INDUSTRIAL WAXES

Volume 2

By the Same Author

Practical Emulsions
Trademarks
Substitutes
Commercial Waxes

Editor of

Concise Chemical and Technical Dictionary
The Chemical Formulary Series

INDUSTRIAL WAXES

Volume II

COMPOUNDED WAXES
& TECHNOLOGY

by

H. BENNETT, F.A.I.C.

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Compounded Waxes and Technology

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PREFACE

In any work as large as this, it is expedient to break the text at some logical point in order to prevent its being physically unwieldy. The logical point in INDUSTRIAL WAXES is with the discussion of *Compounded Waxes.*

Volume I treats exhaustively of all types of natural waxes, and synthetic waxes—those various chemical compounds that, alone or in combination, resemble natural waxes in function and application. Although the field is open for new developments, most of the synthetic waxes we know are not new substances.

The materials discussed in this volume as *Compounded Waxes* have made remarkable progress in recent years. Research on physical mixtures of waxes themselves, or mixtures of natural and synthetic waxes, with such dissimilar materials as cellulose, natural and synthetic resins, and plastics, has opened up vast opportunities for further developments. The presentation here is intended to survey what is available and hint at further possibilities.

Technology in waxes has kept apace with advances in materials. Many new tests for properties and behavior have been devised, and many older ones simplified.

All the sections on industrial applications have been reviewed, and many have been completely rewritten or enlarged from the respective discussions in COMMERCIAL WAXES.

In an industry that is expanding so rapidly, all avenues must be left open. The author will welcome information on anything new related to industrial waxes so that future editions of this work can give them deserved recognition.

H. BENNETT

Part 1

COMPOUNDED WAXES

Chapter 1

COMPOUNDED WAXES: GENERAL

Wax compositions, containing different waxes and/or other substances, are often employed for special effects, not obtainable otherwise. For example, in making paper milk-bottle caps or hoods, a composition of paraffin wax, polyethylene, plus other additives is used.

Paraffin wax is extremely slow setting. When employed alone, it is rather greasy and adheres to glass. Rosin 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 intermixture and that carnauba or another high-melting wax, even in the small proportion of about 10%, 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]

In planning any compounding of waxes for special purposes, several properties of the waxes must be taken into consideration. Important among these are compatibility, hardness, melting point, solubility, specific gravity and viscosity.

---

[1] Ellis, U. S. Patent 1,987,288 (1935).

COMPATIBILITY 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.

Table 1:1

COMPATIBILITY[1] OF WAXES WITH OTHER SUBSTANCES

Wax	Other Substance	Proportions[2]
Acrawax	Acrawax B	1:1
	Albacer	1:1
	Beckacite No. 1100	9:1
	Beckacite, Super No. 2000	9:1
	Candelilla Wax	2:1
	Carnauba Wax	1:1;1:99
	Cetyl Alcohol	3:2;1:1

[1] The compatibilities in this section refer to wax compositions at normal temperatures. Certain substances may be compatible at higher temperatures, but will separate on solidification of the wax.

[2] The first figure in the ratio indicates the proportion of wax and the second figure that of the other substance (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.

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	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 No. 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
	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
	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

• Where no proportion is given, compatibility in certain proportions does exist, but the exact amount has not been noted.

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	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 No. 34	1:1
	Polyvinyl Butyral	
	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
	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 Z152	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 S	
	Elemi	
	Ethyl Cellulose	< 50%
	Glyceryl Monostearate	
	Japan Wax	
	Methacrylate Polymers	

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	Ozokerite	
	Paraffin Wax	1:1
	Petrolatum	3:97;1:4
	R. H. Resin	< 10%
	Rosin	
	Spermaceti	
	Staybelite Esters	
	Stearic Acid	
	Tallow	
	Wool Wax	
Candelilla Wax	Acrawax	1:2
	Acrawax B	1:1
	Albacer	1:9;1:7;1:4;1:1
	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
	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	
	Albacer	1:1;3:7;1:9
	Beeswax	2:1;3:1;4:1;6:1
	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 S932	2:23
	Hercolyn	
	Hydrogenated Vegetable Oils	2:23
	Methacrylate Polymers	
	Montan Wax	3:1;1:1;1:2
	Nypene	
	Ouricury Wax	3:2;4:1

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	Ozokerite	2:1;3:1;15:1
	Paraffin Wax	1:1;1:5;4:1;5:1;6:1;15:1
	Petroleum, Dark Green	4:1;3:2;2:3;1:4
	Polymer No. 34	1:4
	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 No. 1	1:2
	Utah Wax No. 4, Yellow	4:3;7:2;5:2;3:2;2:1
Ceresin	Carnauba Wax	
(See also Paraffin	Cumarone Resins	< 30%
Wax)	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	
	Opalwax	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	Acrawax C	
Naphthalene	Butyl Stearate	
	Chlorinated Diphenyl	
	Cumarone Resins	< 30%
	Gilsonite	
	Naphthalene	
	Polymerized Isobutylenes	
	Resins	
	Rosin	
	Rubber	
	Rubber, Depolymerized	
	Stearic Acid	
	Sulfur	
	Vinylite Resin AYAF	9:1
Dammar Wax	Paraffin Wax	1:3
Diglycol Stearate	Beeswax	
	Cocoa Butter	

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	Paraffin Wax	
	Spermaceti	
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 No. 1	4:1
	Utah Wax No. 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 No. 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
	Glycol Monostearate	
	Paraffin Wax	
Glyceryl Tristearate	Acrawax B	1:1
	Acrawax C	1:1
	Carnauba Wax	
	Ethyl Cellulose	
Glyco Wax S932	Acrawax B	
	Carnauba Wax	23:2
	Cocoa Butter	
	Ethyl Cellulose	3:1
	Japan Wax	5:4;4:5
Halowax		
(See Chlorinated		
Naphthalene)		
Hydrogenated Oils	Acrawax B	1:1
(See also	Carnauba Wax	23:2
Opalwax)	Cumarone Resins	
	Ethyl Cellulose	
	Naphthalene Tetrachloride	
	Paraffin Wax	1:100

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	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 S932	5:4;4:5
	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	
	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	
Opalwax (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

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	Staybelite Esters	1:1
	Staybelite Resin	92½:7½
	Stearone	5:1
Ouricury Wax	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
	Microcrystalline Wax	3:2;1:1;2:1
	Ozokerite	15:1
	Paraffin Wax	4:1;3:1;1:1
	Utah Wax No. 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	
	Ouricury Wax	1:15
	Paraffin Wax	All proportions
	Rubber	
	Staybelite Esters	
	Rubber Resins	
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%
	Aroclor	
	Asphalt, Blown	
	Balsam, Oregon	
	Beeswax	
	Bitumens	
	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 No. 409	
	Durez Resin No. 51185	
	Durez Resin No. 219	

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	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
	IG Wax OP, S, Z	1:1
	Jelutong	
	Kavri Resin	
	Lanolin	
	Lard	
	Lead Stearate	3%
	Lewisol Rosin 21	
	Limed Resin	1:8.9
	Methacrylate Polymers	
	Microcrystalline Wax	All proportions
	Montan Wax	97:3;3:2;1:3
	Nevtex Resin No. 10	9:1;3:1;1:1
	Nuba (Resinous Pitch)	
	Nypene Resin	
	Opalwax	1:1;1:4;5:1
	Ouricury Wax	2:3;1:1;1:2
	Ozokerite	All proportions
	Petrolatum, Dark Green	2:3;1:4
	Piccolyte Resin	1:1;3:7;19:1
	Pliolite	
	Polybutenes	
	R. H. No. 4	1:3;3:1
	R. H. Resin	3-4%;3:1
	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)		
Santowax M	Acrawax	1:9;1:1
	Candelilla Wax	1:9;1:3
	Carnauba Wax	1:9;1:1
	Ester Gum	1:9;1:3

Table 1:1 (Continued)

Wax	Other Substance	Proportions
	Japan Wax	1:9
	Manila Resin	1:9
	Opalwax	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
	Opalwax	1:9
	Paraffin Wax	All proportions
	Rosin	1:9;1:3
Santowax P	Acrawax C	1:3
	Paradene No. 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	Carnauba Wax	1:1;2:1;3:1
Tristearin (See Glyceryl Tristearate)		
Utah Wax	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	

HARDNESS

Table 1 : 2

HARDNESS OF WAX COMPOSITIONS

	86% Wax 14% Carbon Black Hardness	*43% Wax 43% Ink Oil* 14% Carbon Black Hardness*
Special Wax A	0.10	
Code 150 (Werner G. Smith)	0.15	
Code 200 (Werner G. Smith)	0.00	
Code 1000 (Werner G. Smith)	1.00	
Utah Wax	0.00	
Z–51 (Allied Asphalt)	0.10	
Z–52 (Allied Asphalt)	0.70	
NC Wax (Foster D. Snell)	0.25	
HC Wax (Foster D. Snell)	0.25	>4.0
LOH Wax (Foster D. Snell)	0.10	
Dallawax (Black, 190°F)	0.60	>4.0
Carnauba Wax NC No. 3		1.3
Norcowax C–37 (Neatsfoot Oil Refineries)		>4.0
Norcowax No. 55 (Neatsfoot Oil Refineries)		>4.0

* Mid-continent mineral oil, 100 Saybolt viscosity at 100°F.

Table 1 : 3

HARDNESS OF WAXES AND WAX COMPOSITIONS

Temperature of Wax	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 Aerosol OT* Hardness
Carnauba Wax N.C. No. 3	0.5	23.2	21.2
"Santowax" M	0.3	>45.0	53.6
Code 200 (Werner G. Smith)	1.0	59.3	
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		

* 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.

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