This mixture is to be mixed with four gallons more of the paraffin oil and one gallon of turpentine substitute (petroleum spirit). Kerosene or turpentine will do, but the odor will not be pleasant, except if some essential oil is added to hide the odor. The compound will not be slippery. This mixture can also be used as a reviver or polish for any varnished surface.

No. 4

Santowax OSA	7.00
Beeswax	1.00
Paraffin Wax	2.00
Stearic Acid	1.00

Melt together.

Add to melted wax with stirring.

Morpholine	0.25
Water	88.75

No. 5

Morpholine	0.5
Water	78.0
Stearic Acid	1.5
Santowax OSA	7.0
Paraffin Wax	2.0
Beeswax	1.0
Turpentine	10.0

No. 6

Morpholine	0.5
Water	68.0
Stearic Acid	1.5
Santowax OSA	7.0
Paraffin	2.0
Beeswax	1.0
Turpentine	20.0

Liquid Wax Polish

Heavy Panoline	165
Mineral Seal Oil	75
Paraffin Wax	13½
Carnauba Wax	1½
Varnolene	24

Emulsion Polish

1. Carnauba Wax	10
2. Petromix No. 5	6
3. Deodorized Kerosene	34
4. Water	50

1 and 2 are melted together. Add 3 and heat to 180° F. Heat water to 200° F. and add to above with stirring.

Pure Carnauba Polish

1. Carnauba Wax	10
2. Petromix No. 5 (Emulsifier)	4
3. Butyl Cellosolve	1
4. Water	85

Melt 1 and 2, then add 3. Add 4 at 200° F. with constant stirring.

Carnauba-Shellac Polish

1. Carnauba Wax	10
2. Petromix No. 5	4
3. Butyl Cellosolve	1
4. Water	65
5. B Solution *	20

Directions as for pure Carnauba polish.

** B Solution*

Dry Powdered Shellac	20
Water	79
Ammonium Hydroxide	1

Heat to boiling. Makes a clear solution.

Carnauba Wax Resin Emulsion Polishes

	Formula No. 1	No. 2	No. 3	No. 4	No. 5
Carnauba Wax No. 1 ..	45	45	30	30	30
Gum Dammar A	15	15	30	30	30
Manila Gum DBB	5	5	..	..	..
Caustic Soda	1	1.5	0.9	2	2
Water	420	420	422	422	422
Triethanolamine	4	4	..	..	..
Trigamine	..	..	9.9	9.5	19
Oleic Acid	9	9	7	7	14
	Film Dull Slight Rubbing Gives Good Gloss	Film Same as No. 1	Film Same as No. 1	Film Same as No. 1	Film Same as No. 1

	Formula No. 6	No. 7	No. 8	No. 9	No. 10
Carnauba Wax No. 1 ..	33.5	47	47	30	30
Gum Dammar A	26.5	13	13	..	..
Manila Gum DBB	..	..	..	..	..
Caustic Soda	1.5	0.6	0.6	1	0.5
Water	420	420	420	420	420
Triethanolamine	2	4	4	4	4
Trigamine	..	..	..	..	..
Oleic Acid	4	..	9	9	9
Stearic Acid	..	9	..	..	..
"Run" Boea (Hard Bold Amber)	..	..	..	30	..
	Film Glossy	Film Glossy	Film Glossy	Film Glossy	Film Glossy

Non-Aqueous Colloidal Carnauba Wax

U. S. Patent 2,311,338

100 parts of carnauba wax are melted on a steam bath by heating to a temperature of about 190° F. About 2400 parts of a highly paraffinic petroleum oil solvent boiling in the range between about 300 to 450° F. are then heated to 190° F. and added to the liquid wax. The solvent and the oil are mixed to form a complete solution comprising approximately 4% carnauba wax and 96% petroleum oil solvent by volume. A small amount of pale green dye is added to the heated solution. The solution is allowed to cool to room temperature. The cooled composition is then passed through a colloid mill, care being exercised that the temperature of the composition does not rise substantially above 75° F. The resulting product is a highly dispersed colloid solution of the crystalline carnauba wax in the solvent.

When applied as a polish, the resulting finish is said to be non-spotting when exposed to rain.

Dance Floor Polishes

Formula No. 1

Batavia Dammar	1
Carnauba Wax	1

No. 2

Batavia Dammar	1
Paraffin Wax	1

No. 3

Pale East India Resin	1
Carnauba Wax	1

No. 4

Pale East India Resin	1
Paraffin Wax	1

No. 5

Batu Bold Scraped	1
Carnauba Wax	1

No. 6

Batu Bold Scraped	1
Paraffin Wax	1

No. 7

Melt

a. Paraffin Scale Wax	12
Dye, Yellow or Red, Oil-Soluble	25–30
b. Talc	80
Ochre, Yellow	8

Mix *a* and *b* thoroughly, cool, pulverize.

No. 8

Ceresin	10
Stearic Acid	10
Paraffin Wax	80
Pine Needle Perfume	To suit

No. 9
(Discs)

Paraffin Wax (50–52° C.)	100
Ozokerite (68–70° C.)	5

Colored with oil-soluble color yellow and cast in discs.

No. 10

Stearic Acid	20
Paraffin Wax	50
Zinc Stearate	½
Talcum	30
Pine Needle Oil	To suit

No. 11

Ceresin	44
Stearic Acid	12
Scale Wax	140
Carnauba Wax	4
Oil-Soluble Color	To suit

No. 12

Stearic Acid	20
Ceraflux	50
Talc	30

No. 13

Stearic Acid	5
Ceresin	5
Paraffin Wax, Soft	40
Talc	50

Non-Slippery Linoleum Wax

Carnauba Wax	15
Montan Wax	5
Rosin, Light	5
Turpentine	20
Potash Carbonate	5
Diglycol Stearate	5
Water	45
Alkaline Yellow Dye	To suit

Melt the first three ingredients on the water bath, stir in the turpentine and add the hot solution of soap and alkali in a thin jet with stirring. Keep at 55–60° C. on bath until completely "bound." Pour at lowest possible temperature.

Linoleum Polish

Formula No. 1

Carnauba Wax	1 lb
Paraffin Wax	1 oz
Yellow Wax	7 oz
Turpentine	1 gal

No. 2

Carnauba Wax	1 lb 6 oz
Ceresin Wax	1 lb 6 oz
Petroleum Spirits	8 lb

Melt the two waxes together and stir in the petroleum spirits. The wax should then be ground.

No. 3
(Red)

Carnauba Wax	1½
Ceresin Wax	1½
Venetian Red, Dry	½
Petroleum Spirits	6½

Battleship Linoleum Polish

Ceresin Wax	27.2
Carnauba Wax	25.0
Rezo Wax B	2.2
Naphtha	72.0

Floor Polish for Inlaid Floor

a. Carnauba Wax	6
Montan Wax, Bleached	4
Ozokerite, Low-Grade	2
Paraffin Wax (50/52° C.)	4
b. Heavy Benzine	160
Turpentine	24–20

Melt *a*, thin with *b*. By using more or less solvent, the product can be adapted to various requirements.

Wax Polishes for Wood

Formula No. 1

Montan Wax, Bleached	70
Soft Ozokerite	10
Paraffin Wax (50–52° C.)	20

No. 2

Paraffin Wax (50–52° C.)	80
Ozokerite	20

No. 3

Montan Wax, Crude	50
Ozokerite, Soft	20
Paraffin Wax (50–52° C.)	30

No. 4

a. Montan Wax, Double Bleached	4
Beeswax	5
b. Soft (Potash) Soap	1
Potassium Carbonate	3
Water	82
c. Ammonia (0.910)	5

Melt *a*, boil up with *b*, and stir until a smooth emulsion has formed. Cool. Add *c*.

No. 5

Crude Montan Wax	5
Beeswax	4
Soft Soap	1
Potassium Carbonate	3
Water	87

Boil all ingredients together until a smooth emulsion has formed. Stir cold.

Natural Resin—Wax Polishes

Formula No. 1

Pale East India Gum	18
Paraffin Wax	8
Carnauba Wax	6
Turpentine	68

Melt the paraffin and carnauba, and sift in the Pale East India. Keep at 150° C. until the mixture is homogeneous. Add the turpentine. Allow to cool with occasional stirring.

This has a buttery consistency. Apply a small amount on a clean rag and rub until dry. A quick-drying, hard, glossy film results.

No. 2

Pale East India Gum	18
Carnauba Wax	15
Paraffin Wax	17
V. M. & P. Naphtha	70

Melt the paraffin and carnauba and sift in the Pale East India. Keep at 150° C. until the mixture is homogeneous. Add the V. M. & P. naphtha and allow to cool, stirring occasionally.

This compound has a greater consistency than the preceding polish. By applying with a clean rag and rubbing until dry, a quick-drying, hard, glossy film results.

No. 3

Pale East India Gum	23
Beeswax	6
Carnauba Wax	20
Montan Wax	8
V. M. & P. Naphtha	89
Turpentine	10
Pine Oil	3

Melt the waxes and sift in the resin. Keep at 150° C. until the mixture is homogeneous. Add the solvents and allow to cool, stirring occasionally.

This is a liquid at room temperature with pasty particles precipitated from it, but when applied with a clean rag it gives a quick drying, hard, glossy film.

No. 4

Pale East India Gum	18
Carnauba Wax	15
Paraffin Wax	17
Turpentine	35
V. M. & P. Naphtha	35

Melt the wax and sift in the resin. Keep the temperature at 150° C. until the mixture is homogeneous. Add the solvents and allow to cool, stirring occasionally.

This has about the same consistency as Formula No. 2. When applied with a clean rag, rubbing until dry, a quick drying, hard, glossy film results.

Polishing Wax

Formula No. 1

Montan Wax	15
Carnauba Wax	5
Candelilla Wax	2
Paraffin Wax	3
Japan Wax	1
Turpentine	75

No. 2

French Patent 837,418

A wax composition comprises candelilla wax 20–95%, gum lac wax 5–50, lignite wax 0.5–10, stearic acid, 1–50, zinc stearate 0.05–20.

No. 3

Carnauba Wax	10
Candelilla Wax	15
Paraffin	75

No. 4

Bleached Beeswax	2
Carnauba Wax	6
Halowax No. 1013	4
Turpentine	20
Stearic or Oleic Acid	3½
Triethanolamine	1½
Water	63
Perfume	To suit

Melt the three waxes and add the turpentine with agitation. Prepare the soap solution by heating the triethanolamine dissolved in the water almost to the boil and adding the molten stearic acid or liquid oleic. The soap may also be prepared by heating the triethanolamine and water with stearic acid in powdered form. Run the former solution into the latter with agitation. Continue to agitate until cool. If properly made the emulsion is stable.

U. S. Patent 2,010,297

	No. 5	No. 6
Carnauba Wax	25	2.75
Ceresin Wax	28	3.08
Beeswax, Yellow	20	2.20
Montan Wax	22.5	2.47
Calcium Stearate	4.5	0.50
Light Petroleum Solvent	—	89

The four waxes should be melted together at about 200° F., or somewhat higher, and the calcium stearate then dissolved in the molten wax with gentle agitation. When the melt becomes clear, about half of the solvent is added. The solution is then cooled, to as low a temperature as 135–140° F. and vigorously agitated as by means of high speed stirrers, with the cooling continued until crystallization occurs around 100–110° F. The vigorous agitation is further continued until the batch reaches a temperature of 90–95° F., whereupon the other half of the solvent is slowly added in connection with gentle agitation. The product may then be packaged.

No. 7

Paraffin Wax	28
Ozokerite	6
Carnauba Wax	3
Beeswax, Yellow	4
Turpentine	60

No. 8

Paraffin Wax	15
Candelilla Wax	3
Ester Gum	2
Acrawax B	10
Varnolene	70

Melt the solids together on a water bath until dissolved and then work in the Varnolene.

No. 9

Glyceryl Abietate	10
Paraffin Wax	20
Candelilla Wax	3
Acrawax B	10
Varnolene	80

No. 10

a. Paraffin Wax (50/52° C.)	5
Diglycol Stearate	16
b. Oleic Acid	25
c. Whiting	20
Magnesium Carbonate	30

Melt *a*, add *b*, and at last *c* in small portions.

No. 11

Santowax M	15
Barnsdall Special Wax (160/165° F. M.P., No. 2 Color)	8
Carnauba Wax	8
Candelilla Wax	6
Paraffin Wax	8
Solvasol No. 5	48
Turpentine	5
Pine Oil	2

No. 12

Santowax M	15
Barnsdall Special Wax	8
Carnauba Wax	8
Candelilla Wax	6
Paraffin Wax	8
Turpentine	55

No. 13

Santowax OSA	6
Candelilla Wax	14
Beeswax	2
Paraffin Wax	4
Turpentine	74

Pour at 43° C.

No. 14

Santowax PSA	8
Opal Wax	13
Paraffin Wax	6
Turpentine	73

Pour at 92° C.

No. 15

Santowax P	8
Candelilla Wax	8
Paraffin Wax	6
Beeswax	2
Turpentine	76

Pour at 120° C.

The waxes are first melted together. Refined grades must be used as crude waxes always contain varying amounts of dirt, part of which would settle out when the waxes are melted, but part of which would remain in fine suspension in the wax mixture to give a thoroughly unsatisfactory product. The temperature should be kept as low as possible, not only to conserve steam, but to speed up the process so that the solvents can be added as soon as the waxes are melted and mixed. The kettle used is preferably equipped with an automatic mixer, as thorough mixing is absolutely necessary. Melting and mixing of the waxes can be accomplished at 190° F. As soon as the molten waxes are well mixed the heat is turned off and the solvents added with rapid stirring. Odorants and dyes are then added as soon as the solvent-wax mix appears to be homogeneous, and the rapid stirring continued so that the mix will cool as quickly as possible. Refrigeration is often employed to hasten cooling and insure proper setting.

Rapid cooling makes the product smooth and prevents granules from forming. Shortly before the mixture is ready to congeal it is drawn off into containers and allowed to solidify uncovered. The temperature at which it should be drawn off will probably be about 125° F., but this can be determined for the individual mix by experiment, by determining the approximate solidifying point of samples withdrawn from the batch at a temperature safely above this. As soon as the paste has solidified so that it will not be disturbed by handling, the covers should be fitted on tightly to prevent further evaporation of solvent.

The room in which the process is carried out must be well ventilated because of the escape of fumes during the mixing and congealing of the polish. It must also be remembered that although the petroleum solvents referred to here are not classed as inflammable, their hot vapors are combustible and due caution must be exercised to prevent a flame or spark coming near them.

Solvent Polishes for Furniture and Floors

Formula No. 1

Santowax PSA	8
Opal Wax	8
Paraffin Wax	8
Mineral Spirits	76

No. 2

Santowax OSA	2
Beeswax	2
Paraffin Wax	2
Mineral Spirits	94

Valve Grinding Compounds

Formula No. 1

Ceresin	5
Glass Powder	40
Cylinder Oil, Pale	55

No. 2

Montan Wax, Double Bleached	5
Montan Wax, Crude	25
Abrasive	70

No. 3

Ceresin	3
Oleic Acid	17
Petrolatum	4
Spindle Oil	6
Quartz or Pumice, Powdered	45
Chrome Oxide, Powdered	25

No. 4

Ceresin	8
Oleic Acid	10
Spindle Oil	12
Neuburg Chalk	20
Quartz, Powdered	10
Emery, Powdered	25
Silicon Carbide	15

No. 5

a. Ceresin	5
Tallow	2
Oleic Acid, Distilled	30
Mineral Oil	10
b. Abrasive, Powdered*	53

Melt *a* at 80–90° C. Mix in *b* in small portions. Stir until cooled to sufficient viscosity.

* Emery, Quartz, Tripoli, Carborundum, Slate Powder, Iron Oxide, Diatomaceous Earth, Chrome Oxide, Graphite, Viennese Chalk.

Composition for Impregnating Grinding Wheels

U. S. Patent 2,240,302

Hydrogenated Cottonseed Oil	90.00–97.0
Salt	0.75–7.5
Sulphur	0.75–7.5
Turpentine	0.75–7.5

Polish for Piano Keys

Montan Wax	30
Tallow	20
Diglycol Laurate	100
Micro-Asbestos	1200

Polish for Lacquered or Polished Objects

Swiss Patent 172,736

Turpentine	100	cc
Paraffin Wax	50	g
Beeswax	15	g
Silica Powder	2	g
Chalk Meal	1½	g
Vienna Lime	2	g
Oxalic Acid	1	g
Ammonia (28%)	10	cc

Polish for Leather Furniture

Paraffin Wax (50–52° C.)	20
Ozokerite/Ceresin (58–60° C.)	5
Woolfat, Neutral	5
Beeswax	10
Carnauba Wax	10
Turpentine Oil	150

Color similar to that of furniture. Pour at 40–45° C. into jar.

Furniture, Lacquer Enamel and Polished Nickel or Chromium Wax Polish

Carnauba Wax	12
Beeswax	10
Benzine	40
Turpentine	13
Xylol	20
Paraffin Oil	5

Shoe Polish

Formula No. 1

Albacer	2
Rezo Wax B	5
Paraffin Wax	11
Candelilla Wax	4
Oil-Soluble Black Dye	9/10
Turpentine	9
Naphtha (V. M. & P.)	21
Sovasol No. 5	20

The waxes are melted and the color dispersed in the melted mass. The solvents are added and the solution poured at 200° F. If the solution is not kept up to this temperature, the surface of the cooled paste will be rough looking and the paste will not be homogeneous. This shoe polish will give an excellent polish with a very high, smooth surface luster.

No. 2
(Base)

Paraffin Wax (50/52° C.)	2.50
Carnauba Wax, Pale	0.65
Beeswax, White	0.80
Turpentine	10.00

Dyes for this Formula

Brown:

Brown 1435	2
Brown 3148	10
Orange, in Pieces	2½

Pale Brown:

Brown 1435	1
Brown 3148	6
Orange, in Pieces	1½

Dark Brown:

Brown 1435	1½
Brown 3148	13
Orange, in Pieces	3

Reddish Brown:

Brown 1435	6
Brown 20162	6
Brown 17484	6
R. L. Ponceau	1

No. 3

Beeswax	1 lb
Ceresin Wax	1 lb
Carnauba Wax	6 oz
Turpentine	3 pt
Yellow Soap	6 oz
Oil-Soluble Black Aniline	Enough to color
Water	Sufficient

Shave the soap and dissolve in the smallest possible quantity of water by means of heat, melt the waxes together, add the turpentine and stir well, then add the aniline dye and stir in the soap solution, continuing to stir until cold.

No. 4
(Black)

Carnauba Wax	4989
Solvent Naphtha	7000
Stearic Acid	1360
Nigrosine, Oil-Soluble	907
Diglycol Laurate	200
Triethanolamine	450
Water	29937
Nigrosine, Water-Soluble	453

Dissolve the water-soluble nigrosine in the water, add the triethanolamine, and, while hot, the stearic acid and digylcol laurate. Take up to a boil.

Add to this the solution of carnauba wax and the oil-soluble nigrosine in the naphtha, at 85–90° C. Stir until cold.

No. 5

(Non-Alkaline)

Carnauba Wax	6
Ceresin Wax	3
Candelilla Wax	3
Turpentine	5
Lemongrass Oil	½
Light Mineral Oil	1
Diglycol Stearate	5

Heat together below 90° C. and stir until clear. Pour slowly while stirring with high speed stirrer into

Water (Boiling)	100

Stir until temperature falls to 70° C. The finished product is snow white, applies easily and rubs to a high gloss. If a paste polish is desired reduce the water to about 50 to 60 parts. If a colored paste is desired an aniline dye is dissolved in the water used.

No. 6

a.	Carnauba Wax	5
	Ceresin Wax	15
	Rosin	30
	Paraffin Wax	60
	Naphtha	165
b.	Glue	35
	Water	75
	Soft Soap	3
	Starch	1/10

Warm *a* and *b* separately and stir until uniform then mix together while stirring vigorously.

No. 7

a.	Beeswax	100
	Paraffin Wax	20
	Carnauba Wax, Gray	8
	Naphtha	80
	Turpentine	70
b.	Water	200
	Potassium Carbonate, Calcined	6
	Glue	35

Method as above.

No. 8

a.	Carnauba Wax, Yellow	500 g
	Carnauba Wax Residue	500 g
	Montan Wax, Bleached	500 g
	Paraffin Wax (50–52° C.)	200 g
	Colophony	150 g
b.	Water	8500 cc
	Potash, Caustic	300 g
	Olive Oil Soap	100 g
c.	Turpentine Oil or Substitute	1500 cc

Melt up *a*, saponify with *b*, stir until cool, and add *c*, shortly before solidified.

No. 9

Montan Wax, Crude	6 g
Carnauba Wax	3 g
Ozokerite (58–60° C.)	2 g
Candelilla or Shellac Wax	3 g
Paraffin Scales (50–52° C.)	14 g
Nigrosine Base	3 g
Turpentine	20–30 cc

No. 10

Esparto Wax	2½ lb
Montan Wax, Crude	¾ lb
Beeswax	1 lb
Paraffin Wax (M.P. 118° F.)	½ lb
Paraffin Wax (M.P. 135° F.)	2½ lb
Lamp Black	¾ lb
Turpentine	2 gal
Cassia Oil	1 oz
Lemongrass Oil	6 oz

Liquid Sporting Shoe Polishes

Formula No. 1

Carnauba Wax, N.C.	3 g
Montan Wax, Crude	2 g
Paraffin (50–52° C.)	3 g
Black Dye,* Oil-Soluble	3 g
Thinners	75 cc
Spindle Oil, Refined	14 cc

No. 2

Carnauba Wax, N.C.	3 g
Montan Wax, Crude	2½ g
Paraffin (50–52° C.)	2½ g
Black Dye,* Oil-Soluble	3 g
Thinners	72 cc
Petrolatum Oil	11 cc
Sardine Train Oil	6 cc

No. 3

Carnauba Wax, N.C.	4 g
Montan Wax, Crude	2 g
Paraffin (50–52° C.)	2 g
Black Dye,* Oil-Soluble	3 g
Thinners	70 cc
Spindle Oil, Refined	19 cc

* Black Dyes
Nigrosine Base 51017
Nigrosine Base 4322
Nigrosine Base LIF
Nigrosine Base SRN
Nigrosine Base SR
Nigrosine Base C

How to dissolve the black dye:

a. Olein	1
Montan Wax, Raw	1
Nigrosine Base	1

Warm together and stir.

or

b. Stearin	2
Nigrosine Base	1

Liquid Shoe Polish

Carnauba Wax	30 g
Paraffin Wax	45 g
Ozokerite	10 g
V.M.&P. Naphtha	215 cc
Turpentine	20 cc
Stearic Acid	20 g
Triethanolamine	7½ g
Water	650 cc
Oil-Soluble Black	15 g
Water-Soluble Black	5 g

Shoe Cream

Formula No. 1

1. Trigamine Stearate	25
Beeswax	10
Candelilla Wax	30
Carnauba Wax	40
Turpentine	20
2. Water	500

Heat 1 to 200° F. and in a separate pot heat 2 to 200° F. Run 1 into 2 slowly while stirring vigorously. This gives a light neutral cream. If a colored cream is desired, dissolve some oil-soluble dye in the wax mixture while it is melting. A thicker cream suitable for tubes is made by decreasing the water content.

No. 2

Montan Wax, Crude	15
Paraffin Wax, Soft	20
Rosin	4–6
Potassium Carbonate	3
Water	95
Oil-Soluble Color	
{Mandarin Yellow}	1
{Metanil Yellow }	each

No. 3

Montan Wax, Double Bleached	15
Paraffin Wax, Soft	20
Rosin	4–6
Potassium Carbonate	3
Water	95
Oil-Soluble Color	
{Mandarin Yellow}	0.1
{Metanil Yellow }	each

No. 4

Montan Wax, Crude	10
Montan Wax, Double Bleached	4
Rosin	3
Potassium Carbonate	2½
Hard Soap	½
Borax	½
Water	100
Nigrosine, Water-Soluble	2

No. 5

(High Temperature Pouring)
(75 to 80° C.)

Wax Mass:

Crude Montan Wax	20
Paraffin Wax (50–52° C.)	10
Rosin	5

Saponifying Solution:

Potassium Carbonate	6
Water	60

Dye Solution:

Nigrosine T.	5.5
Water	50
Final Additional Water	50

No. 6

(Low Temperature Pouring High Grade Cream)
(40 to 50° C.)

Wax Mass:

Crude Montan Wax	10
Beeswax	4
Carnauba Wax	1
Japan Wax	5
Shellac Wax	1.25

Saponifying Solution:

Potassium Carbonate	1.5
Boiling Water	75
Borax	0.5
Diglycol Stearate	1
Palm Oil Soap	1.5

Dye Solution:

Water	50
Nigrosine	5
Final Additional Water	150

No. 7

Montan Wax, Crude	10
Montan Wax, Double Bleached	3
Rosin	2
Paraffin Wax (50/52° C.)	2
Potassium Carbonate	2.2
Soap, Castile	0.3
Sodium Tetraborate	0.3
Nigrosine, Water-Soluble	2
Metanil Yellow Dye	0.08
Water	95

Pour at 65° C.

No. 8

Montan Wax, Crude	15
Paraffin Wax (40/42° C.)	20
Rosin	5
Potassium Carbonate	3
Water	96
Metanil Yellow	0.9
Yellow Mandarin Dye, Water-Soluble	0.8

Pour at 40–45° C.

No. 9

Montan Wax, Double Bleached	15
Paraffin Wax (40–42° C.)	20
Rosin	5
Potassium Carbonate	3
Water	95
Metanil Yellow	0.05
Yellow Mandarin Dye, Water-Soluble	0.1

Pour at 40–42° C.

Shoe Stain:

a. Montan Wax, Crude	15
Rosin	2
Paraffin Wax (40/42° C.)	3
Potassium Carbonate	0.5
Soap, Castile	4
Water	65
b. Shellac	20
Sodium Tetraborate	7
Water	75
c. Nigrosine, Water-Soluble	5.5
Water	25

a, b, c are prepared separately and then mixed together.

No. 10
(Tropical)
Black

Montan Wax, Crude	4.5
Nigrosine Base	1.2
Carnauba Wax, Gray	5.5
Paraffin Wax (54–56° C.)	8.0
Ozokerite, Yellow (66° C.)	1.3
Candelilla Wax	1.3
Shellac Wax	1.2
Turpentine, American	77.0

Mahogany

Carnauba Wax, Gray	8.5
Ozokerite, Yellow	3.5
Paraffin Wax (54–56° C.)	4.5
Shellac Wax, Refined	0.5
Sudan Brown 5B	0.1
Sudan Red 5B	0.05
Turpentine	83.0

No. 11

A. Crude Montan Wax	18
Japan Wax	2
Carnauba Wax	4
Rosin	2
B. Water	260
98% Potash	6
Water-Soluble Nigrosine	12

Heat A and B separately to 95–100° C. and add B to A while stirring vigorously with an electric mixer.

No. 12

Acrawax B	10
Paraffin Wax	15
Candelilla Wax	3
Ester Gum	2
Varnolene	54

Gives a very fair paste which has a good consistency, spreads well and polishes well.

No. 13

Candelilla Wax	50
Diglycol Stearate	30
Stroba Wax	25
Varsol	250
Water	225–300

Melt first three ingredients together and, after removing flame, stir in Varsol. Add the water (at 90° C.) slowly, with vigorous stirring, to the wax-solvent mixture.

No. 14

Carnauba Wax	20
Paraffin Wax	12

Heat to 200° F. and add to this slowly with good stirring while heating on a steam table

Turpentine	65
Carbon Black No. 1	2½
Oil-Soluble Black Dye	½

Stir until uniform.

No. 15

Carnauba Wax, Fat-Gray	6 g
Montan Wax, Bleached	7 g
Paraffin (50–52° C.)	11 g
Ozokerite	2 g
Dyestuff	2 g
Thinner (Turpentine Oil, or Substitute or a Mixture of Both)	72 cc

No. 16

Candelilla Wax	30 g
Paraffin Wax	45 g
Ozokerite	10 g
Turpentine	20 cc
V.M.&P. Naphtha	80 cc
Oil-Soluble Black	15 g

No. 17

Montan Wax, Crude	4.0
Japan Wax	0.3
Paraffin Wax (50–52° C.)	1.0
Carnauba Wax Residue	2.0
Carnauba Wax	0.5
Rosin	0.7
Beeswax	0.3
Potassium Carbonate	1.15
Water	30.0
Turpentine	10.0

No. 18

Carnauba Wax, Gray	7 g
Montan Wax, Crude	7 g
Paraffin (50–52° C.)	12 g
Black Dye, Oil-Soluble	3 g
Thinner (Turpentine Oil, or Substitute, or a Mixture of Both)	51 cc
Petrolatum Oil	20 cc

No. 19

Mixture 1

Carnauba Wax	8
Montan Wax	8
Paraffin Wax	4

These are saponified in a hot solution of:

Potash	3
Water	50

Replace any evaporation with additional warm water.

Mixture 2

No. 1 Polish Black	4
Water	25

These should be milled together in a color mill until thoroughly dispersed.

While Mixture No. 1 is hot, add Mixture No. 2 slowly and with constant stirring. As it cools, the mass will slowly set to a paste. Before it is too stiff for flowing pour into suitable containers and set aside until cold.

No. 20

Carnauba Wax	2
Paraffin Wax	4
Ceresin Wax	2
Beeswax	2
Glyceride	4
Silica Black	3
Water	17
Turpentine	6
Glucarine B	5

Melt the first five ingredients together. Then stir in the silica black and add the water while heating and stirring until homogeneous. Remove from the flame, let cool a little and stir in the turpentine and Glucarine B, and continue stirring till mass thickens to the proper consistency.

Shoe Polish and Preservative

Carnauba Wax	2
Beeswax	2
Neatsfoot Oil	1

Heat by hot water bath (not over fire) till melted, and then add turpentine until a soft paste is obtained when the mixture is cold. This should be applied to the clean, dry leather with a rag or a piece of waste, and rubbed hard until no more polish is absorbed. Polish with a clean cloth. A higher polish will be obtained by reduction of the proportion of oil, but the leather will not be so well preserved.

"Polishing Dye" (or Polishing Ink)

(to dye and polish shoes by means of a "rag wheel")

a. Water	80
Marseilles Soap	3
Carnauba Wax	4
Japan Wax	2
b. Water	20
Methyl Cellulose	1
c. Turpentine Oil	1
Citronella Oil	0.3

Boil the mixture *a*, when cooled, add the dispersion *b* which has been boiled separately. When cooled, add *c*.

White Shoe Polishing Stick

Carnauba Wax, Flora	4
Stearic Acid	4
Paraffin Wax	17
Montan Wax, Bleached	16
China Clay	9
Titanium Dioxide	1

Shoemaker's Waxes

Black, Soft:

Rosin	5
Paraffin Wax	70
Beeswax	5
Asphaltum	20
Black Color	To suit

Black, Hard:

Rosin	10
Paraffin Wax	45
Beeswax	5
Asphaltum	10
Black Color	To suit

Yellow, Soft:

Rosin	10
Paraffin Wax	85
Beeswax	5
Yellow, Oil-Soluble Color	To suit

Yellow, Hard:

Rosin	10
Paraffin Wax	55
Beeswax	5
Yellow, Oil-Soluble Color	To suit

Leather Polish

Carnauba Wax	11
Turpentine	16
Stearic Acid	3
Oil-Soluble Nigrosine	2
Triethanolamine	1
Water	66
Water-Soluble Nigrosine	1

Dissolve the water-soluble nigrosine in the water, add the triethanolamine and stearic acid and heat to boiling. Stir until a smooth soap solution is obtained. In a separate container, melt the carnauba wax in the turpentine and add the oil-soluble nigrosine. When this solution has reached a temperature of 85–90° C., add it to the soap solution. Stir vigorously to obtain a good dispersion of the wax and then stir slowly until the emulsion is cold.

Leather Dressing

Tallow	70
Petroleum Jelly	3½
Diglycol Stearate	13
Beeswax	9
Rosin	2
Water	2

Polish for Patent Leather

Yellow Wax or Ceresin	3 oz
Spermaceti	1 oz
Turpentine	11 oz
Asphaltum Varnish	1 oz
Borax	80 gr
Frankfort Black	1 oz
Prussian Blue	150 gr

Melt the wax, add the borax, and stir until smooth. In another pan melt the spermaceti; add the varnish, previously mixed with the turpentine; stir well and add to the wax; lastly add the colors.

White Kid Cleaner

a.	Carnauba Wax, Gray	50
	Montan Wax, Bleached	50
	Paraffin Wax (50/52° C.)	20
	Japan Wax	20
	Rosin	15
	Diglycol Stearate	10
	Potassium Carbonate	32
	Water	600
b.	Turpentine	150
	Benzene	100
	Trichlor Ethylene	150
	Acetone	50

Boil *a* together with stirring, until a homogeneous emulsion has been formed. Cool to 40° C., and add the solvents *b*. Stir until cooled.

Military Leather Paste Polish

Carnauba Wax	18
Candelilla Wax	2
Japan Wax	10
Paraffin Wax	2
Turpentine	20

Military Leather Dressing

Beeswax, Yellow	65
Acrawax C	2
Turpentine	33

Belt Wax

Rosin	25
Paraffin Wax	15
Japan Wax	10
Tallow	50
Lanosyn	20
Turpentine, Venice	10

Ski Wax

Formula No. 1

Wood Tar	70
Diglycol Stearate	20
Carnauba Wax	10

No. 2

(For cold weather)

Wood Tar	50
Paraffin Wax	25
Turpentine	5

No. 3

(For melting weather)

Montan Wax	17
Woolfat	18
Paraffin Wax	10
Rosin	28
Ozokerite	25
Spindle Oil	5
Wood Tar	2

No. 4
(For collapsible tubes)

Montan Wax	10
Rosin	5
Beeswax	5
Roseen Oil	30
Linseed Oil	10
Spindle Oil	20
Wood Tar	20

No. 5
(Climbing and gliding)

Paraffin Wax (50–53° C.)	40
Crude Montan Wax	15
Woolfat, Neutral	15
Colophony	10
Mineral Oil	15
Wood Tar	5

No. 6
(Climbing klister)

Crude Montan Wax	17
Woolfat, Neutral	18
Paraffin Wax	10
Rosin	28
Ozokerite	25
Mineral Oil	5
Wood Tar	2

No. 7
("Skate")

Crude Montan Wax	10
Rosin	12
Paraffin Wax	30
Ozokerite	20
Petrolatum	8
Wood Tar	5

No. 8
(Climbing)

Rosin	10
Ceresin	5
Montan Wax	5
Paraffin	5
Japan Wax	10
Beeswax	5
Tallow	5
Lanosyn	5

No. 9
(Gliding)

Rosin	5
Ceresin	20
Montan Wax	7½
Ceraflux	5
Japan Wax	7½
Woolfat	5

No. 10
(Climbing and gliding)

Montan Wax, Crude	30
Rosin	10
Woolfat	25
Wood Tar	8
Paraffin (52/54° C.)	20
Ozokerite-Ceresin	7

Apply on dry ski. Rub in (until shiny) using a cork or the palm of the hand. For climbing rub in some wax transverse to axis of ski. Polish this down before gliding.

No. 11

Montan Wax, Crude	18
Paraffin Wax	60
Ozokerite	4
Woolfat	6
Colophony	12

Melt together and add turpentine oil to desired consistency.

No. 12
(Ascension wax)

Ceresin	10
Paraffin Wax	20
Woolfat	28
Colophony	15
Montan Wax	27

Melt together and add turpentine to desired consistency.

No. 13
(Gliding wax)

Paraffin Wax	60
Ceresin	16
Tallow	14

Melt together and add turpentine to suit.

No. 14
(Gliding wax)

Black Ozokerite	55
Rosin	30
Tallow	15

Melt together and add turpentine to suit.

No. 15

Paraffin Wax	30 g
Montan Wax, Bleached	80 g
Colophony	20 g
Japan Wax	20 g
Wood Tar Oil	10 cc
Turpentine Oil	10 cc
Yellow Dyestuff	Enough to color

No. 16
(White wax polish)

Paraffin Wax	16 g
Carnauba Wax, Light	3 g
Beeswax, White	1 g
Turpentine	46 cc

No. 17
(Liquid wax polish)

Paraffin Wax	50 g
Ozokerite	5 g
Carnauba Wax	100 g
Turpentine Oil	750 cc
Benzoline	94 cc
Camphor Oil	2 g
Amyl Acetate	3 cc

No. 18
(For gliding)

Paraffin (50–52° C.)	60
Ceresin (60° C.)	16
Tallow or Palm Oil	14
Talcum	10

No. 19
(For Climbing)

Paraffin (40–42° C.)	50
Rosin	20
Woolfat	15
Wood Tar	15

Liquid Ski Waxes

Formula No. 1

Carnauba Wax	4
Montan Wax	12
Linseed Oil Varnish	84

No. 2

Montan Wax, Refined	15
Ceresin	3
Turpentine Oil Substitute	82

No. 3

Colophony	30
Ceresin	25
Tallow	55

No. 4

Talc	10
Palm Oil	14
Ceresin	16
Paraffin Wax	60

No. 5

Tallow	125
Colophony	275
Montan Wax	400
Turpentine Oil	200

No. 6

Rice Starch	40
Tallow	125
Larch Turpentine	260
Yellow Wax	500

No. 7
(Sohm's ski wax)

Ozokerite	55
Tallow	15
Rosin	30

All these waxes may be thinned with turpentine oil to desired fluidity.

Norwegian Klister (Ski) Waxes

Formula No. 1

Rice Starch	40
Tallow	125
Larch Turpentine	260
Yellow Wax	500

No. 2

Paraffin (40–42° C.)	60
Colophony	12
Woolfat	6
Carnauba Wax	4
Montan Wax	80

No. 3

Ozokerite	55
Colophony	35
Spindle Oil, Refined	10

No. 4

Paraffin	70
Colophony	15
Woolfat	10
Carnauba Wax	5
Montan Wax	15

No. 5

Ozokerite	5
Colophony	4
Train or Spindle Oil	1½

No. 6

Montan Wax, Crude	120
Paraffin	30
Woolfat	20
Seal Train Oil	15
Tallow, Hard	10
Rosin	5
Wood Tar	3

No. 7

Paraffin	1
Tallow	1½
Rosin	2½
Ozokerite	15

No. 8

Woolfat	10
Ceresin	90

Stove Polishes

Formula No. 1

Paraffin Wax (40–42° C.)	3.5
Ozokerite, Crude	2.0
Turpentine	40.0
Rosin (D to K Grades)	0.7
Lampblack	4.0
Graphite	24.0
Ammonium Linoleate	4.0
Water	20.0
Nigrosine, Oil-Soluble	0.8
Potassium Carbonate	1.0

No. 2

Carnauba Wax	1.5
Self-Emulsifying Wax (Japsol)	2.0
Diglycol Stearate	2.0
China Clay (Colloidal)	4.0
Rosin	1.5
Potassium Carbonate	1.5
Graphite	18.0
Lampblack	5.0
Nigrosine, Water-Soluble	1.0
Water	63.5

Several self-emulsifying waxes, suitable for inclusion in such a formula, are now commercially available. The diglycol stearate also helps to improve the suspension and homogeneity of the preparation, while the colloidal clay tends to prevent caking of the graphite and lampblack.

No. 3

Cumarone Resin	2
Paraffin Wax, Soft	2
Montan Wax, Crude	5–6
Potash Carbonate	4
Water	200
Nigrosine Base BB	10
Lampblack	24
Graphite	56

No. 4

Ceresin (56/58° C.)	8 kg
Oleic Acid	10 kg
Spindle Oil	12 kg
Neuburg Chalk	20 g
Quartz Flour	10 kg
Emery, Powdered	25 kg
Carborundum	15 kg

No. 5

Ceresin (56/58° C.)	3
Oleic Acid	17
Petroleum Jelly, Natural	4
Spindle Oil	6
Quartz or Pumice, Powdered	45
Chrome Oxide	25

No. 6

a. Crude Montan Wax	5.0
Ceraflux	1.5
Beeswax	0.5
b. Nigrosine, Oil-Soluble	0.5
c. Graphite	40.0
Lampblack	2.5
Turpentine	50.0

Melt *a*, dissolve *b* in the melted *a* with stirring.

Prepare suspension *c*, and stir it slowly into the melted wax—color. Let solidify in cans.

No. 7

a. Montan Wax, Crude	2.5
Rosin	0.8
Japan Wax	0.7
b. Nigrosine, Oil-Soluble	0.6
c. Potassium Carbonate	1.5
Water	53.9
d. Graphite	28.0
Soot	12.0

Melt *a*. Dissolve *b* in the melted *a*.

Boil *c*, and stir in *d* to get a smooth suspension.

Mix *c* + *d* into *a* + *b* with good stirring. Put into cans while hot.

No. 8
(Solid Oven Polish)

Emery	25
Quartz, Powdered	25
Scale Wax (52/54° C.)	10
Oleic Acid, Distilled	10
Spindle Oil	10

No. 9

Flake Graphite	33
Lampblack	1.7
Beeswax	4
Ceresin (58/60° C.)	1

Liquid Stove Polishes

Formula No. 1

Montan Wax, Crude	5.0
Colophony (Rosin—D to K Grades)	1.5
Paraffin Wax (40–42° C.)	2.5
Diglycol Stearate S	2.5
Potassium Carbonate	3.5
Graphite	50.0
Bone Black	20.0
Nigrosine, Oil-Soluble	3.0
Turpentine (or Substitute)	97.0
Water	115.0

Melt the waxes together with the oil-soluble dyestuff, then thin out with turpentine and mill in the graphite and lampblack. The stearate, rosin and potassium carbonate are heated together until homogeneous, and added slowly with high speed agitation.

No. 2

a. Montan Wax, Crude	2.0
Beeswax	1.0
b. Turpentine	64.0
Graphite	20.0
Lampblack	3.0
c. Ammonium Linoleate	2.5
Water	8.5

Melt *a*. Make suspension *b*; thin *a* with *b*.

Heat *c* to almost boiling temperature, add to *a* and *b*.

No. 3

a. Crude Montan Wax	2
Carnauba Wax	2
Rosin	1
Potash Carbonate	2
Water	72
b. Nigrosine, Water-Soluble	1
Graphite	20

Boil *a* until homogeneous. Stir in *b* gradually, until smooth.

No. 4

Crude Montan Wax	2
Rosin	1
Carnauba Wax	2

Heat to 90° C. with stirring and to it add slowly

Caustic Potash	2
Water (Boiling)	86
Nigrosine	3

Keep on heat and agitate vigorously until uniform. Cool and work in

Graphite Flake	5
Lampblack	3

Mix thoroughly until uniform.

No. 5

a. Nigrosine, Water-Soluble	1
Hard Soap	3
Water	32
b. Paraffin Wax	3
Ozokerite	1
Nigrosine, Oil-Soluble	1
c. Turpentine	20
d. Graphite	39

Melt *b*, thin with *c*; make a paste of this wax solution with *d*.

Boil *a* separately, and add *b*, *c*, and *d* to this with good stirring.

No. 6

a. Montan Wax, Crude	2
Rosin	1
Carnauba Wax	2
b. Potassium Carbonate	2
Water	83
c. Lampblack	3
Graphite Flakes	5
d. Nigrosine, Water-Soluble	3–4

No. 7

Rosin Oil	2
Montan Wax (Black)	2
Carnauba Wax	2
Water	82
Caustic Potash	2
Nigrosine	3
Graphite	5
Lampblack	3

The oil and waxes are carefully melted. The potash and nigrosine are dissolved in the water and gradually stirred into the wax mixture at 85 to 90° C. The resultant product is agitated thoroughly during the cooling, when the graphite and lampblack are uniformly incorporated. The caustic potash forms a soap with the resin and aids emulsification and retards settling of the black.

No. 8

Graphite, Flaky	1000
Lampblack	50
Beeswax, Crude	10
Montan Wax, Crude	100
Paraffin Scales (50–52° C.)	30

Melt together.

Nigrosine, Fat-Soluble	5
Naphtha	To suit

No. 9

Graphite, Colloidal	20
Paraffin Wax	13
Lacquer Benzoline (White Spirits)	67

Nickel, Chrome, Copper and Brass Polish

Kieselguhr, Calcined	40
Whiting	35
Iron Oxide, Red	10
Paraffin (50/52° C.)	15

Melt and grind in a mill.

Brass Polish

Triethanolamine Oleate	1	lb
Potassium Oleate	4	oz
Naphtha	1	gal
Ammonia (28° Bé.)	7	fl oz
Silica (300 Mesh)	3½	lb

Mix thoroughly the silica and naphtha then stir in thoroughly the two oleates and finally the ammonia. This makes a superior metal polish which gives a very fine finish on brass. If carefully prepared, there will be no separation of the ingredients on long standing.

Metal-Polish Cake

Montan Wax, Crude	25
Montan Wax, Double Bleached	5
Chromium Oxide	70

Melt together and stir until cool.

Metal Polish Pastes

Formula No. 1

a. Ceraflux	8
Ozokerite	2
Oleic Acid	40
b. Whiting, Finest	50

Melt up *a*, and work in the well sifted *b*.

No. 2

a. Paraffin Wax (50–52° C.)	5
Stearic Acid	16
Oleic Acid	29
b. Whiting, Finest	20
Magnesium Carbonate	30

Combine as in No. 1.

No. 3

a. Paraffin or Scale Wax (50–52° C.)	17
Montan Wax, Refined	3
Spindle Oil, Refined	30
b. Whiting, Finest, Sifted	46
Iron Oxide, Red	4

Combine as in No. 1.

No. 4

(For chrome and nickel)

a. Paraffin Wax (50–52° C.)	10
Montan Wax, Refined	2
Spindle Oil, Refined	38
b. Kieselguhr	49
Iron Oxide, Red	1

Combine as in No. 1.

No. 5

Scale Wax (50/52° C.)	5
Ceresin (58/60° C.)	3
Stearin	15
Olein, Distilled	17
Spindle Oil	10
Calcium Carbonate, Floated	30
Neuburg Chalk	15
Chrome Green	5

Melt up the 5 first ingredients and stir in the abrasive powder.

Wax Polish for Varnished Metals

Two types of waxing composition have been evolved, one suitable for application immediately after varnishing and containing 16% ceresin wax, 10%

calcium stearate, 30% petroleum and 44% mineral cleaning oil; the other a wax cleaning composition and containing a mild abrasive, consisting of 33% abrasive powder, 3% calcium stearate, 7% ceresin wax, 2% iron oxide, 0.5% carbolic acid, 53% petroleum and 1.5% concentrated ammonia.

Silver Polish

a. Paraffin Wax (50/52° C.)	8
Mineral Oil, White	45
b. Magnesium Carbonate	35
Calcium Carbonate	12

Metal Polish for Chromium or Silver

Orthodichlorbenzol	400 cc
Water	70 cc
Strong Ammonia	1 cc
Saturated Solution of Castile Soap	2 cc
Levigated Alumina	35 g

If carefully made a stable emulsion results.

For brass or copper polish substitute precipitated chalk for levigated alumina. If a more abrasive polish is desired substitute kieselguhr for precipitated chalk.

Chromium Polish

Formula No. 1

Carnauba Wax	10 g
Yellow Wax	15 g
Japan Wax	15 g
Paraffin Wax (46–48° C.)	60 g

Melt on water bath.

Melt together and add:

Turpentine	130 cc
Tripoli, Dry	70 g
Turpentine	100 cc

No. 2

Chromium Oxide, Powdered	50
Paraffin Wax	50
Emery	30–50

Ferrotype Polish

(For metal photographic plates)

Beeswax	40 gr
Carbon Tetrachloride	4 oz

Aluminum Polish

Stearic Acid or Paraffin Wax (Powdered)	10
Magnesium Oxide	40
Calcium Carbonate, Precipitated	30
Iron Oxide, Red	20

Buffing Nickel Polish

Double Pressed Saponified Stearic Acid	86
Paraffin Wax	16
Edible Tallow	10
Japan Wax	3
Silex	376

Bakelite Polish

Formula No. 1

Montan Wax	3
Tallow or Bone Fat	2
Diglycol Oleate	1
Asbestos, Fine Fibres	12

No. 2

Montan Wax	1½
Tallow or Bone Fat	1½
Diglycol Stearate	2
Mineral Oil	12
Chalk, Vienna	To suit

Polishing of Plastic and Hard Rubber Articles

Formula No. 1

Carnauba Wax may be satisfactorily replaced by Albacer where a non-aqueous solvent is employed. 1 lb of Albacer dissolved by heat in 2 qt of Turkelene gives a non-greasy, high polish on Catalin and similar plastic articles. Approximately 3–4 oz in the standard 1½ bushel tumbling barrel is usually sufficient. The work is tumbled for about 16 hours either in sawdust or wooden pegs which are slightly wet with the polishing solution. Using Turkelene in place of oleic acid gives a much less greasy film and is not subject to rancidity. If a volatile solvent is desired, the Albacer may be dissolved by heat in approximately 1 gal of naphtha or a high-boiling solvent such as Varnolene. If a pint of butanol is added to the solvent, more of the wax will remain dissolved at room temperature. Wax which separates in fine particles should be re-dispersed by stirring before adding the proper quantity to the contents of the tumbler barrel.

When a solvent or oily vehicle is undesirable, a very satisfactory aqueous liquid preparation is a bright drying carnauba wax emulsion. About 4 oz to each 1½ bushel barrel containing either sawdust or, preferably, wooden pegs, is ordinarily sufficient.

No. 2

Stearic Acid	8
Montan Wax	2
Lauryl Sulphonate	2
Iron Oxide	38

Tripoli Composition

Stearic Acid	55
Edible Tallow	2
Oleo Stearine	5
Rosin	9
Petrolatum	40
Japan Wax	1
Flint	315
Tripoli Flour, Double Ground	93
Ponolith	2

Tripoli Buffing Stick

Double Pressed Saponified Stearic Acid	30
Edible Tallow	25
Paraffin Wax	25
Tripoli Flour (or as much as will be absorbed)	20

A buffing or polishing paste may be made, using the above formulae, with the addition of a small amount of turpentine and of water to bring to the consistency desired.

Polishing Wax for Rotating Discs

Montan Wax	3
Tallow	3
Stearic Acid	4
Mineral Oil, Yellow	24
Viennese Chalk	To desired consistency

Polish for Cord

Paraffin Wax (50–52° C.)	10
Japan Wax	5
Caustic Potash	2
Water, To desired consistency	

Boil together until saponified.

Knife-Polishing Stones

Formula No. 1

a. Paraffin Wax (50/52° C.)	10
Ozokerite	5
b. Diglycol Laurate	10
c. Pumice, Powdered	30
Emery	25
Lime Green	20

Melt *a*, add *b*, and stir in slowly *c*. Cool till the paste sets, and pour into molds.

No. 2

a. Stearic Acid	10
Japan Wax	10
b. Oleic Acid	10
c. Pumice, Finely Powdered	60
Chrome Oxide	10

As in No. 1.

No. 3

a. Paraffin Wax (50/52° C.)	10
Stearic Acid	10
Japan Wax	8
b. Pumice, Powdered	25
Kieselguhr	25
Yellow Ochre	22

Stir the powders *b* into the melted waxes *a*. Stir till the paste sets, and pour into forms.

No. 4

a. Paraffin Wax (50/52° C.)	25
Montan Wax	10
b. Whiting	40
Emery	20
Carbon Black	5

As in No. 3.

Wood Button Polish

Turpentine	120 cc
Wax, White	120 g
Melt.	
Add	
Alcohol	50 cc

with stirring.

Axe or Hammer Handle Wax

Formula No. 1

White Beeswax	5½
White Rosin	½
White Lead	4
Dammar Varnish	⅛

Melt the beeswax; crush, melt and stir in the rosin; add white lead while stirring, and finally pour in the dammar varnish. While still in a liquid state, this material is poured into small paper bags which serve as molds.

No. 2

White Rosin	10	lb
Paraffin Wax	2	lb
White Lead	2	oz
Linseed Oil	½	lb

The finished product looks like beeswax, but is lighter in color. The rosin and paraffin are melted and mixed and allowed to cool somewhat before stirring in the white lead and linseed oil—this to prevent foaming.

Polish for Cellulose Lacquer

Any hard wax polish can be used as a base, and to this are added abrasive compounds such as silica, air-floated tripoli pow-

der, pumice flour, kieselguhr, etc. A suitable wax polish base is

Beeswax	5
Carnauba Wax	6
Xylol	10
Benzine	20
Paraffin Oil	2½
Turpentine	6½

The proportion of abrasive will depend upon the type used and the degree of cutting action required. The abrasive should be mixed with a proportion of the paraffin and turpentine to wet it thoroughly and is then mixed thoroughly into the wax base.

Pore Filler for Polish Bases

German Patent 607,521

Carnauba Wax	5
Pumice Powder	100
Sandarac	100
Castor Oil, Blown	10
Shellac Wax	10

Melt up while stirring, cool, and pulverize. The "Pore Filler" is then applied as usual by rubbing it in on the wood surface together with the polishing liquid.

Barrel Tumbling Polish

Formula No. 1

Beeswax	½ lb
Carnauba Wax	1½ lb
Turpentine	1 gal

Shave the wax into chips, place in a suitable container and add the turpentine and dissolve.

No. 2

Stearic Acid	4 oz
Carnauba Wax	8 oz
Turpentine	1 gal

Dissolve same as above, or

Stearic Acid	4 oz
Spermaceti	4 oz
Paraffin Wax	4 oz
Carnauba Wax	4 oz
Flushing Oil	4 oz
Beeswax	2 oz
Turpentine	1 gal

No. 3

Chalk, Precipitated	2
Turkelene	8
Hydrogenated Castor Oil Wax	4
Sawdust	56

Razor-Strop Preparations

Formula No. 1

Tallow, Acidless	250
Caput Mortuum	750

Melt the fat, and work in the iron pigment.

No. 2

Emery, Finest Powder	30
Tin Oxide	15
Paris Red	15
Petrolatum, Natural	30
Beeswax	30

No. 3

Petrolatum, Natural	82
English Red (Iron Oxide)	18

For collapsible tubes. Run through a mill.

Razor Hone Paste

Levigated or washed emery or carborundum powder 400–500 or 600 mesh, 6 lb, beef suet (freshly rendered), 2 lb. and yellow beeswax, 1 lb. Melt the suet and the wax then incorporate the emery or carborundum. Cool and cut into small bars.

PAPER

Waterproofing for Paper

Formula No. 1

Trihydroxyethylamine Stearate	4½
Stearic Acid	½
Water	100

Boil and mix until smooth; pour into this slowly while stirring vigorously

Paraffin Wax (Heated to 90–100° C.)	30

Stir until cool.

Use 1 part of above emulsion to 5–10 parts of warm water.

No. 2

Paper is coated with following melted together and applied by a special brush coater.

Carnauba Wax	20
Ceresin Wax	5
Petrolatum	10
Rosin	5

No. 3

Paraffin Wax	20
Ceresin Wax	10
Congo Gum	20
Rosin	10
Rubber Latex	2
Titanium Dioxide	38

Melt the gums and waxes, add rubber and filter and blend while molten.

No. 4

(Millboard)

Cellulose Waste Fibers	100

are mixed with following emulsion

Paraffin Wax (Match)	1.50
Turpentine	0.75
Aluminum Oxide	12.00
Naphthenic Acid	15.00
Water	70.00

Press between rollers heated to 50° C.

No. 5

("Cellophane")

U. S. Patent 2,073,301

Sheets are treated with

Tung Oil	¼
Gasoline	100

Dry at 124° F.; then dip in

Chloro-Rubber	9
Paraffin Wax	1
Gasoline	300

Dry at 88° F.

No. 6

To meet the frequent need to waterproof and strengthen paper without the use of paraffin or wax, the following simple method is worth keeping in mind:

Using 1 part of glycerin by weight to 1 part by weight of gelatin and 4 parts by weight of water, cover both sides of the paper with the warmed solution. Then after a few minutes, before it is fully dry, place the paper in a solution of 7½ parts by weight of formaldehyde with 50 parts by weight of water.

Waterproofing Paper and Fiberboard

The following composition and method of application will render uncalendered paper, fiberboard and similar porous material waterproof and proof

against the passage or penetration of water.

Paraffin (M.P. about 130° F.)	22.5
Trihydroxyethylamine Stearate	3.0
Water	74.5

The paraffin is melted and the stearate added to same. The water is then heated to nearly boiling and then vigorously agitated with a suitable mechanical stirring device, while the above mixture of melted wax and emulsifier is slowly added. This mixture is cooled while it is stirred.

The paper or fiberboard is coated on the side which is to be in contact with water. This is then quickly heated to the melting point of the wax, which then coalesces into a continuous film that does not soak into the paper which is preferentially wetted by the water. This method works most effectively on paper pulp molded containers and possesses the advantages of being much cheaper than dipping in melted paraffin as only about a tenth as much paraffin is needed. In addition, the outside of the container is not greasy, and can be printed upon after treatment which is not the case when treated with melted wax.

Non-Staining Waterproofing for Paper

U. S. Patent 1,968,907

Petrolatum Wax	25–90
Ester Gum	5–75
Paraffin Wax	5–50

Milk Bottle Cap Coating

U. S. Patent 2,325,168

Rubber, Isomerized	100
Paraffin Wax	12½
Hydrogenated Rosin	25

Embossed Waterproof Wallpaper

U. S. Patent 1,936,355

Stearic Acid	4 lb
Japan Wax	5 lb
Triphenyl Phosphate	8 lb
Dibutyl Phthalate	1 lb

Heat to 90° C. and add

Water Shellac (40%)	56 lb
Triethanolamine	2 lb

Cool to 70° C. and add successively with vigorous stirring

Ammonia (28%)	1 qt
Water	3 gal
Ammonia (28%)	3 qt
Water	3 gal
Latex + 4% Sulphur	3 lb
Water	To make 28 gal

Mothproof Paper

Spray or paint paper with a warm solution of following

Eucalyptus Oil	1
Naphthalene	42
Paraffin Wax	25
Naphtha	11
Cedar Wood Oil	1

Flameproof Cellulose Sheet

U. S. Patent 2,316,496

A process of producing flameproof, non-sticking, transparent regenerated cellulose sheet comprises passing gel regenerated cellulose in sheet form through an aqueous bath comprising 7% ammonium sulfamate, 1.5%

glycerol, and sufficient emulsion of the composition:

Carnauba Wax	22.7
Stearic Acid	9.7
Morpholine	11.3
Shellac (Bleached)	18.2
Mono-Sulfonated Alkyl Benzene	2.3
Water	391.0

to give 0.5% solids and thereafter drying the sheet material.

Self-Sealing Waxed Paper

U. S. Patent 2,233,186

Formula No. 1

Paper is coated with a melted mixture of:

Paraffin Wax	20
Crepe or Synthetic Rubber	2–3
Ester Gum	80

This gives a transparent, flexible, grease- and waterproof product which can be heat-sealed above 70°C.

No. 2

U. S. Patent 2,227,516

Paper is coated with:

Paraffin Wax	100
Rubber or Polymerized Isobutylene	1–3
Titanium Dioxide, Colloidal	5–15
Sodium Benzoate	1–3

Waxed Paper Impregnant

Paraffin Wax (150° F. M. P.)	186
Carnauba Wax No. 1 Yellow	14

Paper Waxing

U. S. Patent 1,953,085

Paraffin Wax	33
Silicate of Soda	4
Alum	2
Glue	1
Water	60

The silicate of soda used in the above formula is a commercial form of syrupy consistency containing about 50% of water. This silicate of soda syrup is mixed with 65% of the total water. The remaining 35% of the total water is used to dissolve the alum. The glue is added to the diluted silicate of soda. The wax composition is prepared by first melting the wax, adding the silicate of soda solution containing the glue and agitating, finally adding the alum solution with agitation. The temperature at which the composition is prepared is about 170° F.

Wax Emulsions for Paper Coating

Formula No. 1

Yellow Beeswax	360	lb
Caustic Potash	2	lb
Ammonium Hydroxide	8¼	lb

Boil with stirring for 1 hour. Add 150 gal water and shut off heat.

No. 2

Ceresin	200 lb
Stearic Acid	200 lb
Caustic Potash	9 lb
Ammonium Hydroxide	13 lb
Water	200 gal

Boil with stirring for 1 hour; bring up to 800 gal with water while stirring.

No. 3

Carnauba Wax	50 lb
Water	50 gal
Soap	12 lb

The soap is dissolved in the water and brought to boiling. The wax is added and boiling continued until all is emulsified. The emulsion is preferably stirred continuously until cold. The soap may be any good grade of washing soap free from rosin.

No. 4

Yellow Laundry Soap	7 lb
Carnauba Wax	50 lb
Water	12½ gal

Boil with live steam till thoroughly emulsified (from 3–4 hours).

No. 5

Montan Wax, Crude	9.0
Paraffin Wax (50/52° C.)	1.0
Soap, Castile	0.8
Borax	0.2
Distilled Water	50.0

No. 6

Montan Wax	6.0
Soap, Castile	1.9
Distilled Water	40.0

No. 7

Marseilles Soap	2.0
Montan Wax, Crude or Bleached	6.5
Water, Free of Calcium	40.0

No. 8

Carnauba Wax	50 lb
Stearic Acid	7 lb
Borax Soap	10 lb
Water	To make 50 gal

This is added to a clay-casein mixture to produce a coating on paper which can be readily friction-calendered to give a high finish.

Paper Sizing

Canadian Patent 398,980

Scale Wax (Paraffin)	608
Rosin	1216
Stearic Acid	36
Corn Starch	122
Caustic Soda	130
Water	3168

Tranfer Printing Paper

U. S. Patent 1,965,257

Rubber Latex (60%)	40
Casein	10
Zinc Stearate	5
Paraffin Emulsion	50–100
Formaldehyde (40%)	5
Triethanolamine	2
Water	2

The colored design is printed on this paper by using a dye ink.

Dielectric Paper

U. S. Patent 2,020,468

Paper is impregnated with

Chlorinated Naphthalene	9
Paraffin Wax	1

PHOTOGRAPHY

Photo Print Pastes or Waxes

The paste form of print enhancement and protection has merits and drawbacks and each worker must choose which suits him and his methods. The following has served long and well in practice.

Beeswax, White	1 oz
Dammar Varnish *	200 min
Turpentine	1 oz

* Dammar Varnish

Gum Dammar	1 oz
Turpentine	2½ oz

Dissolve with gentle heat in double boiler and bottle for use.

Lithographic Plate Wax Ground

Turpentine	16
Asphalt, Powdered	3½
Beeswax	2½

To dissolve the wax, first heat the turpentine; after the wax has been dissolved in the warm fluid, add the asphaltum and stir until completely dissolved.

Litho Washout Solution

For strengthening litho images on metal plates for offset printing:

Asphaltum	2 lb
Beeswax	3 oz
Stearin	2 oz
Transfer Ink	1 oz
Lavender Oil	2 oz
Japan Liquid Drier	4 oz

Mix thoroughly by heating, then add one gallon of turpentine.

Lithographers' Protective Hand Cream

Lanolin (Anhydrous)	20
Paraffin Wax	6
Paraffin Oil	7
Glycol Stearate	12
Water	55

Melt lanolin, glycol stearate, and wax; add oil; then add water while agitating rapidly until cold. This gives protection against water solutions of moderately concentrated acids.

PYROTECHNICS

Match Head Composition

Sulphur, Powdered	1 lb
Manganese Dioxide	2 lb
Ferric Oxide	½ lb
Glass, Powdered	1¼ lb
Glue, Powdered	1 lb
Potassium Bichromate	0.8 lb
Potassium Chlorate	6¾ lb
Paraffin Wax, Powdered	1 oz

This should be mixed with great caution as it is explosive.

Match Box Striking Composition

U. S. Patent 2,030,892

Rosin	85
Shellac	3
Paraffin Wax	1
Beeswax	1
Gutta Percha	10

The above is melted together and mixed until uniform.

Grains of abrasive are embedded in a coating of the above.

White Pyrotechnic Light

U. S. Patent 2,035,509

Barium Nitrate	38
Strontium Nitrate	7
Magnesium, Powdered	52
Paraffin Wax	3

Signal Torch (Flare)

U. S. Patent 2,073,530

Strontium Nitrate	45
Lacquer	4
Potassium Chlorate	7
Sulphur	6
Potassium Nitrate	2
Sawdust	2
Petrolatum	2
Strontium Carbonate	2
Paraffin Wax	7

SOAPS AND CLEANERS

Parquet Floor Cleaner

a. Montan Wax, Refined	15
Ceresin	15
Paraffin Wax, Soft	15
Stearic Acid	15
b. Turpentine	864
Tetralin	52
Benzol	24

Melt *a*, thin with *b*. Stir till cold. Perfume with pine needle oil.

Dustless Sweeping Mixture

Sand	50
Sawdust	25
Mineral Oil	20
Beeswax	5

Melt the wax in the oil and then stir in the sand and sawdust. A green oil-soluble dye is usually added to give the mixture a pleasing appearance.

Glass Windshield Cleaner

Triethanolamine Oleate	2
Kerosene	15
Beeswax	4
Carnauba Wax	1
Celite (Light Abrasive)	16

Typewriter Cleaner

Petrolatum, Yellow	2– 5
Lanolin, Anhydrous	12–15
Montan Wax, Bleached	10
Paraffin Wax, Soft (40° C.)	20
Clay, Finely Ground	50
Earth Color	3–13

Abrasive Cleaner

a. Scale Wax (50/52° C.)	5
Ceresin	5
Oleic Acid	8
Spindle Oil	5
Petroleum	3
b. Neuburg Chalk	25
Bitter Almond Oil, Artificial	1/10

Melt *a*, and mix thoroughly with *b*. Fill into cans, while hot.

Saddle Soap

Formula No. 1

Soap Powder	15
Water	72
Neatsfoot Oil	5
Beeswax	8

Dissolve the soap in hot water. Heat the neatsfoot oil and wax until melted and pour the hot mixture into soap solution. Stir until it begins to thicken, pour into cans.

No. 2

Palm Oil Soap Chips	8
Water	24
Beeswax	1½
Neatsfoot Oil	1¼
DuPont Orange No. 110 (2% solution)	10

Dissolve soap chips in hot water, add color. Melt wax with the neatsfoot oil, and add to soap solution. Stir until the mix begins to thicken, and pour into cans.

Soap Superfatting and Neutralizing Compound

Beeswax	700
Lanolin	3000
Stearic Acid	400
Borax	62
Distilled Water	3000

The beeswax and half of the lanolin are heated together to about 80° C. The borax is dissolved in the water, which is boiling hot, and the solution stirred into the melted fats and allowed to boil for some time. The mixture is then allowed to cool to about 60° C. with stirring. The stearic acid is melted in another suitable vessel and the balance of the lanolin added to it. This is added to the first mixture at a temperature of 50° C. and stirred. About 2% of the compound may be used as a superfatting agent with soap chips.

Coloring Wax Emulsions

There are two kinds of emulsions. 1—oil in water emulsions, 2—water in oil emulsions. The oil in water emulsions are best colored with water-soluble dyes. The water which is used in the emulsions is first colored. If the emulsion is to be colored after completion, the color is dissolved in as little water as possible and the concentrated dye solution is added to the emulsion and stirred vigorously. The following colors are recommended. The proportions are anywhere from one pound to four hundred gallons, to one pound to twelve hundred gallons, depending upon the depth of shade desired.

Pink	—Rhodamine B Extra
Green	—Cyanine Green
Golden Yellow	—Metanil Yellow
Canary Yellow	—Tartrazine
Blue	—Alizarine Blue
Red	—Cloth Red
Heliotrope	—Violamine
Opal	—Fluorescein
Black	—Nigrosine

Water in oil emulsions are best colored with oil-soluble colors. The colors are dissolved in the oils before emulsification. The colors recommended are:

Yellow	—Azo Oil Yellow
Red	—Azo Oil Red
Black	—Oil Black
Orange	—Azo Oil Orange
Blue	—Alizarine Oil Blue
Violet	—Alizarine Oil Violet
Green	—Oil Green

With the exception of the black, one pound colors 200 gallons. One pound of the black colors 50 gallons.

TEXTILE COMPOUNDS

Water and Alkali Resistant Textile Finish

Ceresin Wax	90
Bitumen (M.P. above 100°)	45
Tricresyl Phosphate	45
Turpentine	820

Water-Repellent for Textiles

Formula No. 1

Paraffin Wax (130° F.)	140
Stearic Acid	60
Naphthenic Acids	10
Gelatin	20
Aluminum Formate (30% Solution)	200
Water	570

Melt the wax and stearic acid and add the naphthenic acids, following with 150 g of boiling water. Stir until an emulsion is produced. Dissolve the gelatin in 180 g of water. Add the wax mixture to the gelatin solution at 60° C. Run through a colloid mill if desired. Finally add the aluminum formate solution very slowly and with much stirring. Now add the remaining water and filter if necessary.

No. 2

U. S. Patent 2,057,960

Paraffin Wax	100
Tetralin	15
Hexalin	15

Warm and mix till clear. Add to following brought to a boil:

Casein	70
Aluminum Formate	30
Water	600

No. 3

Rubber Cement	46
Ester Gum	22
Cumar	2
Paraffin	31
Naphtha	100

No. 4

Paraffin Wax	40
Oleic Acid	5
Trigamine	3
Water	112

The trigamine is dissolved in the water and the oleic acid is added, stirring thoroughly until completely homogeneous. This is then heated to 65–70° C. and the wax, previously melted, added with rapid agitation. Stirring is continued until the emulsion is cold. This emulsion can be diluted readily with warm water.

No. 5

Rubber	2½
Xylene	90

Allow to stand until swollen and then mix slowly until dissolved and then add

Hydrogenated Fish Oil	7½

This may be brushed or sprayed.

No. 6
(White)

Asbestine	20
Lithopone	10
Paraffin Wax (135°)	20
Petrolatum (140°)	72
Aluminum Stearate	8

With this formula which is designed to fill the more open

constructions from 35–45% fill should be used based on the original weight of the fabric. The closeness of the fabric will have to be the determining factor for the degree of fill in the final analysis.

No. 7

(Sunproof)

Hard Amorphous Wax (148°)	22
Petrolatum (130°)	70
Magnesium Stearate (or Aluminum)	8

No. 8

(Acetate Rayon)

Paraffin Wax	5 g
Soap	5 g
Ammonium Hydroxide (0.880)	30 cc
Water	970 cc

Heat to 55° C. and stir vigorously until a uniform emulsion results. Soap the rayon in this emulsion at 45° C. for 15 minutes; remove; centrifuge and treat for 10 minutes at 20° C. with a 5° Tw. solution of aluminum acetate.

No. 9

(Mattress)

U. S. Patent 2,082,592

Cellulose Nitrate	3.05
Dibutyl Phthalate	6.00
Ceresin	4.05
Paraffin Oil	3.00
Ethyl Acetate	22.60
Alcohol	32.60
Toluene	28.70

No. 10

(Canvas)

Gilsonite	10
Asphaltum	2
Degras, Neutral	4
Beeswax, Crude	1
Lead Oleate	3
Kerosene	31
Gasoline	41

No. 11

(Canvas)

Aluminum Oleate	2–3
Paraffin Wax	7–8
Linseed Oil Varnish	100

Apply by brush from both sides of the canvas.

No. 12

(Canvas)

Ammonia (sp.gr. 0.880)	1
Linseed Oil	5
Paraffin Wax, Hard	8
Stearic Acid	8
Montan Wax, Bleached	8
Glue	10
Soft Soap	15
Water	200

No. 13

(Canvas, Brown)

Amorphous Wax (145–165°)	40
Paraffin Wax (133°)	50
Gilsonite Selects	20
Petrolatum (140°)	15
Red Oxide of Iron	5
Extender, Repeller Clay or Asbestine	55

No. 14

(Tan)

Amorphous Wax	45
Paraffin Wax	45
Yellow Ochre	30
Extender	30
Petrolatum	18

No. 15
(Olive)

Amorphous Wax	25
Paraffin Wax	25
Petrolatum	16
Asphalt (190°)	2
Yellow Ochre	10
Chrome Green	2
Extender	20

No. 16
(Canvas)

Raw Linseed Oil	1 gal
Beeswax, Crude	13 oz
White Lead	1 lb
Rosin	12 oz

Boil the above and apply warm to upper side of canvas, wetting the canvas with a sponge on the underside before applying.

No. 17
(Canvas)

Gilsonite	80
Stearine Pitch	62
Scale Wax	34
Mineral Oil	10
Creosote Oil	10
Copper Linoleate	9

Melt together.

Apply at a temperature of 300° F. Scrape off excess while hot.

No. 18
(Canvas)

Beeswax	25
Glyceryl Stearate	5
Stearine Pitch	102
Copper Oleate	15
Castor Oil	48
Naphtha	50

No. 19
(Canvas)

Petrolatum, Dark or Amber	8½ lb
Beeswax, Yellow Refined	1½ lb
Earth Pigment, Dry (Ochre, Sienna, or Umber)	5 lb
Volatile Mineral Spirits (Painters' Naphtha)	5 gal

No. 20
(Tarpaulin)

Crude Fuel Oil	60
Paraffin Wax, Hard	20
Paraffin Wax, Soft	5
Montan Wax	10
Wood Pitch	10

The hardness of the coating may be varied by changing the relative proportions of the first three ingredients.

No. 21
(Tarpaulin)

Neutral Petroleum Asphalt	25
Paraffin Wax (124–126°)	20
Petrolatum (135–140°) (Amorphous Wax)	25
Venetian Red	35

No. 22
(Tarpaulin)
British Patent 414,242

Paraffin Wax	3–5
Naphtha	200

Warm together on steam bath and mix until clear. Then mix in:

Aluminum Powder	5–20

Rotproofing Canvas

Formula No. 1

Japan Wax	28
Paraffin Wax	22
Rosin Soap	12
Starch	33
Alum Solution (5%)	5

No. 2

British Patent 382,073

A modern efficient type of formulation intended for a one-bath process includes alum and lead acetate as the source of aluminum hydroxide for waterproofing, paraffin wax for softening or providing pliability, soap as emulsifier, and gum to improve wetting properties.

Alum	2 lb
Lead Acetate	2.5 lb
Paraffin Wax	6.5 oz
Hard Soap	4 oz
Gum Tragacanth	4 oz
Water	67 lb

No. 3

(Jute)

British Patent 462,306

The material is first boiled in a 3.3% aqueous solution of cutch for three hours, and then boiled in a 1.5% solution of potassium bichromate for twenty minutes, after which it is washed free from bichromate and dried.

Sizing and Waterproofing Emulsion

Paraffin Wax	40
Oleic Acid	3.75
Stearic Acid	3.75
Trigamine	3
Water	273.5

The Trigamine is dissolved in the water and the oleic acid is added stirring thoroughly until completely homogeneous. This is then heated to 60–70° C. and the wax and stearic acid previously melted, added with rapid agitation. Stirring is continued until the emulsion is cold.

This emulsion can be diluted readily with warm water.

Size, Concentrated Rosin

Rosin	70
Soda Ash	7
Beeswax	2
Water	21

Boil together until a sample solidifies on cooling. This may be shipped solid and is dispersed in hot water when needed.

Wax Size

Formula No. 1

The following is used for treating paper-cloth.

Japan Wax	100
Soap	10
Water	40

Boil and stir until homogeneous. This is diluted with boiling water and stirred before use.

No. 2

Water	59.60
Beeswax	9.40
Japan Wax	11.00
Stearic Acid	11.00
Oleic Acid	3.00
Caustic Soda	3.00
Soluble Olive Oil	3.00

Sizing for Polishing

(Cotton cordage)

Tri-Sodium-Phosphate	2	oz
Irish Potato Starch	4	lb
Japan Wax	1¾	lb
Paraffin Wax (127° M.P.)	1¾	lb
Narobin	6	oz
Mineral Oil Softener	14	oz

Mix thoroughly and make up to 10 gallons with necessary amount of water. Use sufficient amount of water to dissolve starch and heat with constant stirring until all products are thoroughly mixed—then allow to cool and use cold.

The tri-sodium phosphate is used primarily because of "hard water."

Cotton Warp Sizing

Formula No. 1

Tapioca Flour	14–20 lb
Animal Glue (Ground)	1⅓–3 lb
50% Sulfonated Tallow	3– 5 lb
Paraffin Wax	3– 5 lb
Water	90–150 gal

No. 2

French Patent 841,162

(Non-oxidizing benzene soluble)

Colza Oil	200
Rosin	800
Paraffin Wax	100
Borax	10

Heat together, mix well.

Concentrated Finishing Compound

(For cotton piece goods)

Sulphonated Tallow (75%)	22–26
Japan Wax	12–15
25% Tri-Sodium-Phosphate Solution	20–24
Water	50–60

The Japan wax should be emulsified in a separate vessel.

Mix the tallow, ⅓ of the Japan wax (emulsified) and required amount of tri-sodium-phosphate solution until thoroughly blended.

Add the remainder of the Japan wax emulsion, agitate and heat; it is best not to boil.

Stir until a creamy mix is secured.

Yarn Finish

Potash Carbonate	2
Rosin	7
Paraffin Wax, Soft	10
Montan Wax, Bleached, A	10
Water	65

Dressing for Prepared Yarns of Upholstery Cottons

Montan Wax, Double Bleached	10
Stearic Acid	15
Soap	2.5
Gelatin	2.5
Soda Ash	0.3
Starch	10
Water	400

Textile Gloss Oil

Formula No. 1

Paraffin Wax	20
Lanette Wax Sx	10
Water	70

Heat together and stir until dispersed.

No. 2

Paraffin Wax	20
Petrolatum, White	2
Glycosterin	10
Water	180

Heat together and stir until dispersed.

Increased Flexibility and Luster for Cotton and Rayon Braid

A mixture of glyceryl tristearate and Flexo Wax C gives high luster and flexibility to cotton and rayon braids, shoe laces, etc. The blended waxes are melted and the braid is run through in continuous lengths and then over brushes on polishing rollers. The addition of oil-soluble colors to the wax mixture will enable the coating to be used for different colored braids.

Cotton Cord Glaze Finish

Water	50 gal
Potato Starch	15 lb
Castile Soap	½ lb
Paraffin Wax	4 lb
Beeswax	1 lb
Lard Oil	2½ pt

Mix the starch in cold water and add to the boiler when the water is at the boiling point. Add the other ingredients and boil 15 minutes. Use when cold.

Luster Emulsion for Starching

Stearic Acid	1 kg
White Beeswax	200 g
Borax	60–75 g
Water	4 kg
Citronella Oil for Perfume	5 g

Of this emulsion, 10 spoonfuls are used for 1 kg of starch.

Cotton Softener

Stearic Acid	15
Paraffin Wax	5
Water	100–400
Ammonia	1

Melt the stearic acid wax and water and while agitating vigorously run in the ammonia in a thin stream.

Stiffening and Waterproofing for Cotton Goods

Batavia Dammar A/D	5
Paraffin Wax	5
Morpholine	1
Oleic Acid	2
Water	100

Melt the paraffin. Sift in the dammar and mix the two thoroughly. Keep temperature at about 125° C. during this combination. Allow to cool to 90–95° C. Add oleic acid and stir in. Then add and stir in the morpholine, keeping temperature at 90–95° C. Heat the water also to 90–95° C. and add it to the mixture slowly with thorough agitation.

Strips of cotton cloth may be impregnated with this material and dried at 210° F. The cloth is stiffened.

Felt Hat Stiffener

Carnauba Wax Emulsion (Bright Drying)	90
Shellac (Ammonia Water Solution)	10

Impregnation Composition for Stiffening Shoe Tips

Glue	250
Water	250
Portland Cement	300
Ceresin	100
Coal-Tar Pitch	100

Cotton Corset Filling Composition

Formula No. 1

Corn Starch	56 lb
Paraffin Wax Emulsion	1½ gal
China Clay	5 lb
Glycerin	8 lb
Water	100 gal
Bluing	To suit

No. 2

Corn Starch	35 lb
Dextrin, White	12 lb
Paraffin Wax Emulsion	8 lb
Sulphonated Castor Oil	4 lb
Water,	To make 65 gal

Runproof Stockings

Canadian Patent 389,679

Hosiery is dipped in following, squeezed and then dried on forms:

Crepe Rubber	2 oz
Paraffin Wax	2 oz
Naphtha	1 gal

Primer for Rubber Cloth

Hard Soap	1.7
Carnauba Wax, Light	8.7
Shellac	1.3
Borax	1.4
Water	86.9

Non-Slippery Belt and Rope Preservative

British Patent 488,643

Tallow	6
Beeswax	1
Soap	3

Melt together and add slowly with vigorous stirring

Water (Boiling)	30

When emulsion is complete, dilute with water to a density of 0.950.

String Impregnations

(Waxing)

Formula No. 1

Pull the string through melted paraffin and rub off with leather when cooled.

No. 2

Turpentine, Venice	500
Wax, Vegetable	400
Ozokerite	300
Spermaceti	250

Sash Cord Impregnants

Paraffin Wax (130–132° F. M.P.)	8
Rosin	4
Rosin Oil	1
Carnauba Wax	1

MISCELLANEOUS

Dental Waxes

(Sticky Waxes)

For temporarily cementing small pieces of plaster or similar materials together in order to make molds from broken plaster impressions. Also to hold small pieces of metal together for investment before soldering.

Formula No. 1

Rosin	16
Yellow Beeswax	8
Vermilion	1

Melt on water bath and stir together, pour on a glass slag and roll with wet fingers into pencils or pour in molds.

No. 2

Yellow Beeswax	4
Rosin	1
Gum Dammar	1

No. 3

Gum Dammar	1
White Beeswax	4
Light Yellow Rosin	7

Pink Base Plate Wax

Formula No. 1

White Beeswax	50
Paraffin Wax	25
Alkanet Root, Whole	1

Melt the waxes and add the alkanet root. Leave on the fire until the desired shade of pink is obtained, strain through cheese-cloth into tin molds, about 1/32 or 1/16 of an inch thick. Have the molds coated with a film of glycerin. To polish the sheet wax, pass between the rubber rollers of a wash wringer.

No. 2

White Beeswax	40
Gum Turpentine	10
Cotton-Seed Oil	3
Vermilion	4

No. 3

(To be used in hot weather.)

White Beeswax	20
Crude Turpentine	4
Cottonseed Oil	1
Vermilion	2

No. 4

(To be used in cold weather.)

White Beeswax	20
Crude Turpentine	6
Cottonseed Oil	2
Vermilion	2

No. 5

(Hard base plate wax)

Yellow Beeswax	50
Gum Mastic	6
Prepared Chalk	3
Vermilion	4

No. 6

Rosin	1
Ceresin	3
Paraffin Wax	6

Wax for Partial Impressions

Rosin	1
Yellow Beeswax	16

Gold Inlay Impression Waxes

Formula No. 1

Yellow Beeswax	10
Gum Dammar	10
Yellow Ceresin	20
Hard Paraffin (120° F.)	30
Carnauba Wax	30
Dye	To suit

Melt the beeswax, ceresin, paraffin and carnauba wax in a porcelain dish on a water-bath, add the gum dammar in small portions and stir constantly until a uniform mass is obtained. Remove from the fire and add the dyestuff.

Gold inlay waxes should be colored deeply with a dye, especially suitable to the needs of the operator. Lamp black or an oil-soluble aniline dye are best suited for this purpose. (The

red and blue "Cerasine" or "Sudan Red" aniline dyes are recommended.)

No. 2
(Price's)

Stearic Acid	110
Paraffin Wax	10
Beeswax	15
Tamarack (Larch Turpentine)	10
Gum Dammar	110

No. 3
(National Bureau of Standards)

Carnauba Wax	25
Paraffin Wax (55° C.)	60
Ceresin	10
Beeswax	5

Oil-soluble aniline dye in suitable colors may be added.

No. 4

Carnauba Wax (Light)	10
Paraffin Wax (70° C.)	35
Beeswax, Pure	55

Melt the carnauba wax on a low flame, avoiding foaming; add the paraffin and after complete melting add the beeswax.

Carving Wax for Tooth Forms

Carnauba Wax	80
Ceresin	128
White Wax	64
Zinc Oxide	48
Saturated Solution Acriflavine in Alcohol	1

Dental Wax

Formula No. 1

Stearic Acid	1
Paraffin Scale Wax	2
Glyceryl Tristearate	1
Carnauba Wax	2
Ethylene Glycol Glyceryl Stearate	2

No. 2

U. S. Patent 1,933,907

A wax composition for dentists' use comprises beeswax 99% and impalpable aluminum powder 1%, admixed and incorporated into the said wax.

Dental Impression Wax

Formula No. 1

Stearic Acid	19
Ethyl Cellulose	1
Paraffin Wax	40
Beeswax	40

No. 2

Manila Copal, White	30
Rosin, Pale	30
Carnauba Wax, Refined	10
Stearic Acid	5
Talc	75
Peru Balsam	3

No. 3

Paraffin Wax	90
Ceresin	39
Beeswax	40
Venice Turpentine	30
Japan Wax	20

Dentist's Molding Mass

Manila Copal, Soft	30
Colophony, Light, French	30
Carnauba Wax, Refined	10
Stearin	5
Peruvian Balsam	2½

Dental Molding Wax

Formula No. 1

Paraffin Wax	75
Japan Wax	10
Beeswax	15
Thymol	0.05
Menthol	0.05

No. 2

Carnauba Wax	5
Beeswax	40
Kauri Copal	15
Ozokerite (58/60° C.)	10
Soft-Paraffin (40/42° C.)	30

This plastic mass softens at 55° C.

No. 3

Manila Copal	15
Dammar Resin	15
Stearin (53/54° C. Titer)	1
Ceresin (58/60° C.)	2
Peru Balsam	1
Barium Sulphate, Precipitated	20
Carmine	To color to suit

Melt the first five ingredients together, work in the barium sulphate, dye with some carmine, and stir down to very little above the solidification point, where plates can be poured without danger of separation of the barium sulphate.

Dental Modeling Waxes

Formula No. 1

Paraffin Wax	2
Carnauba Wax No. 1	2
Glyceryl Tristearate	5
Beeswax	1

No. 2

Beeswax, Yellow	16
Wheat Starch	8
Turpentine, Thick	4
Olive Oil	1
Venetian Red	1

Dental Duplicating and Impression Compound

For ten units of impression compound, mix:

Alginic Acid (Insoluble)	40
Calcium Sulphate ($CaSO_4 \cdot 2H_2O$)	50
Magnesium Oxide	20
Borax	5
Trisodium Phosphate	30
Powdered Wax (Acrawax C)	50

Pass through a number 100 sieve. Package for use as needed.

Sift one-tenth of the above quantity of powder into 40 to 60 cc water at 65 to 75° F. and stir rapidly about 1½ minutes. Place in the dental tray and take the impression. The set will be satisfactory in 3 to 4 minutes. Hotter water hastens and colder water retards the set.

Wash the impression in cold water and immerse for 10 to 15 minutes in a solution of manganese sulphate, 75 grams dissolved in ½ liter of water. Rinse and blow or blot off the adhering water. Pour the model immediately.

When used as a duplicating material use water at 50° F. Treat surface of model with a thin coat of petrolatum. Vibrate the impression material to place in the same manner as for agar compounds. The set will be slower by reason of the use of colder water.

Modeling Waxes

Formula No. 1

Beeswax	10
Mastic	10
Ceresin	7½
Paraffin Wax, Hard	15
Tallow	65
Sulphur (Flowers)	90
Calcium Sulphide	42½
Kaolin	120

Grind the powders into the melted waxes. A mineral pigment, e.g., Armenian bolus, is added. (4%). Stir thoroughly and cool.

No. 2

Montan Wax, Bleached	10
Paraffin Wax (40–42° C.)	20
Petrolatum, Yellow	2
Woolfat	15
Clay, Fine Powdered	50
Mineral Color	20

No. 3

Venice Turpentine	90
Rosin	16
Beeswax	60
Tallow	14
Thin Mineral Oil	4
Color	To suit

No. 4

Beeswax	4
Venice Turpentine	9
Lard	4
China Clay	3½

No. 5

Gum Mastic	3
Beeswax	3
Ozokerite	2
Paraffin Wax	4
Tallow	19

Melt together and keeping hot work in

Sulphur Flowers	22
Gypsum	12
Pipe Clay	33
Mineral Pigment	4

Modeling Compounds

Formula No. 1

Stearin	25
Gum Dammar	50
Powdered Soapstone	85
Carmine	Enough to color

Melt the stearin on a water-bath, add the gum dammar, and, when melted, stir in the powdered soapstone, tinted with the carmine.

No. 2

Stearic Acid	20
Oleic Acid	4
Gum Copal	19
Seed-Lac	17
Powdered Soapstone	40

No. 3

Manila Copal	30
Light Colored Rosin	30
Carnauba Wax	10
Stearic Acid	5
Powdered Soapstone	75
Carmine	Enough to color

No. 4

Glyceryl Oleate	10
Red Oil	50
Beeswax, Crude	20
Castor Oil	15
Pipe-Clay, Powdered	To suit

No. 5

Tallow	19
Gum Mastic	30
Beeswax, Crude	3
Ozokerite	2
Paraffin Wax	4
Gypsum	12
Pipe Clay	60

No. 6

Plastic Clay	46
Cup Grease	24
Paraffin Wax	11
Rosin Oil	1

Modeling Waxes for Engravers

Formula No. 1
(Winter Wax)

Syrian Asphalt	15
Gum Mastic	30
Beeswax	40

No. 2
(Summer wax)

Syrian Asphalt	60
Gum Mastic	30
Amber	30
Beeswax	120

No. 3

Yellow Beeswax	1
Tallow	1
Burgundy Pitch	2

Engravers' Transfer Wax

Beeswax	3
Tallow	3
Balsam, Fir	1
Olive Oil	1

Melt together and stir while cooling.

Sculptors' Modeling Wax

Formula No. 1

Burgundy Pitch	1
Beeswax	10
Lard	1
Venice Turpentine	1

No. 2

Burgundy Pitch	2
Beeswax	16
Lard	1

The lard can be replaced by tallow.

Wax, Carving

(For statuettes and models)

Formula No. 1

Stearic Acid	6
Ceraflux	24
Carnauba Wax	1
Terra Alba	75

No. 2

Montan Wax, Bleached	40
Barium Sulphate	60
Red Iron Oxide	0.5

Modeling Wax for Brass Foundries

Burgundy Pitch	5
Beeswax	50
Lard	5
Venice Turpentine	5

Wax Molds

Paraffin Wax	10
Beeswax	2¼
Carnauba Wax	2

Melt together and mix until uniform. Pour into a box or other form (the inside of which has been painted with a soap solution). When cool, tap out. Cut out and engrave design desired. With this plaster casts can be made.

Molding Composition

Formula No. 1

Zinc Oleate		147
Made from Oleic Acid Distilled	133	
Zinc Oxide	17	
Japan Wax		33
Mineral Oil		40
Sulphur		107
Kaolin, White		68
Pigment		6–7

No. 2

U. S. Patent 2,036,574

Paraffin Wax	50
Rosin	35
Sulphur	10
Carnauba Wax	5

Melt together and mix until uniform.

Parting Wax for Molding Work

U. S. Patent 2,103,527

Formula No. 1

a. Paraffin Wax, Melted	1	pt
Gasoline	1	pt
Light Cylinder Oil	1	pt
Kerosene	⅔	gal
Castor Oil	½	oz
b. Rosin	1/6	lb
Gasoline	½	pt

No. 2

(To substitute for lycopodium powder)

Calcspar, Finely Ground	100 g
Montan Wax, Coarsely Powdered, Light, Refined	5 oz

Heat together for 30 minutes at 110–120° C. in an agitated kettle, until homogeneous. May be dyed with 0.1–0.2% of oil-soluble dye, to match the yellow color of the lycopodium.

Cool, powder, sift.

Jewelers' Molding Wax

Formula No. 1

Cumar Resin	5
Beeswax	20
Carnauba Wax	5
Diglycol Stearate	5
Montan Wax	35
Ceresin Wax	30

This wax gives sharper moldings and is tough and sufficiently elastic. It burns out easily without leaving a residue.

No. 2

Diglycol Stearate S	12
Acrawax B	14
Beeswax	16
Ceresin Wax	30

The above materials are melted together and stirred until homogeneous. This wax gives sharper definition, is tougher and more elastic. It burns out more easily and leaves no residue.

Standard Candle Formula

Paraffin Wax	60
Double Pressed Stearic Acid	35
Beeswax	5

The above are melted together and agitated to insure complete blending. When melted an oil-soluble dye of the desired hue is added and then the combination is poured in molds and cooled. Care in the selection of the dye should be exercised to eliminate "bleeding" or fading, but many good dyes are available. It may be desirable to make up known strength of dyes in blocks of paraffin by merely adding the dye to the melted wax and then pour in molds, forming blocks of uniform size. This permits easy storing and somewhat facilitates the complete blending of the color when introduced to the melting kettle.

A better grade of candles is made by increasing the amount of stearic acid and decreasing the amount of paraffin, or vice versa.

Pure Beeswax Candles

Formula No. 1

Are made from the pure wax and range down to combinations

as low as 40% beeswax, 50% paraffin and 10% stearic acid.

No. 2

U. S. Patent 1,960,994

A molded candle comprises a mixture of seventy parts of beeswax, twenty parts of stearic acid, ten parts of paraffin and one part of monoethyl ether of ethylene glycol.

Hand Dipped Candles

White

135/137° F. Paraffin Wax	90 lb
Stearic Acid (Double Pressed)	10 lb

To make colored candles add any one of the following amounts per 100 lb of above white composition.

Red

Oil Red GRO National 1½ oz

Rose

Oil Red GRO National 3½ g

Med. Green

Quinolene Yellow Base 21 g
Quinizarine Green Base 2½ g

Yellow

Quinolene Yellow Base 1½ oz

Illumination Candles

Paraffin (50–52° C.)	79.0
Stearin	19.5
Carnauba Wax, Bleached	1.5

Long Burning Candles

U. S. Patent 1,954,659

Paraffin Wax	49
Hydrogenated Vegetable Oil	51

Molded Candle

U. S. Patent 1,960,994

Beeswax	70
Stearic Acid	20
Paraffin Wax	10
"Cellosolve"	1

Colored Light—Candles

German Patent 646,129

Red Light

Paraformaldehyde	30
Paraffin Wax (Scale)	5
Lithium Chloride	0.1
Menthol	0.2
Coumarin	0.2
Lithium Nitrate	0.025

Blue Light

Paraformaldehyde	30
Paraffin Wax (Scale)	3.5
Copper Chloride	0.15
Menthol	0.2
Coumarin	0.2

Green Light

Paraformaldehyde	30
Paraffin Wax (Scale)	3
Copper Chloride	0.05
Barium Nitrate	0.4
Boric Acid	0.3
Menthol	0.2
Coumarin	0.2

The mixtures are pressed into the shape of candles, without wicks.

The candles are wrapped in a thin cellulose fiber foil, and covered with a thin coating of paraffin to give the impression of real candles.

Candle String

(Summer)

Paraffin Pitch, Pale (44/46° C.)	70
Woolfat	20
Ozokerite, Yellow	5
Rosin, Pale	5

Candle String

(Winter)

Paraffin Pitch (38/40° C.)	30
Paraffin Pitch (44/46° C.)	40
Ozokerite, Second Quality	5
Woolfat, Crude	25

The wicks are made from strings, unbleached yarn, cotton strings or jute.

The production is easiest in winter (quick, cheap cooling). Colors: Yellow and black.

Wax Lighting Tapers

Paraffin Wax (40–42° C. or 42–44° C.)	65–85
Ceresin (58–60° C.)	30–10
Beeswax	2–3
Turpentine, Thickened	3–2

Wick of loose cotton threads, 30 together for a size of 2–4 mm, wound on wire.

Sealing Wax for Candle Decorations

Rosin	50
Ruby Shellac	3
Gypsum	1

Electrotypers' Waxes

Formula No. 1

Beeswax	5½
Paraffin Wax	3
Burgundy Pitch	¾
Rosin W.W.	½
Zinc Oxide	1½

Melt together the waxes and resins and add the zinc oxide slowly with good mixing.

No. 2

Ozokerite	63½
Beeswax	31¾
Graphite Powder	4¾

No. 3

Beeswax	85
Burgundy Pitch	5
Turpentine	10

No. 4

Ozokerite	95
Graphite Powder	5

No. 5

Ozokerite, Green	33
Paraffin Wax	50
Rosin W.W.	16
Petrolatum	⅛

No. 6

Ozokerite, Brown	90
Graphite Powder	2
Pine Pitch	8
Rosin Oil	¼

No. 7

Ozokerite (Green Austrian)	100
Pitch	20
Beeswax	10

No. 8

Ozokerite (Green Austrian)	50
Candelilla Wax	6½
Pitch	10
Beeswax	5

Recording (Phonograph) Wax

Formula No. 1

Stearic Acid	84

Melt and add slowly with stirring:

Litharge	8½

Boil off water at 220–230° F. Stirring must be of such type to prevent caking at bottom of kettle. When solution is complete add slowly (by sifting in):

Soda Ash	7

When a drop cools to a clear mass reaction is complete. Drive off all gas, froth and water by heating up to 270° F.

If a brown wax is desired add to above

Stearin Pitch	2

If a black wax is wanted add some oil-soluble nigrosine to brown formula.

No. 2

Distilled Montan Wax	60
Litharge	4½
Soda Ash	4
Paraffin Wax	30

Follow method exactly as in Formula No. 1.

No. 3

British Patent 473,459

Stearic Acid	632
Montan Wax	140

Heat to 175° C.

Mixture of	
Soda Ash	55
Basic Lead Carbonate	84

After reaction has ceased, mix in a plasticizer such as sperm oil, dimethyl phthalate, or methyl abietate.

No. 4

Polymerized Vinyl Chloride (M.P. 120–130° C.)	21
Novolac (M.P. 92–96° C.)	21
Slate, Powdered	49
Gas Black	4½
Pitch	5½
Calcium Stearate	2
Montan Wax	2

No. 5

U. S. Patent 2,206,636

Vinyl Resin	90.0
Chromium Oxide	7.5
Carbon Black	50.0
Calcium Stearate	1.0
Carnauba Wax	1.5
Chlorinated Naphthalene	4.5

Sponge Rubber

Solution A

Water	25	gal
Ammonium Carbonate	50	lb

Compound B

Pale Crepe Rubber	44	lb
Amber Petrolatum	1.75	lb
Aldol Alpha Naphthylamine	0.5	lb
Vulcacit D (D.P.G.)	0.15	lb
Paraffin Wax	2.85	lb

Rubber Flooring Composition

Crepe Rubber	100
China Clay	30
Lithopone	30
Paraffin Wax	2½
Sulphur	2½
Nonox N.S.	1
Woodflour*	160
Whiting	50
Zinc Oxide	10
Stearic Acid	2
Vulcatex Blue (B.S.)	4
Vulcafor F.	1

Cure: 20–30 minutes at 141° C.

* White Softwood Fir, 200 mesh.

Chocolate Rubber Stair Tread

Reclaimed Rubber	32.000
Whiting	24.625
Mineral Rubber	12.000
Clay	24.000
Iron Oxide	4.000
Zinc Oxide	1.000
Paraffin Wax	1.000
Stearic Acid	0.250
Sulphur	0.875
Mercaptobenzothiazole	0.250

Neutral Colored Rubber Mat

Reclaimed Rubber	38.00
Smoked Sheets	4.00
Sulphur	0.75
Diphenylguanidine	0.25
Zinc Oxide	1.00
Clay	27.00
Whiting	25.25
Medium Process Oil	3.00
Paraffin Wax	0.50
Stearic Acid	0.25

Non-Blooming Rubber Flux

U. S. Patent 1,985,261

Coumarone Resin	8.65
Stearic Acid	5.00
Paraffin Wax	1.35

The above is used in following proportions:

Rubber	25
Above Flux	1¼
Zinc Oxide	3
Sulphur	1¾
Accelerator	¾
Pigment	10
Filler	60

Rubber Wax Mixture

Rubber can be introduced into waxes or high boiling oils by heating the molten wax or oil to 120 to 130° C., stirring, and introducing rubber latex in a fine stream at a rate which allows the water in the latex to boil off. Heating and stirring is continued until all the water is out of the mix. Up to 4% by weight of rubber can thus be introduced into molten paraffin wax, yielding a very viscous mass. The rubber is disseminated in a fine condition throughout the oil or wax. In waxes, the rubber serves to give the product additional strength and cuts down brittleness. The rubber can be vulcanized by the addition of vulcanizers.

Rubber Paraffin Embedding Composition

To 200 g of paraffin add 2 g of rubber and 0.5 g of beeswax. Heat at 105° for 16 hours with occasional stirring. The most suitable rubber is "Heveatex" which is 37% rubber latex in aqueous solution with a small amount of ammonium hydroxide as a preservative. It is air-dried in thin layers and cut into small pieces. The method is superior to paraffin for any tissue which varies in density. For trichrome staining it is excellent, since it permits cutting the entire specimen without fraying. Specimens can be re-embedded in celloidin.

Artificial Ice for Skating Rink

Formula No. 1

British Patent 466,908

Carnauba Wax	100
Naphthalene	70- 90
Montan Wax	20

Melt together and apply hot. Spread with heated rollers. When cool coat glycerin with or without a small amount of soap solution as a lubricant.

No. 2

U. S. Patent 2,057,906

IG Wax	100
(Esterified Montan Wax)	
Naphthalene	40–100

Melt together; mix well and pour on an even surface. After this composition has hardened it is made smooth by scraping and hot irons. For reducing friction, the surface is moistened with glycerin.

Any of the IG waxes may be used in the above with or without carnauba wax.

No. 3

U. S. Patent 2,179,664

Carnauba Wax	10
Gum Dammar	2
Naphthalene	7

Melt together with mixing and apply hot. Smooth surface with hot irons and lubricate surface with low viscosity mineral oil.

Solidified Benzine

German Patent 630,280

a. Beeswax, Yellow, Crude	3
Benzine	100
b. Caustic Soda (0.33%)	½
c. Ammonium Stearate	1–2

To the solution *a* add *b*, heat to saponify the beeswax, and add *c* while hot. Let cool.

Defoaming Agent

Paraffin Wax	1 oz
Liquid Petrolatum	1 oz
Octyl Alcohol	2 fl. oz

Warm together and stir until uniform.

Solidification of Mineral Oils

German Patent 620,260

1. Beeswax	5
2. Kerosene	100
3. Soft Soap, Medicinal	3
4. Alcohol, Denatured	5

Melt 1; add 2, and thereafter the mixture of 3 and 4, which has been previously heated to 65° C.

This is done by pouring both additions at the same time, or in two separate thin jets. Quick and thorough stirring is necessary. Cool. Product is of petrolatum-consistency.

Perbunan Laboratory Tubing Compound

Perbunan	100.0
Diphenyl Phthalate	20.0
Zinc Oxide	5.0
Stearic Acid	2.0
Paraffin Wax	1.5
Sulphur	1.8
Soft Brown Factice	50.0
Semi-Reenforcing Gas Black (Gastex)	25.0
Semi-Reenforcing Carbon Black (for Example P-33)	25.0
Benzo Thiazyl Disulphide (Altax)	1.5
Butyl Amine	0.25

Cure: 45 minutes at 287° F.

Beeswax Compound, Cable Impregnating

Formula No. 1

Beeswax (Yellow or Brown)	50
Paraffin Wax	50

No. 2

Rosin	10
Ozokerite	5
Ceresin	30
Montan Wax	10
Stearin Pitch	15
Paraffin Wax	20

Wax Strings for Foundry Work

Montan Wax, Bleached	10
Beeswax	10
Paraffin Wax (40–42° C.)	20
Woolfat	5
Nigrosine, Oil-Soluble	½

Telephone Transmitter Membrane Coating

U. S. Patent 2,281,940

Polymerized Isobutylene	100
Stearic Acid	1
Ethyl Cellulose	10
Paraffin Wax	20
Carbon Black	To suit

Ethyl Cellulose Plastic

U. S. Patent 2,215,249

Ethyl Cellulose	99–90
Esparto Wax	1–10

White Carnauba Wax

A white carnauba wax having a melting point of 80.8° C. can be obtained from "fat-gray" carnauba wax of melting point 82.1° C. by fractional crystallization. A by-product consisting of a wax-paraffin residue, melting point 60.2° C. is also obtained. Carnauba wax partially purified with the aid of paraffin is dissolved in 10 times its weight of benzine at 55° C. The benzine fraction used is that boiling between 80 and 130° C. Turbidity appears at 50° C. The mixture is allowed to cool with gentle stirring to 16°, when crystallized wax is filtered off. It is freed from solvent by steam distillation. A yellow wax-paraffin mixture is obtained from the filtrate as a by-product. Cooling cannot go much below 16°, as paraffin separates from benzine solution at about 12°.

Carnauba Wax Substitute

Shellac Wax	85
Beeswax	10
Sal Dammar	5

Artificial Beeswax

Formula No. 1

Carnauba Wax	½
Paraffin Wax	9½
Ceres Yellow Color	1/16

Melt the carnauba wax and paraffin in separate vessels and pour the paraffin into the carnauba wax. Stir until thoroughly mixed. To the liquid material add the ceres yellow and continue the stirring until the mixture is perfectly homogeneous.

Cast in cakes of convenient size in metal molds. Lycopodium may be used to prevent the wax from sticking to the mold.

No. 2

Glyceryl Stearate	20
Beeswax	8
Japan Wax	10

No. 3

Japan Wax	20
Indene or Paracumarone	5
Glyceryl Tristearate	1

Melt together and stir until quite thick.

Bleaching Montan Wax

British Patent 488,381

Montan Wax, Crude	1,000 kg
40% Sulphuric Acid	4,500 kg
30% Peroxide	500 l
Chromic Anhydride	1,000 kg

Crude montan wax is fused, sulphuric acid mixed in, peroxide added little by little and the whole stirred for 3 hours at 105° C. Chromic anhydride is slowly added and the whole stirred until the anhydride is used up; the wax is washed with sulphuric acid and then with water.

Purifying Lignite, Ozokerite or Montan Waxes

Crude Wax	100
Benzol	220

Warm and stir until dissolved. Add

Alcohol	400–800

Filter and wash residue with

Alcohol	1200
Benzol	300

Bleach by heating at 105–115° C. for 7 hours using

Potassium Dichromate	1
Sulphuric Acid (48%)	10
Nitric Acid (4%)	10

"Soluble" Waxes

The following formulae will give waxes which are readily dispersible in hot water to form stable, white emulsions of different viscosities. These are useful in the textile industry for sizing, finishing, etc., in the polishing industries for furniture, floor and automobile polishes, for leather finishing, paper sizing and finishing, etc.

Carnauba Wax ("Soluble")

a. Carnauba Wax	90
Oleic Acid	10
Trigamine	10
b. Caustic Soda (50%)	6
Water	24

a is melted. *b* is mixed together and heated. It is added to *a* slowly with stirring and the whole stirred until it begins to solidify. One part of the above disperses easily in five parts of boiling water.

Paraffin Wax ("Soluble")

a. Paraffin Wax	50
Stearic Acid	14
b. Trigamine	7

Melt *a* to about 70° C. Turn off the heat and add *b* stirring thoroughly. Continue stirring till it begins to solidify. One part of the above disperses easily in two parts of hot water.

Japan Wax ("Soluble")

a. Japan Wax	50
Stearic Acid	14
b. Trigamine	7

Procedure as for paraffin wax. Emulsion obtained by dispersing one part of above in eight parts of hot water.

Opaque Paraffin Wax Coating

U. S. Patent 2,159,218

0.5–5% of hydrogenated cottonseed oil is added to paraffin wax to render its film opaque.

Stabilizing Chlorinated Paraffin Wax

British Patent 495,410

Add 0.5–1% pinene, limonene, turpentine or phellandrene.

"Hardened" Stearic Acid Wax

Stearic Acid	75
Magnesium Oxide	5.3

Heat with stirring for ½ hour at 130–150° C. Pour at lowest possible temperature.

Thread Wax

Beeswax	40
Japan Wax	10
Paraffin Wax	150

Tailor's Wax

Ceresin	15
Paraffin Wax	15
Japan Wax	25
Beeswax	45

Ironing Wax

Ceresin	10
Stearic Acid	30
Japan Wax	5
Beeswax	5

Bed Wax

(To tighten the cover cloths of feather beds)

Formula No. 1

Beeswax	10
Rosin	1
Caustic Soda (30° Bé.)	1½
Water, Hot	47½

Melt first two ingredients, saponify, and stir with the water to obtain a white, smooth cream.

No. 2

Rosin	2
Ceresin	3
Paraffin	20
Japan Wax	5
Beeswax	20

Wax Composition To Protect Parts of Surface of Painted Tiles Against the Adhesion of Glaze

Colophony	10
Montan Wax, Bleached	20
Ozokerite, Soft	40
Paraffin, Soft (48–50° C.)	30

Upholsterers' Wax

For rubbing the inside of the ticking cover before the down is put in so the feathers do not pierce the fabric.

Yellow Wax	50
Venice Turpentine	8
Burgundy Pitch	1

Wax-Like Emulsifiable Materials

U. S. Patent 1,932,643

A wax-like material capable of combining with 5 times its quantity of water containing 2% sodium carbonate to form a colloidal mass may be formed of spermaceti 65, cetyl alcohol 25 and stearic acid 10%.

Hard White Wax

Formula No. 1

U. S. Patent 1,730,563

448 grams of stearic acid are heated to 130–150° C. with 31.6 grams magnesium oxide for ½ hour. This mixture may be diluted with paraffin or other

waxes to make a hard, white, high melting point mixture.

No. 2

Heat one part cumar resin and 15 parts paraffin wax. When solidified, on cooling, this mixture will be white. Another process for getting similar results is the addition of Arochlor No. 1268 and paraffin.

Slow Flowing Wax

(High Melting Point)

Prepare by mixing equal parts of methyl abietate and aluminum palmitate, stirring to a paste. Add ethylene dichloride in quantities sufficient to thoroughly dissolve with heat. To this paraffin is added by constant stirring. This turns into a gel which solidifies on cooling. On reheating the gel reappears in temperatures up to 350° F. By varying the portions of wax the characteristics may be changed.

Soft Elastic Wax

This wax has proved valuable in the chemical laboratory, especially for making joints which must be air-tight and somewhat flexible. It does not harden on exposure to air.

Yellow Beeswax	100
Finely Powdered Red Mercuric Oxide	10
Venice Turpentine	10
Oil-Soluble Red Dye	3

The above ingredients are melted together, stirred thoroughly to distribute the mercuric oxide and allowed to cool. The hardness of the wax may be altered by varying the amount of the Venice turpentine used. The dye is used only to give a pleasing color and may be omitted.

Horse Hoof Grease

Formula No. 1

Paraffin Wax	10
Woolfat	30
Spindle Oil	20
Cresylic Acid Emulsion	1

No. 2

Hog Fat	40
Cod Liver Oil	20
Beef Tallow	15
Woolfat	5
Bone or Charcoal	5
Potash Soap	5
Water	10

No. 3

Train Oil	10
Woolfat, Crude	15
Montan Wax, Crude	20
Mineral Oil, Dark	50–55
Preservative	0.2–0.5
Nigrosine, Oil-Soluble	1

Horse Hoof Healing Grease

Ceresin (58/60° C.)	15
Cresylic Acid Emulsion	10
Spindle Oil, Refined	75

Horse-Shoe Grease

Formula No. 1

Woolfat, Neutral	5.2
Spindle Oil	2.0
Soft Tar	0.5
Paraffin Wax	0.3
Water	2.4

No. 2

Montan Wax, Crude	20
Woolfat, Crude	15
Train Oil	5
Black Color	1
Paraffin Oil, Dark	59

Flexible Wax

Methyl Abietate	10
Gelowax	90

Heat together and stir until homogeneous. The finished product has a softening point of 58° C. and a melting point of 67° C.

Sticky Non-Oxidizing Wax

Formula No. 1

Hydrogenated Rosin	90
Flexo Wax C	5
Partially Polymerized Petroleum	5

No. 2

Hydrogenated Rosin	80
Flexo Wax C	10
Partially Polymerized Petroleum	10

Hard Synthetic Wax

Durocer	95
Glyceryl Tristearate	5

Slow Burning Wax

Durocer	90
Arochlor	10

Hot Melt Wax Coating

(Non-Blocking)

Formula No. 1

U. S. Patent 2,297,709

Ethyl Cellulose	5–20
Hydrogenated Castor Oil	25–55
Rosin or Synthetic Resin	15–40
Paraffin Wax (M.P. > 40° C.)	15–30

No. 2

U. S. Patent 2,311,609

A hot-melt, non-blocking coating composition, consists of

Ethyl Cellulose (10 Centipoises)	10
12-Hydroxy Stearin	44
Compatible Non-Thermo-setting Phenol-Formal-dehyde Resin	13
Paraffin Wax (M.P. above 60° C.)	28
Hydrogenated Rosin	5

This composition is characterized by its low viscosity and good retention of color on prolonged heating at 130° C.

Fire Kindler

Paraffin Wax, Crude	30
Rosin Pitch	10
Wood Flour	60

Compress strongly into bricks.

Wax Bottle Cap Binder

U. S. Patent 1,815,615

Carnauba Wax	80
Rosin	20
Sulphur	2

Melt together and stir at 120–125° C.

Stuffing Box Packing

Kaolin	69
Beeswax	8
Rubber	23

The above is worked together in a rubber mill. As a filler the following may be added:

Barium Carbonate	4
Calcium Carbonate	1

Packing for Fluid Seals

U. S. Patent 2,027,389

Asbestos is steeped in following at 200° F. then drained and cooled.

Hydrogenated Castor Oil	78
Sodium Stearate	10
Graphite	12

Transparent Cellulosic Film Wrapping

Canadian Patent 356,860

Ethyl Cellulose	20
Paraffin Wax	1
Chloroform	70
Ligroin	30

Dissolve and cast into forms and dry for 18 to 20 hours.

Moisture-Proofing Cellophane

Canadian Patent 359,729

The following solution is applied to the Cellophane and the solvent is evaporated at a temperature just below the melting point of the waxes used:

Carnauba Wax	4
Paraffin Wax (M.P. 62° C.)	4
Candelilla Wax	1½
Triethanolamine Oleate	1/10
Toluol	100

Heat Resistant Stencil Film

U. S. Patent 2,242,313

Cellophane or other tough, non-absorbent transparent foil is coated with

Mineral Black	5
Aluminum Powder	34
Cottonseed Oil	12
Vegetable Wax	49

Natural Resin-Wax Compounds

Petrolatum Wax	45
Pale East India or Batu or Black East India Gum	45
Paraffin Wax	10

Melt the waxes together and add the resin, stirring until mixture is uniform. Allow to cool.

Such mixtures are of higher melting point and are more water-resistant than the similar material made with ester gum instead of the natural resins.

Imitation Chocolate for Display

Barium Sulphate	60
Montan Wax, Crude	40
Sienna	0.5–0.7
Vanillin	0.1–0.2

To obtain a better smelling wax base, it is recommended to use the following:

100 g of melted montan wax, crude are poured over 5 g of finely powdered Sumatra gum benzoin. The mass is stirred for 2–3 hours on a boiling water bath, strained hot through a cloth, and the filtrate is to be used in the above formula.

APPENDIX

SUBSTITUTES

Every material is unique in its chemical and physical properties. Therefore, no wax can replace another equally in all its characteristics. The following list which should be studied carefully gives most of the factors which must be considered in searching for a suitable substitute or alternative. Only those properties which are absolutely essential should be demanded, otherwise the search for a substitute will be greatly hampered, if not made futile.

Any substitute must be tried and tested before commercial use is attempted. Such tests should be made by a competent worker or consultant to avoid subsequent difficulties.

Availability
Homogeneity
Uniform Replacement
Grade or Purity
Form
Optical Properties
Odor
Taste
p H
Density and Specific Gravity
Viscosity
Gelling or Thixotropic Tendencies
Slipperiness
Drying Qualities
Feel or "Hand"
Hygroscopicity or Efflorescence
Inflammability
Explosiveness
Toxicity
Effect on Skin, Hair or Finger-Nails
Edibility
Thermal Changes
Effects of Pressure
Solvency
Plasticizing or Flexiblizing Properties
Melting Point and Titer
Boiling Point
Solubility
Hardness
Tenacity or Cohesion
Plasticity and Ductility
Flexibility
Elasticity
Length
Stickiness
Adhesion
Interaction With Other Materials
Stability
Bacterial Content
Emulsifiability
Surface Tension
Dispersing Properties

Adsorption and Absorption
Heating Power
Lighting Power (Candle Power)
Electrical Properties
Thermal Conductivity
Handling and Working
Legal Restrictions

Material	*Substitutes*
Bayberry Wax	Diethylene glycol distearate Japan wax
Beeswax	"B.Z. Wax" Ceresin with soap Coffee wax Flax wax "Flexo Wax" "Glaurin" "Isco 662, 663." "Norco Wax 36" "Prostearin" Sugar cane wax
Cacao Butter	Borneo tallow Cetyl alcohol with mineral or vegetable oil Hydrogenated vegetable oils, partially "Acrawax"
Carnauba Wax	Candelilla wax Cotton wax, green "Durocer" Esparto wax Hydrogenated castor oil "Norcowax 350" Ouricuri wax "Rezowax" "Santowax M" Stearamides, substituted "Stroba Wax" Sugar cane wax "Wax S 688"

Material	*Substitutes*
Cetyl Alcohol	Lanolin alcohols Monostearin Oleyl alcohol Stearyl alcohol
Esparto Wax	Carnauba wax "Durocer" "Wax S 688"
Flax Wax	Beeswax
Japan Wax	Bayberry wax "Hydrofol Wax #1" "Hydrofol Glycerides #50" "Isco Japan wax substitute" "Nipocer N" "Norco Wax 110"
Montan Wax	Lignite wax "Monten wax" "Norco Wax 12A" Peat wax "Rezo Wax" "Santowax"
Ozokerite	Carnauba with amorphous paraffin wax "Deetee Wax" "Ozowax"
Paraffin Wax	Aluminum stearate "Diglycol" stearate Glyceryl tristearate Graphite Naphthalene Stearic acid Stearin
Spermaceti	Cetyl palmitate

Material	*Substitutes*
Stearic Acid	Abietic acid Fatty acids Lauric acid Myristic acid Naphthenic acid Oxidized paraffin wax Palmitic acid Paraffin wax Rosin Tallow
Stearin	Glyceryl tristearate Paraffin wax Zinc stearate
Stearyl Alcohol	Cetyl alcohol
Sugar Cane Wax	Beeswax
Yellow Wax	See Beeswax "Flexowax C" Soap with rosin

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