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Final Report on the Safety Assessment of Fossil and Synthetic Waxes

Toxicological test data on Ozokerite, Ceresin, Montan Wax, Paraffin, Microcrystalline Wax, Emulsifying Wax N.F., Synthetic Wax and Synthetic Beeswax are presented. Based on the documented animal and clinical test data, it is concluded that these waxes are safe for use as cosmetic ingredients in the present practices of concentration and use.

FOSSIL AND SYNTHETIC WAXES: INTRODUCTION

The fossil waxes used in cosmetic products are grouped in this report according to their source. The mineral waxes, which include Ozokerite, Ceresin and Montan Wax, are derived from coal and shale. Paraffin and Microcrystalline Wax are derived from petroleum.[1,2]

This report also includes a safety review of three synthetic waxes: Emulsifying Wax N.F., Synthetic Wax, and Synthetic Beeswax, which are manufactured to meet specific use requirements.

Each of the eight waxes is reviewed separately in this report.

OZOKERITE: CHEMICAL AND PHYSICAL PROPERTIES

Structure/Composition

Ozokerite is a naturally occurring fossil wax which consists of aliphatic series of straight-chain, branched-chain, and cyclic hydrocarbons, and some oxygenated resinous bodies. It has a delicate needle or short plate microcrystalline structure.[1,2]

Ozokerite is found near soft shale, which acts as a molecular filter and condenser. It has been suggested that the wax was produced when small hydrocarbon molecules were polymerized under pressure into large ones. Waxes from different deposits have somewhat different chemical compositions and physical properties. Most of the commercial wax is mined in Eastern Europe.[2] Commercial products called Ozokerite may be mixed with Paraffin to reduce its cost and with Carnauba Wax, resins, or asphaltum to increase its melting point or hardness.[1-3]

Properties

Crude Ozokerite is black; after refining, its color varies from yellow to white. It hardens on aging, the hardness varying according to its source and refinement. For other specific properties, see Table 1.[1,2,4-7]

Reactivity

Ozokerite is less stable than the solid paraffins, reacting readily with fuming sulfuric acid, chlorosulfonic acid, and concentrated nitric acid. It is water and alkali resistant.[2]

Refining and Analytical Methods

The newly mined Ozokerite is first melted in boiling water and separated from the other residues. The wax is then purified with concentrated sulfuric acid and decolorized with charcoal. Any remaining color may be bleached out with more sulfuric acid.[1,2,7]

The chemical composition of Ozokerite varies according to its source. Procedures for separating the various chemical fractions and identification have been published. The various chemical fractions are separated and usually characterized by infrared spectroscopy and gas chromatography. Normal paraffins, isoparaffins, aromatics, and napthalenes are normal constituents.[8]

USE

Noncosmetic Uses

Ozokerite is used in shoe and floor polish, leather dressings, pharmaceuticals, electrical insulation, cable wax, wax figure making, candles, paper

TABLE 1. Fossil Wax Properties.

Properties	*Ozokerite*	*Ref.*	*Ceresin*	*Ref.*	*Montan Wax*	*Ref.*
Melting pt.	63°-91°C	7	53°-79°C	17	85°-88°C	18
Specific gravity	0.85-0.95	6	0.92-0.94	6	1.00	1
Acid value	nil	7	nil	17	25-30	18
Saponification value	nil	7	nil	17	62-80	18
Iodine value	7.8-9.2	1	7-10	1	14-18	18
Refractive index	1.440	1	1.4416-1.4465	1	—	
Color	Black, yellow, green white when pure	6	White, yellow	4,6	White, brown (crude)	4,6
Soluble in	Benzene	6	Alcohol	4,6	Carbon tetrachloride	4,6
	Turpentine		Benzene		Benzene	
	Kerosene		Chloroform		Chloroform	
	Carbon disulfide		Naphtha		Dichloroethylene	
	Isopropyl ether		—		Isopropyl ether	
	Trichloroethylene		—		Naphtha	
	—		—		Trichloroethylene	
	—		—		Turpentine	
Insoluble in	Ethyl and methyl alcohol	6	Water	4,6	Water	4,6
	Water		—		—	

coating, crayons, matches, cord coating, waterproofing cloth and electrotypers plates.[1,2,9-14]

Purpose and Use in Cosmetics

Ozokerite lends stiffness to cleansing cream preparations and lessens the brittleness of cosmetic stick formulations. The wax adds strength and thermal stability to lipstick preparations and thixotropic properties to rouges; it holds the oil phase in hair creams.[15]

Ozokerite is used in lipsticks, baby products, eye and facial makeup preparations, manicuring, skin care, suntan, fragrance, and, noncoloring hair preparations (see Table 2).[15,16]

Ozokerite is applied to the face, hands and general body surface. It also comes in contact with the nails, hair, scalp, and lips, and periocular skin.[15,16]

The cosmetic product formulation computer printout which is made available by the FDA is compiled through voluntary filing of such data in accordance with Title 21 part 720.4 of the Code of Federal Regulations.[19] Ingredients are listed in prescribed concentration ranges under specific product type categories. Since certain cosmetic ingredients are supplied by the manufacturer at less than 100% concentration, the value reported by the cosmetic formulator may not necessarily reflect the actual concentration found in the finished product; the concentration in such a case would be a fraction of that reported to the FDA. The fact that data are submitted only within the framework of preset concentration ranges also provides the opportunity for overestimation of the actual concentration of an ingredient in a particular product. An entry at the lowest end of a concentration range is considered the same as one entered at the highest end of that range, thus introducing the possibility of a two- to 10-fold error in the assumed ingredient concentration.

The 1976 FDA cosmetic ingredient data list Ozokerite in 1,269 formulations. The 1979 information lists it in 1,085 formulations in concentrations up to 50%. Ozokerite may come in contact with the body from a few hours (in suntan preparations) to several days (in hair conditioners).[16,20]

BIOLOGICAL PROPERTIES

General Effects

Microbiological Effects

Ozokerite may be metabolized by some microorganisms, and also acts as a bacteriocidal agent for others. Metabolism of this wax by some microorganisms changes its chemical composition. After microbial action there may be 12%–38% fewer hydrocarbons than in the initial product, and there can be an increase in the concentration of resin-like compounds. Such decomposition is accompanied by an accumulation of oxygen-, nitrogen-, and sulfur-rich compounds. These changes are similar to those that occur in nature.[21,22]

Ozokerite demonstrated an antibacterial effect against *Salmonella sp., Shigella flexneri, Staphylococcus aureus, Shigella sonnei, Cornybacterim diphtheriae* at concentrations as low as 0.62%. This effect was attributed to the presence in the Ozokerite of trace elements and organic compounds.[12]

TABLE 2. Product Formulation Data.

Product category	Total no. containing ingredient	No. of product formulations within each concentration range (%)						
		Unreported concentration	>25–50	>10–25	>5–10	>1–5	>0.1–1	≤0.1
Ozokerite								
Baby lotions, oils, powders, and creams	3	—	—	—	—	3	—	—
Eye shadow	152	—	—	31	31	26	64	—
Eye makeup remover	2	—	—	2	—	—	—	—
Mascara	71	—	—	24	2	45	—	—
Other eye makeup preparations	17	—	—	4	7	5	1	—
Perfumes	41	—	41	—	—	—	—	—
Sachets	3	—	—	—	—	3	—	—
Other fragrance preparations	7	—	—	7	—	—	—	—
Hair conditioners	1	—	—	—	1	—	—	—
Other hair preparations (noncoloring)	1	—	—	—	—	—	1	—
Blushers (all types)	65	—	—	34	4	25	2	—
Face powders	1	—	—	—	1	—	—	—
Makeup foundations	45	—	—	8	7	28	2	—
Leg and body paints	1	—	—	—	—	1	—	—
Lipstick	559	—	—	93	20	292	154	—
Makeup bases	149	—	—	1	—	142	6	—
Rouges	35	—	—	17	5	13	—	—
Makeup fixatives	1	—	—	—	—	—	1	—
Other makeup preparations (not eye)	36	—	—	22	1	13	—	—
Cuticle softeners	1	—	—	—	1	—	—	—
Skin cleansing preparations (cold creams, lotions, liquids, and pads)	17	—	—	—	7	9	1	—
Face, body, and hand skin care preparations (excluding shaving preparations)	18	—	6	3	—	4	5	—
Hormone skin care preparations	1	—	—	—	—	1	—	—
Moisturizing skin care								

preparations	13	—	—	1	1	7	4	—
Night skin care preparations	9	—	1	—	2	6	—	—
Wrinkle smoothers (removers)	4	—	—	1	2	1	—	—
Other skin care preparations	8	—	—	3	2	3	—	—
Suntan gels, creams, and liquids	5	—	—	2	1	2	—	—
Other suntan preparations	3	—	—	—	—	3	—	—
1976 TOTALS	1269	—	48	253	95	632	241	—
1979 TOTALS	1085	85	28	168	161	535	105	3
Ceresin								
Baby lotions, oils, powders, and creams	1	—	—	—	1	—	—	—
Other bath preparations	2	—	—	2	—	—	—	—
Eyeliner	3	—	—	—	—	3	—	—
Eye shadow	48	—	48	—	—	—	—	—
Eye lotion	2	—	—	—	2	—	—	—
Eye makeup remover	2	—	—	—	2	—	—	—
Mascara	32	—	—	2	21	8	1	—
Other eye makeup preparations	17	—	—	5	5	7	—	—
Colognes and toilet waters	6	—	—	—	6	—	—	—
Perfumes	8	—	—	8	—	—	—	—
Other fragrance preparations	33	—	—	33	—	—	—	—
Hair conditioners	1	—	—	—	1	—	—	—
Tonics, dressings, and other hair grooming aids	7	—	—	1	2	3	1	—
Wave sets	1	—	—	—	1	—	—	—
Other hair preparations (noncoloring)	2	—	—	—	1	1	—	—
Blushers (all types)	19	—	—	2	2	13	2	—
Face powders	4	—	—	—	4	—	—	—
Makeup foundations	7	—	—	1	3	3	—	—
Lipstick	109	—	—	1	21	80	7	—
Makeup bases	7	—	—	1	1	2	1	2
Rouges	1	—	—	1	—	—	—	—
Other makeup preparations (not eye)	19	—	—	7	1	8	3	—
Deodorants (underarm)	1	—	—	—	—	1	—	—

TABLE 2. (Continued.)

Product category	Total no. containing ingredient	No. of product formulations within each concentration range (%)						
		Unreported concentration	>25–50	>10–25	>5–10	>1–5	>0.1–1	≤0.1
Skin cleansing preparations (cold creams, lotions, liquids, and pads)	29	—	—	4	9	13	2	1
Face, body, and hand skin care preparations (excluding shaving preparations)	5	—	—	1	—	1	3	—
Hormone skin care preparations	1	—	—	—	—	1	—	—
Moisturizing skin care preparations	10	—	—	2	3	5	—	—
Night skin care preparations	12	—	—	1	4	7	—	—
Wrinkle smoothers (removers)	3	—	—	1	—	2	—	—
Other skin care preparations	9	—	—	7	2	—	—	—
Suntan gels, creams, and liquids	1	—	—	—	1	—	—	—
Other suntan preparations	1	—	—	—	1	—	—	—
1976 TOTALS	403	—	48	80	94	158	20	3
1979 TOTALS	386	—	—	77	107	180	21	1
Montan Wax								
Eyebrow pencil	5	—	—	5	—	—	—	—
Eye shadow	18	—	—	—	—	18	—	—
Perfumes	1	—	—	—	—	—	1	—
Lipstick	323	—	—	2	—	297	24	—
Rouges	7	—	—	—	7	—	—	—
Face, body, and hand skin care preparations (excluding shaving preparations)	1	—	—	—	—	—	1	—
1976 TOTALS	355	—	—	7	7	333	26	—
1979 TOTALS	309	—	—	—	5	295	9	—

Data from Refs. 16, 20.

Gastric Effects

The effects of different doses of Ozokerite on the secretory activity of dog stomachs isolated by the I.P. Pavlov method have been studied. Ozokerite suspended in 150 ml tap water was injected into the pouch in 10, 20, 50, or 100 mg/kg doses, with or without a food stimulus. Ozokerite had no effect on either the secretion of gastric juice or the total and free acidity at the 10 and 20 mg/kg levels; however, 50–100 mg/kg increased these variables.[23]

Animal Toxicology

Acute

Oral toxicity

No toxic effects were reported after gastric administration to mice of up to 200 mg/kg of a 0.2% solution of Ozokerite, or to rabbits of up to 200 mg/kg of a 2.0% solution of the wax.[24]

A lipstick formulation containing 4.5% Ozokerite and another containing 19.1% were tested for acute oral toxicity in rats. The formulation with 4.5% wax was administered by gavage to 10 Sprague–Dawley rats in a 20 mg/kg dose. No deaths or toxic effects resulted.[25] The formulation containing 19.1 percent wax was given by gavage to 10 CFE rats in a dose of 25 g/kg. One animal died from intestinal obstruction, but no toxic effects were seen.[26]

Formulations of 5% (two lipstick formulations), 13% (two blush cream formulations), 28% and 29% (lipstick formulations), were tested for acute oral tox-

TABLE 3. Acute Oral Toxicity: Ozokerite.

Wax conc. in test soln. (%)	*Dose of test subst./kg*	*Solution or formulation*	*Species and number*	*Comments*[a]	*Ref.*
0.2	50–200 mg	Solution	Mice	Ingastric administration. No toxic effect.	24
2.0	10–200 mg	Solution	Rabbits	Ingastric administration. No toxic effect.	24
4.5	20 g	Formulation-lipstick	10 Sprague–Dawley rats	Gavage. No deaths; no toxic effects.	25
5	15 g	Formulation-lipstick	5 albino rats	LD_{50} not determined.	27
5	15 g	Formulation-lipstick	5 albino rats	LD_{50} not determined.	28
13	5 g	Formulation-blush cream	5 albino rats	LD_{50} not determined.	29
13	5 g	Formulation-blush cream	5 albino rats	LD_{50} not determined.	30
19.1	25 g	Formulation-lipstick	10 CFE rats	Gavage. 1/10 died from intestinal obstruction; no toxic effects.	26
28	5 g	Formulation-lipstick	5 albino rats	LD_{50} not determined.	31
29	5 g	Formulation-lipstick	5 albino rats	LD_{50} not determined.	31

[a] 21 CFR 1500.3

icity in five albino rats per sample. The animals were intubated with the compounds after an overnight fast and observed for seven days. The LD_{50}s for the formulations were not reached[27-31] (see Table 3).

Dermal irritation/toxicity

Eight samples of a 50% concentration of Ozokerite in petrolatum were tested for skin irritation on groups of nine albino rabbits. The rabbits were given three consecutive 24 h applications. The first application of each sample produced erythema in one to four animals. Erythema decreased with each subsequent application, and after the third (final) application, three samples produced no irritation. The remaining five samples caused erythema in one or two animals per group[32-39] (see Table 4).

A lipstick formulation containing 4.5% Ozokerite was tested for dermal irritation on the intact and abraded skin of six New Zealand white rabbits. Three consecutive 24 h applications produced mild erythema in one rabbit's intact skin, and mild erythema in the abraded skin of three rabbits.[25] Another lipstick formulation containing 19.1% Ozokerite produced no irritation when tested under the same conditions.[26]

Two lipstick formulations each containing 5% Ozokerite were tested for dermal irritation; nine albino rabbits were used per formulation. Both samples were applied full strength under a 24 h closed patch. One formulation produced a PII of 0.17 out of a possible score of 8.0, and the other produced no irritation (score = 0.0).[27,28] Two lipstick formulations, one containing 28% and the other 29% Ozokerite, were tested for dermal irritation. Both were minimally irritating.[31] Three 24 h applications of a lipstick containing 19.1% Ozokerite produced no irritation on the abraded and intact skin of six rabbits.[26]

One of two blush cream formulations, each containing 13% Ozokerite and tested for dermal irritation, was minimally irritating and the other produced no irritation.[29,30]

Ocular irritation

Eight different samples of 50% Ozokerite in petrolatum were tested according to the Draize method. Each 0.1 ml sample was instilled into one eye of each of six rabbits. Five samples produced no irritation after two days.[32-36]

Similar procedures were used to test eight cosmetic formulations: two lipstick formulations containing 5% Ozokerite were tested as above. One product produced no irritation. The second caused mild irritation in one rabbit on Day 1, but the irritation had cleared by Day 2.[27,28] One of two blush cream formulations containing 13% Ozokerite produced mild eye irritation in one rabbit at four days and the other produced no irritation.[29,30] Two lipstick formulations, one containing 28% and the other containing 29% Ozokerite, produced mild eye irritation for two days and none thereafter.[31] One lipstick formulation containing 4.5% Ozokerite and another containing 19.1% were each tested for ocular irritation in six New Zealand white rabbits. When 0.1 ml volume was instilled into one eye per animal, no irritation occurred up to 72 hours[25,26] (see Table 5).

TABLE 4. 24-hour Acute Dermal Irritation/Toxicity: Ozokerite.

Wax conc. (%)	*Dose of test subst.*	*Solution or formulation*	*No. of albino rabbits*	*Primary irrit. score / Max score (8.0)*	*Contact time*	*Comments*	*Ref.*
50	0.5 ml	Solution	9	—	3 applic. at 24 h intervals	Irritation in 2 rabbits at Day 1; 1 at Day 3	32
50	0.5 ml	Solution	9	—		Irritation in 4 rabbits at Day 1; 2 at Day 2	33
50	0.5 ml	Solution	9	—	3 applic. at 24 h intervals	Irritation in 4 rabbits at Day 1; 1 at Day 2; 0 at 3	34
50	0.5 ml	Solution	9	—		Irritation in 4 rabbits at Day 1; 1 at Day 2; 0 at 3	35
50	0.5 ml	Solution	9	—	3 applic. at 24 h intervals	Irritation in 2 rabbits at Day 1; 1 at Day 2 and 3	36
50	0.5 ml	Solution	9	—	3 applic. at 24 h intervals	Irritation in 2 rabbits at Day 1; 1 at Day 3	37
50	0.5 ml	Solution	9	—	3 applic. at 24 h intervals	Irritation in 4 rabbits at Day 1; 2 at Day 2; 1 at Day 3	38
50	0.5 ml	Solution	9	—	3 applic. at 24 h intervals	Irritation in 1 rabbit at Day 1; 3 at Day 2; 2 at Day 3	39

TABLE 4. (Continued.)

Wax conc. (%)	*Dose of test subst.*	*Solution or formulation*	*No. of albino rabbits*	*Primary irrit. score* / *Max score (8.0)*	*Contact time*	*Comments*	*Ref.*
4.5	0.5 g	Formulation-lipstick	6	+1 intact site +3 abraded site	3 applic. at 24 h intervals	Open patch on abraded and intact skin. One +1 score on intact skin (mild erythema) 3 +1 on abraded skin (mild erythema)	25
5	0.5 ml	Formulation-lipstick	9	0.17	24 h	Potential for minimal irritation	27
5	0.5 ml	Formulation-lipstick	9	0.0	24 h	No irritation	28
13	0.5 ml	Formulation-blush cream	6	0.9	24 h	Potential for minimal irritation	30
13	0.5 ml	Formulation-blush cream	6	0.0	24 h	No irritation	29
19.1	0.5 g	Formulation-lipstick	6	0.0	3 applic. at 24 h intervals	Open patch on abraded and intact skin. All zero scores	26
28	0.5 ml	Formulation-lipstick	6	0.08	24 h	Potential for minimal irritation	31
29	0.5 ml	Formulation-lipstick	6	0.17	24 h	Potential for minimal irritation	31

TABLE 5. Ocular Irritation: Ozokerite.

Wax conc. in petrolatum (%)	*Dose*	*Solution/ formulation*	*No. of albino rabbits*	*Observ. time*	*Comments*	*Ref.*
50	0.1 ml	Solution	6	48 h	One instillation. No irritation.	32
50	0.1 ml	Solution	6	48 h	One instillation. No irritation.	33
50	0.1 ml	Solution	6	48 h	One instillation. No irritation.	34
50	0.1 ml	Solution	6	48 h	One instillation. No irritation.	35
50	0.1 ml	Solution	6	48 h	One instillation. No irritation.	36
50	0.1 ml	Solution	6	72 h	One instillation. Minimally irritating at 48 h; no irritation at 72 h.	37
50	0.1 ml	Solution	6	72 h	One instillation. Minimally irritating at 48 h; no irritation at 72 h.	38
50	0.1 ml	Solution	6	72 h	One instillation. Minimally irritating at 48 h; no irritation at 72 h.	39
4.5	0.1 ml	Formulation-lipstick	6	72 h	One instillation. No irritation (Score = 0).	25
5.0	0.1 ml	Formulation-lipstick	6	24 h	One instillation. No irritation.	27
5.0	0.1 ml	Formulation-lipstick	6	48 h	One instillation. Mild irritation seen in one rabbit at 24 h; cleared by Day 2.	28
13	0.1 ml	Formulation-blush cream	6	7 days	One instillation. Mild irritation to Day 4.	29
13	0.1 ml	Formulation-blush cream	6	24 h	One instillation. No irritation.	30
19.1	0.1 ml	Formulation-lipstick	6	72 h	One instillation. No irritation (Score = 0).	26
28	0.1 ml	Formulation-lipstick	6	72 h	One instillation. Mild irritation to Day 2.	31
29	0.1 ml	Formulation-lipstick	6	72 h	One instillation. Mild irritation to Day 2.	31

Clinical Assessment of Safety

The results of these tests are summarized in Table 6.

Skin Irritation/Sensitization

Single 24 hour patch test

Six lots of 100% Ozokerite were each tested on 20 subjects per lot in a single insult 24 h occlusive patch test. The combined results of all tests showed one of 120 test subjects had a moderate reaction, 25 had mild to minimal reactions, and 94 produced no reaction.[40,41]

Each of seven lipstick formulations containing Ozokerite at 5%, 28%, and 29% were applied full strength under occlusion to the upper backs or forearm of 20 subjects for 24 h. Two separate blush cream formulations containing 13% Ozokerite were similarly tested on two groups of 18 and 19 subjects. Only one volunteer in the one blush cream test showed a perceptible erythema. None of the other 176 subjects tested developed a product-induced irritation.[42-44,46-49]

Modified Draize–Shelanski–Jordan test

A lipstick product containing 4.5% Ozokerite, applied under occlusion to 201 subjects for 24 h, caused no allergic or irritant responses.[25]

TABLE 6. Clinical Data: Ozokerite.

TEST						
Wax conc. (%)	*Neat/formulation*	*No. of subjects*	*Contact time*	*PII*	*Comments*	*Ref.*
24 h Patch Test						
100	Neat	20	24 h	—	1/20 showed barely perceptible erythema; 1/20 had definite slight erythema.	41
100	Neat	20	24 h	0	No irritation; 1/20 mild irritation.	41
100	Neat	20	24 h	—	1/20: barely perceptible erythema; 1/20: definite erythema; 1/20: moderate erythema.	41
100	Neat	20	24 h	—	2/20: barely perceptible; 6/20: definite erythema; 1/20: moderate erythema.	40
100	Neat	20	24 h	—	6/20: definite erythema	40
100	Neat	20	24 h	—	5/20: definite erythema	40
5	Formulation-lipstick	20	24 h	0	No irritation	42
5	Formulation-lipstick	20	24 h	0	No irritation	43
5	Formulation-lipstick	20	24 h	0	No irritation	44
5	Formulation-lipstick	20	24 h	0	No irritation	45
5	Formulation-lipstick	20	24 h	0	No irritation	46
13	Formulation-blush cream	18	24 h	0.03	Barely perceptible erythema in 1 out of 18.	47
13	Formulation-blush cream	19	24 h	0	No irritation	48
28	Formulation-lipstick	20	24 h	0	No irritation	49
29	Formulation-lipstick	20	24 h	0	No irritation	49
Modified Draize–Shelanski–Jordan Test						
4.5	Formulation-lipstick	201	1 week	0	No allergic reactions or irritant responses were elicited by the product.	25
Contact Allergy Test. Repeat Insult Patch Test						
13	Formulation-blush cream	300	4 weeks	0	No allergic responses	50
21-Day Cumulative Irritancy Assay Test						
13	Formulation-blush cream	12	21 days	1/756	Product scored 1 out of a possible 756	51

Repeated insult patch test

None of the 300 subjects tested with a blush product containing 13% Ozokerite had an allergic response during the four weeks of the study.[50]

21 day cumulative irritancy test

A formulation containing 13% Ozokerite was applied to the skin of 12 panelists; a sensitization score of one out of a possible 756 was recorded.[51]

Further toxicological testing on Ozokerite in a mixture is discussed in "Waxes: Plant and Insect"[52] under "Mixture Candelilla Wax (4%), Ozokerite (5%), Paraffin Wax (2.5%), and Carnauba Wax (3%) in a formulation."

CERESIN: CHEMICAL AND PHYSICAL PROPERTIES

Structure/Composition

Ceresin Wax, a microcrystalline mixture of complex hydrocarbons, is produced by the purification of Ozokerite with sulfuric acid and filtration through bone black.[17] The wax is available in various grades, with melting points that vary over a wide range. The name "Ceresin Wax" is also used to designate the commercial compound variety with a paraffin base.[1,2]

See "Ozokerite" for chemical and physical properties.

BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Oral toxicity

A lipstick formulation containing 2% Ceresin was tested for acute oral toxicity in 10 rats. A dose of 5 g/kg was administered by oral intubation and the LD_{50} was not determined.[53]

Dermal irritation

The primary skin irritation of a lipstick product containing 2% Ceresin was tested on six rabbits according to the Draize method. A 0.5 ml dose of the formulation produced minimal irritation, with a PII of 0.79 out of a maximum possible score of 8.0.[53]

Five products—one cleansing cream containing 5% Ceresin, another cleansing cream with 6% Ceresin, and the other three eye creams containing 6% Ceresin—were each tested for acute skin irritancy on four New Zealand albino rabbits. A 0.5 ml undiluted sample was applied under occlusion to the clipped, intact, or abraded skin of each animal for 24 h. Sites were evaluated and scored 1, 48, and 72 h after patch removal, according to the Draize Method (maximum PII score is 8.0). The PII of the 5% sample was 1.25.[54] The other four samples had PIIs of 1.63, 1.00, 0.88, and 0.8.[55-58] The irritation was minimal to mild (see Table 7).

Dermal toxicity

The acute dermal toxicity of a lipstick formulation containing 2.0% Ceresin was tested in a dose of 2.0 g/kg on 10 rabbits. The percutaneous LD_{50} for the formulation was not determined[53] (see Table 7).

Ocular irritation

The application of an undiluted lipstick product containing 2% Ceresin caused no eye irritation in six rabbits (scores of 0.0 at 24, 48, and 72 h).[53]

Three formulations, two eye creams and one cleansing cream, each containing 6% Ceresin, were tested for ocular irritation on five New Zealand rabbits each. The undiluted test material (0.1 ml) was instilled without irrigation into one eye of each rabbit and the reactions observed after 1, 2, 4, 48, and 72 h, and four and seven days. The maximum possible score for irritation was 110. One eye cream product caused mild irritation only in the conjunctivae with scores of 8, 4, 2, and 0.8 after 1, 24, 48, and 72 h, respectively. No irritation was seen thereafter.[59] The second eye cream product caused iridial irritation (score = 1) only at 1 h. Conjunctival irritation occurred up to 48 h with scores of 6, 2, and 0.4 after 1, 24, and 48 h.[60] The cleansing cream product caused similar iridial irritation after 1 h (score = 2). Conjunctival irritation was seen at 1, 24, and 48 h with scores of 8, 2, and 6.8, respectively[61] (see Table 8).

TABLE 7. Acute Dermal Irritation/Toxicity: Ceresin.

Wax conc. (%)	Dose of test subst. (per kg)	Type of formulation	No. of albino rabbits	Primary Irrit. score — Max. score	Contact time (h)	Observ. time (h)	Comments	Ref.
Irritation								
2	0.5 ml	Lipstick	6	0.79/8.0	24	—	Minimal irritation	53
5	0.5 ml	Cleansing cream	4	1.25/8.0	24	72	Mild irritation	54
6	0.5 ml	Cleansing cream	4	1.63/8.0	24	72	Mild irritation	55
6	0.5 ml	Eye cream	4	1.0/8.0	24	72	Mild irritation	56
6	0.5 ml	Eye cream	4	0.88/8.0	24	72	Minimal irritation	57
6	0.5 ml	Eye cream	4	0.8/8.0	24	72	Minimal irritation	58
Toxicity								
2.0	2 g	Lipstick	10	—	—	—	LD_{50} was not determined	53

TABLE 8. Ocular Irritation: Ceresin.

Wax conc. (%)	Type of formulation	Dose	No. of albino rabbits	Observ. time	Comments	Ref.
2.0	Lipstick	—	6	72 h	Scores = 0.0	53
6.0	Eye cream	0.1 ml	5	7 days	Mild conjunctival irritation to 72 h.	59
6.0	Eye cream	0.1 ml	5	7 days	Mild iridial irritation after 1 h. Mild conjunctival irritation to 48 h.	60
6.0	Cleansing cream	0.1 ml	5	7 days	Mild iridial irritation after 1 h. Mild conjunctival irritation to 48 h.	61

Clinical Assessment of Safety

One lipstick formulation containing 2% Ceresin was tested with the Schwartz–Peck prophetic patch test and the Draize–Shelanski repeated insult patch test. In the Schwartz–Peck test, "virtually" no reactions occurred in the 102 subjects under open and closed patches. In order to evaluate photosensitivity, the test sites were irradiated for one minute with a Hanovia Tannette Mark I quartz UV source (150 W) at a distance of 12 in. Irradiation occurred after the second insult patch had been read and the site was evaluated 48 h after exposure. The Draize–Shelanski test caused "virtually" no reactions in 50 subjects under open and closed patch and ultraviolet test conditions.[53]

A lipstick containing 2% Ceresin was tested for human skin irritation and sensitization in a Schwartz–Peck prophetic patch test. The undiluted product was applied under occlusion to the skin of the cleansed upper back and under open patch conditions to the inner upper arm. After 48 h, the patches were removed and the sites were graded. Following a 14-day nontreatment period, second open and closed patches were applied and read 48 h later. The reading of this second insult was followed by a test for UV sensitivity. The sites where closed patches had been applied were irradiated with ultraviolet light from a Hanovia Tannette Mark I quartz lamp (150 W) at a distance of 12 in. These sites were read 48 h after irradiation. Out of the 1,078 panelists, one showed a weak, nonvesicular reaction under closed patch conditions after the first insult. No other reactions occurred after the second insult or after UV irradiation.[62]

A repeated insult patch test was conducted on the same lipstick formulation containing 2% Ceresin. The undiluted product was applied under occlusion to the skin of the back for 24 h and under open conditions to the upper arm. The patches were removed, the sites graded, and the skin was allowed to recuperate for 24 h before the next in a series of 10 patches were applied. After the last induction patch, a two- to three-week rest period occurred. A challenge 48 h patch was applied to untreated sites. It was then removed and the reaction was graded. To assess UV sensitivity, sites were irradiated with an ultraviolet source after the first, fourth, seventh, and tenth induction patches, and after the 48 h challenge patch was removed. Of the 506 panelists tested in this study, one had a weak, nonvesicular reaction under the closed patch after the second induction and one had an edematous reaction under the closed patch after the sixth induction. No other reactions occurred.[62]

For additional testing on "Beeswax/Ceresin Wax Composites", see "Waxes: Plant and Insect."[52]

BEESWAX/CERESIN COMPOSITE: BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Oral toxicity

A formulation containing 6% Beeswax and 6% Ceresin was tested for acute oral toxicity in five male and five female Wistar albino rats. The animals were fasted for 16 h and given an 80.0 ml/kg formulation dose by oral intubation.

Observations were made 1 and 6 h after dosing and daily for 14 days. There were no deaths.[63]

Ocular irritation

A cream formulation containing 6% Ceresin and 6% Beeswax was tested for acute eye irritation. A 0.1 ml sample was instilled into the conjunctival sac of one eye of each of nine New Zealand rabbits. The untreated eyes served as controls. Three of the treated eyes were washed with 20 ml of deionized water 30 sec after instillation. Ocular reactions were scored after 24, 48, and 72 h and four and seven days. After 24 h, four of the six rabbits with unwashed eyes showed minimal chemosis and two showed minimal conjunctival redness. No irritation occurred in the washed eyes.[64]

Clinical Assessment of Safety

Skin Irritation/Sensitization

Prophetic patch test

A formulation containing 6% Beeswax and 6% Ceresin was tested for irritation and sensitization with the Schwartz–Peck prophetic patch test. Plastic bandages impregnated with the test product were applied to the cleansed upper backs of each of the 98 persons. Simultaneously, open patches were applied to the left volar forearm surface and the results from both applications were read 48 h later. After a rest of 14 days, there was a second application of the product with open and closed patches. To evaluate photosensitization, the test area of the back was exposed to UV radiation (Hanovia Tannette Mark I lamp) at a distance of 12 in for 1 min after the second insult had been read. This exposure area was read 48 h later. None of the subjects showed irritation or sensitization after any insult.[65]

Repeated insult patch test

A formulation containing 6% Beeswax and 6% Ceresin was tested with the Draize–Shelanski repeated insult procedure on 49 subjects. Patches impregnated with the formulation were applied to the cleansed upper backs of each subject every Monday, Wednesday, and Friday for three and one-half weeks, for a total of 10 insults. An open patch was simultaneously applied to the left forearm, and both sets of patches were removed and the areas read 48 h later. After a 14-day rest, an eleventh open and closed patch was applied and read 48 h later. Photosensitization was evaluated with a UV light source that emitted a wavelength of 360 nm. Formulation-exposed sites were irradiated for 1 min after the final reading was taken. The light-exposed sites were read 48 h later. None of the 49 panelists showed any irritation or sensitization.[65]

21 day cumulative irritancy test

A cream containing 6% Beeswax and 6% Ceresin was tested for 21-day cumulative irritancy on 14 panelists. Patches impregnated with the cream were applied to the back of each panelist for 21 consecutive days. The total irritation score of the entire test population was 6.4 out of a possible 630.[66]

Contact sensitization

The contact sensitization potential of a formulation containing 6% Beeswax and 6% Ceresin was patch tested on 22 subjects. Sites on the volar forearm were pretreated with 5% sodium lauryl sulfate 24 h before the test material was applied under occlusion for alternate 48 h periods. After a 10- to 14-day rest, challenge patches were applied under occlusion to adjacent, fresh sites for 48 h. The preparation produced no irritant or allergic reactions.[67]

In-use test

One hundred women who used a cream preparation containing 6.0% Beeswax and 6.0% Ceresin daily for two weeks experienced no irritation.[68]

MONTAN WAX: CHEMICAL AND PHYSICAL PROPERTIES

Structure/Composition

Montan Wax is a bituminous wax that occurs in lignites (woody coals) from central Europe, Australia, New Zealand, Russia, Great Britain, and the United States. It is extracted with a volatile solvent.[1,2,18,69-71]

Montan Wax consists of monohydric alcohol esters, high-molecular-weight acids, and free alcohols.[18] The crude wax also contains resinous and sulfur compounds (see Table 9).[1]

The refined wax has a higher content of free wax acids than does the crude wax, and it is substantially free of the esters of C_{20}, C_{22}, and C_{24} acids. The resin content varies according to geographical source.[1,69-72]

TABLE 9. Composition of Montan Wax.

Component	*Amount Reported (%)*	*Ref.*
Esters of wax acids:	58–59	1
1. Octacosyl esters of C_{20}, C_{22}, C_{24} acids		
2. Octacosyl cerotate		
3. Octacosyl hydroxyoctacosonate		
4. Montanyl montanate		
5. Ceryl octocosonate		
Free wax acids:	17–10	
1. Carbocerotic acid		
2. Montanic acid		
3. Melissic acid		
Free primary monohydric alcohols:	3–4	
1. Tetracosonol		
2. Hexacosonol		
Secondary alcohols:	1	
1. Montanol		
Resins:	10–12	
1. $C_{20}H_{30}O_2$, and neutral resins		
2. $C_{24}H_{34}O_2$, Montan resin		
Ketones:	Less than 10	
1. Cerotones		
2. Montanones $C_{29}H_{59}CO$		

Properties

Crude Montan Wax is brown but becomes white after purification. The hardest of the nonvegetable waxes, Montan Wax breaks with a conchoidal fracture; in the melt it is a good solvent for basic dyes. It shows good wetting and flow in oil solutions and is fairly resistant to oxidation. For other specific properties see Table 1.[1,2,4,6,18]

Reactivity

Montan Wax undergoes decomposition when distilled at ordinary atmospheric pressures; in a current of steam, in vacuo, a white crystalline montanic acid is produced.[69]

Refining and Analytical Methods

Montan Wax is removed from lignite coal by solvent extraction. It is deresinified by solvent processing followed by chromic acid oxidation and may be further purified by concentrated and fuming sulfuric acid, chlorosulfonic acid, and alkali metal bisulfites treatment. One method of purification recommends saponification of the wax to its component alcohols and acids. The alcohol component may be decolorized by activated carbon, and the acid component by treatment with oxidizers. The results may then be reesterified.[1,2,69-73]

Microdistillation methods and x-ray analysis are used to determine the acid content of this wax. Thin layer, column, and gas chromatography can be used to separate and identify the constituents. Differential thermal analysis, vapor pressure osmometry, infrared spectroscopy, and nuclear magnetic resonance are also used to determine the constituents.[69,70,71,73-78]

Impurities

Purified Montan Wax has no known impurities, whereas crude Montan Wax may contain sulfur and resins.[18]

USE

Noncosmetic Uses

Montan Wax is used as a substitute for Carnauba Wax as a polish, in the manufacture of rubber, in printing ink, electrical insulation, leather finishes and dressings, carbon paper, grease, phonograph records, and waterproofing.[1,2]

Purpose and Use in Cosmetics

Montan Wax is used in eye and facial makeup preparations, in fragrance formulations, and in skin care preparations. It stiffens eyebrow pencil, eye shadow and rouge, and is used as the solid phase of fragrance preparations. It gives form to lipsticks and is a constituent of creams for skin care products (see Table 2).[15,16]

The 1976 FDA voluntary submission of cosmetic data lists Montan Wax in 355 cosmetic formulations. The 1979 data listed it in 309 preparations. It is used in cosmetics which are applied near the eyes, to lips, and the general body surface.[16] The wax is used in concentrations varying from 0.1% in lipsticks to 25%

in some eyebrow pencils (see Table 2). It may come in contact with the body for a few hours (in fragrance preparations) to several hours daily (in makeup and skin care preparations).[16]

BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Dermal irritation

A single application (2 and 3 g/kg) of Montan Wax to the intact skin of rabbits caused no irritation.[79]

Intraperitoneal injection

The single, minimum toxic dose of Montan Wax administered by intraperitoneal injection in mice was 7.5 g/kg.[79]

Subchronic

Oral toxicity

Ten animals (type unspecified) that were fed Montan Wax in 1 g/kg doses for four months had no lesions; however, an increase in the weights of the adrenal glands and kidneys was observed.[79]

Dermal toxicity/irritation

Application of 200 g/kg of Montan Wax to the backs of rabbits for 30 days produced slight, transient hyperemia, which disappeared after 8–10 days.[79]

Inhalation toxicity

Animals showed no behavioral changes when exposed for three months to a gaseous mixture of Montan Wax (concentration of hydrocarbon 0.11 to 0.36 mg/l, benzene 0.01–0.019 mg/l).[79]

Clinical Assessment of Safety

Repeated Insult Patch Test

Four lipstick formulations containing Montan Wax were tested for irritation and sensitization using a Modified Draize–Shelanski–Jordan procedure. The first product, containing 1.61% Montan, was applied under occlusion in eight 24 h induction patches to the upper backs of 92 women and 18 men. Following an 11-day nontreatment period, two consecutive 48 h challenge patches were applied to the back. The material caused no irritation or sensitization.[80]

Similar studies were conducted on lipstick products containing 1.93%, 1.81%, and 2.53% Montan Wax. Subjects testing each formulation received 10 occlusive 24 h induction patches, followed by a 13-day rest. Each subject then received two 48 h challenge patches seven days apart. In 54 women testing the

lipstick containing 1.93% wax, 41 women and 11 men testing the lipstick containing 1.81% wax, and 49 women and six men using the product with 2.53% wax, no irritation or sensitization occurred.[81-83]

PARAFFIN: INTRODUCTION

Paraffin and Microcrystalline Wax are distillation products of petroleum. The crystalline structure of Paraffin is different from that of Microcrystalline Wax: Paraffin solidifies into plates, whereas Microcrystalline forms small, poorly-defined needles. According to one theory that attempts to explain this difference, the Microcrystalline Wax is associated with the heavy, residual stocks of petroleum and cannot be separated completely from the accompanying oil; it is, therefore, unable to form any well defined crystals. Paraffin is only associated with the light distillates and can readily be separated into macrocrystalline types.[1,2]

Paraffin is obtained from a distillate of crude petroleum by cooling, filtering, and pressing to remove the residual oil. Refined Paraffin contains about 0.5% oil.[1,2]

Microcrystalline Wax is separated from the Paraffin distillate residue by solvent extractions and centrifugation. Its oil content varies from 2% to 12%.[1,2]

CHEMICAL AND PHYSICAL PROPERTIES

Structure/Composition

Paraffin is a mixture of organic compounds characterized by relatively large crystals; it contains solid hydrocarbons of the methane series and a small percentage of other organic entities. The hydrocarbon content of Paraffin varies according to the source of the crude petroleum. The four generic hydrocarbon classes of petroleum are in general the paraffins (saturated, open-chain hydrocarbons); the olefins (unsaturated, open chains); the napthalenes (saturated, cyclic hydrocarbons, possibly with multiple ring nuclei); and the aromatics (unsaturated, cyclic hydrocarbons). The constituents of Paraffin have carbon numbers that range from 18 to 36.[1,2] The ring structures are the tri-, tetra-, and pentacyclic compounds, but these are usually removed in the refining process. Paraffin crystallizes in plates and needles and an unidentifiable type of crystal called "malcrystalline." The plate types are straight-chain hydrocarbons and comprise the basic fraction of Paraffin; the needle and malcrystalline types are assumed to be branched-chain hydrocarbons.[84]

Properties

The properties of Paraffin are listed in Table 10.[1,2,4-6,85]

Reactivity

Paraffin is a relatively inert material that tends to oxidize when it is melted and large surface areas are exposed to oxygen. No information was available on the reactivity of this wax.[1,2]

TABLE 10. Properties of Petroleum Waxes.

Properties	*Paraffin*	*Ref.*	*Microcrystalline*	*Ref.*
Melting point	43°–65°C	6	63–90.5	5,85
Specific gravity	0.880–0.915	6,1	0.90–0.94 (at 15.5°C)	1,85
Acid value	0	1	0.1–0.2	1
Saponification value	0	1	0.05–<2.0	1
Iodine value	—		1.5	1
Color	White, translucent	4,6	Pale amber to white	5
Soluble in	Benzene Ligroin Warm alcohol Chloroform Turpentine Carbon disulfide Olive oil	1,6	Carbontetrachloride	2
Insoluble in	Water Acids	4,6	Water —	

Analytical Methods

The constituents of Paraffin can be identified by various chromatographic methods. Infrared spectrophotometry and fluorescence of the molten wax can determine aromatics, and thermal analysis can determine specific physical properties. The percent of unsaponifiable matter and hydrocarbon content may be determined by alcohol dilution. The quality of the refined product may be tested by the determination of melting point, tensile strength, color, and oil content.[1,2,84,86-89]

Impurities

Refined Paraffin used in the cosmetic industry like other petroleum waxes may contain trace impurities of polycyclic aromatic hydrocarbons (PAH) which have been shown to be carcinogenic. Improved refining techniques have been developed to eliminate these impurities.[88]

USE

Noncosmetic Uses

Paraffin is used in candles, waterproofing, lubricating, food coating, fruit and vegetable protection, waxed paper, polishes, crayons, pharmaceutical ointments and salves, and electrical insulation.[1,2,19]

Purpose and Use in Cosmetics

Paraffin is used in baby products, eye and facial makeup preparations, fragrance products, coloring and noncoloring hair preparations, manicuring products, personal cleanliness preparations, shaving and skin care products, and suntan preparations.[4,5,15,16,20,90]

TABLE 11. Product Formulation Data.

Product category	Total no. containing ingredient	No. of Product Formulations Within Each Concentration Range (%)							
		Unreported concentration	>50	>25–50	>10–25	>5–10	>1–5	>0.1–1	≤0.1
Paraffin									
Baby shampoos	1	—	—	—	—	—	1	—	—
Eye shadow	127	—	—	—	1	19	18	89	—
Eye makeup remover	3	—	—	—	—	1	2	—	—
Mascara	3	—	—	—	—	—	3	—	—
Other eye makeup preparations	20	—	—	2	1	5	8	4	—
Colognes and toilet waters	3	—	—	—	3	—	—	—	—
Perfumes	30	—	—	30	—	—	—	—	—
Sachets	6	—	—	—	—	6	—	—	—
Other fragrance preparations	15	—	—	15	—	—	—	—	—
Hair conditioners	14	—	—	—	—	14	—	—	—
Hair rinses (noncoloring)	3	—	—	—	—	—	3	—	—
Hair shampoos (noncoloring)	2	—	—	—	—	—	—	2	—
Tonics, dressings, and other hair grooming aids	29	—	—	—	13	6	8	2	—
Wave sets	1	—	—	—	1	—	—	—	—
Other hair preparations (noncoloring)	3	—	—	—	—	1	2	—	—
Other hair coloring preparations	3	—	—	1	2	—	—	—	—
Blushers (all types)	65	—	—	—	1	10	28	26	—
Face powders	15	—	—	—	—	—	—	15	—
Makeup foundations	76	—	—	—	—	2	51	23	—
Lipstick	439	—	—	—	18	54	290	76	1
Makeup bases	95	—	—	—	—	13	81	1	—
Rouges	29	—	—	—	1	1	25	2	—
Makeup fixatives	3	—	—	—	—	—	3	—	—
Other makeup preparations (not eye)	44	—	—	3	11	13	16	1	—
Cuticle softeners	3	—	—	—	—	—	3	—	—
Nail creams and lotions	2	—	—	—	1	—	1	—	—

Other manicuring preparations	1	—	—	—	—	—	1	—	—
Bath soaps and detergents	3	—	—	—	—	—	—	—	3
Deodorants (underarm)	1	—	—	—	—	1	—	—	—
Other personal cleanliness products	3	—	—	—	—	1	2	—	—
Aftershave lotions	3	—	—	—	—	—	—	3	—
Shaving cream (aerosol, brushless, and lather)	1	—	—	—	—	—	1	—	—
Skin cleansing preparations (cold creams, lotions, liquids, and pads)	69	—	—	—	20	20	25	4	—
Depilatories	1	—	—	—	—	—	1	—	—
Face, body, and hand skin care preparations (excluding shaving preparations)	31	—	—	1	9	13	6	1	1
Hormone skin care preparations	2	—	—	—	—	—	—	1	1
Moisturizing skin care preparations	28	—	—	1	3	5	13	6	—
Night skin care preparations	11	—	—	—	—	1	10	—	—
Paste masks (mud packs)	4	—	—	—	—	—	3	1	—
Skin lighteners	4	—	—	—	—	—	4	—	—
Skin fresheners	1	—	—	—	1	—	—	—	—
Other skin care preparations	22	—	—	1	11	5	5	—	—
Suntan gels, creams, and liquids	13	—	—	—	—	3	7	3	—
Other suntan preparations	6	—	—	—	5	—	1	—	—
1976 TOTALS	1238	—	—	54	102	194	622	260	6
1979 TOTALS	945	14	—	14	92	143	423	249	10
Microcrystalline Wax									
Eyebrow pencil	2	—	—	—	—	1	1	—	—
Eye shadow	37	—	—	—	2	23	11	1	—
Eye makeup remover	2	—	—	—	—	—	2	—	—
Mascara	5	—	—	—	2	2	1	—	—
Other eye makeup preparations	23	—	—	—	1	1	16	5	—
Perfumes	17	—	—	—	17	—	—	—	—
Other fragrance preparations	9	—	—	9	—	—	—	—	—

TABLE 11. (Continued.)

Product category	Total no. containing ingredient	No. of Product Formulations Within Each Concentration Range (%)							
		Unreported concentration	>50	>25–50	>10–25	>5–10	>1–5	>0.1–1	≤0.1
Hair conditioners	2	—	—	—	—	—	2	—	—
Tonics, dressings, and other hair grooming aids	14	—	—	—	4	2	8	—	—
Other hair preparations (noncoloring)	2	—	—	—	1	—	1	—	—
Other hair coloring preparations	1	—	—	—	—	—	1	—	—
Blushers (all types)	38	—	—	—	9	17	12	—	—
Face powders	1	—	—	—	—	—	1	—	—
Makeup foundations	9	—	—	—	—	6	2	1	—
Lipstick	640	—	—	—	13	121	382	124	—
Makeup bases	6	—	—	—	—	2	2	1	1
Other makeup preparations (not eye)	17	—	1	—	—	3	12	1	—
Cuticle softeners	1	—	—	—	—	1	—	—	—
Nail creams and lotions	1	—	—	—	—	—	1	—	—
Skin cleansing preparations (cold creams, lotions, liquids, and pads)	12	—	—	—	—	1	6	5	—
Face, body, and hand skin care preparations (excluding shaving preparations)	10	—	—	—	3	1	5	1	—
Moisturizing skin care preparations	8	—	—	—	1	3	3	1	—
Night skin care preparations	7	—	—	—	1	3	2	1	—
Other skin care preparations	4	—	—	—	2	2	—	—	—
1976 TOTALS	868	—	1	9	56	189	471	141	1
1979 TOTALS	899	13	1	4	67	138	591	84	1

Data from Refs. 16, 20.

Paraffin imparts stiffness to cosmetic preparations and forms the solid portion of stick cosmetics. It holds the oil phase of lipsticks and forms emulsions. It is also used as the wax component of depilatories.[4,5,15,90]

Cosmetics containing Paraffin may be applied to the body surface from several times per day, as in fragrance and skin care preparations, to a few times per month, as in hair coloring preparations. It may remain on the body for a few hours in colognes or toilet waters, or for several days in hair conditioners.[16,20]

The 1976, FDA data on cosmetic ingredients list Paraffin in 1,208 uses; in 1979 it had 945 uses. Its concentration of use ranges from less than 0.1% in some facial makeup, to up to 50% in eye and facial makeups and fragrance preparations (see Table 11).[16,20]

BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Oral toxicity

Doses of 5 g/kg of a 75% and a 100% sample of Paraffin were not lethal to six and five rats, respectively.[91,92]

A dose of 25 ml/kg of an undiluted, melted eye shadow formulation containing 5% Paraffin was administered to four adult beagle dogs. No deaths occurred and no abnormal behavior developed during the subsequent 14 days; no abnormalities were found at necropsy.[93] The same compound was given to 10 albino Wistar rats in 60 ml/kg doses. One animal died on Day 4. The remaining nine animals were normal and survived to the end of the experiment on Day 14.[94]

Doses of 10 ml/kg of three eye shadow products containing 8% Paraffin, and a 5 ml/kg dose of a foot care cream containing 16% Paraffin were intubated into five albino rats per product. None of the 20 animals died in seven days[95-98] (see Table 12).

Skin irritation

Raw Paraffin, solutions, and formulations containing Paraffin were patch tested on the clipped, intact skin of nine rabbits each (only six animals were used in one test). They were applied in 0.5 ml volumes by either open or closed patches for three repeated applications. The patches were removed after 24 h, and the sites were inspected immediately and at 72 h after the application. The results were scored according to the Draize method with a maximum PII score of 8.0. The results are shown in Table 13 and may be summarized as follows.

A sample of 100% Paraffin Wax was applied full strength under a single, closed patch to the skin of nine rabbits. No irritation developed.[99]

Three samples of 50% Paraffin in petrolatum were tested in repeated, open patch applications to six rabbits. Two samples produced erythema in four animals that lasted three days,[100,101] and one produced erythema in one rabbit that lasted two days.[91]

Four eye shadow cream formulations containing 8% Paraffin were tested using closed and open patches. The tests were repeated three times. The closed patches produced PIIs of 3.66 and 3.33 (potential for severe irritation), 2.33 (poten-

TABLE 12. Acute Oral Toxicity: Paraffin.

Wax conc. (%)	*Dose of test mixture/kg*	*Solution or formulation*	*Species and number*	*LD_{50}/kg material*	*LD_{50}/kg Wax*	*Comments*	*Ref.*
75	5 g	corn oil solution	6 rats	—	—	No deaths.	91
100	5 g	Pure	5 rats	>5 g	>5 g	—	92
5.0	25 ml	Formulation-eye shadow	4 beagle dogs			Single dose. 14-day observation period. No deaths or abnormalities. LD_{50} not reached.	93
5.0	60 ml	Formulation-eye shadow	10 albino Wistar rats			Single dose. 14-day observation period. One animal died on Day 4; findings included urinary staining of abdomen; intestines filled with red fluid. No other animals affected.	94
8.0	10 g	Formulation-eye cream	5 albino rats			No deaths	95
8.0	10 g	Formulation-eye cream	5 albino rats			No deaths	96
8.0	10 g	Formulation-eye cream	5 albino rats			No deaths	97
16.0	5 g	Formulation-foot care cream	5 albino rats			No deaths	98

TABLE 13. Acute Dermal Irritation/Toxicity: Paraffin.

Wax conc. (%)	*Dose of test subst./kg*	*Petrolatum solution or formulation*	*No. of albino rabbits*	*Primary irrit. score* / *Max. score*	*Contact time (h)*	*Observ. time (h)*	*Comments*	*Ref.*
Irritation								
50	0.5 ml	Solution	6	—	24	72	Erythema in 4 animals to Day 3	100
50	0.5 ml	Solution	6	—	24	72	Erythema in 4 animals to Day 3	101
50	0.5 ml	Solution	6	—	24	72	Erythema in 1 animal to Day 2	91
100	0.5 ml	Pure	9	0.0	24	72	No irritation	99
8.0	0.5 ml	Formulation-eye shadow	9	3.66/8.0	24	72	Severe irritation	95
8.0	0.5 ml	Formulation-eye shadow	9	3.33/8.0	24	72	Severe irritation	96
8.0	0.5 ml	Formulation-eye shadow	9	2.33/8.0	24	72	Moderate irritation	97
8.0	0.5 ml	Formulation-eye shadow	9	0.17/8.0	24	72	Minimal irritation	102
15	0.5 ml	Formulation-foot cream	9	0.61/8.0	24	72	Minimal irritation	103
16	0.5 ml	Formulation-foot cream	9	0.95/8.0	24	72	Minimal irritation	98
16	0.5 ml	Formulation-foot cream	9	1.06/8.0	24	72	Mild irritation	104
16	0.5 ml	Formulation-foot cream	9	1.22/8.0	24	72	Mild irritation	105
Toxicity								
50	4 ml	Solution	—	—	24	—	No systemic effects	91

tial for moderate irritation), and 0.17 (potential for minimal irritation).[95-97,102] The open patch tests of three of these same products produced PIIs of 0.0, 0.0, and 0.17.[95-97]

A single, open insult patch using a foot cream containing 15% Paraffin produced a PII of 1.61 (potential for minimal irritation).[103]

A single, closed insult patch of three foot cream formulations containing 16% Paraffin caused PIIs of 0.95 (potential for minimal irritation), 1.06 and 1.22 (potential for mild irritation).[98,104,105]

Dermal toxicity

The acute dermal toxicity of 50% Paraffin in petrolatum was tested in rabbits (number not given). A dose of 4 ml/kg, applied under a closed patch for 24 h, produced no systemic effects, and no abnormalities were observed at necropsy[91] (see Table 13).

Ocular irritation

Four 50% solutions of Paraffin in petrolatum were each instilled into the eyes of six albino rabbits with no rinse. Eyes were observed for irritation for three days. Two of the samples caused mild irritation in one rabbit on Day 1;[91,101] the other samples were not irritating.[99,100]

A 0.1 ml volume of an eye shadow product containing 5% Paraffin was instilled into the left eyes of six rhesus monkeys. Three treated eyes were washed with 20 ml warm tap water 30 sec after instillation. Observations up to 72 h after instillation showed no signs of irritation or corneal damage.[106]

Another eye shadow formulation containing 5% Paraffin tested similarly caused no irritation or damage to the treated eyes of six monkeys.[106] A 0.1 ml volume of the sample was instilled into one eye of each of nine albino rabbits; in three, the treated eyes were washed 30 sec after instillation with 20 ml of deionized water. The eyes were inspected at 24, 48, and 72 h, and after four and seven days. Minimal conjunctival redness occurred in four of six animals with unwashed eyes 48 h after instillation. Two of three animals with irrigated eyes showed minimal conjunctival redness after 48 h.[107]

Four eye shadow products containing 8% Paraffin were each instilled full strength, with no rinse, into the eyes of six albino rabbits. Eyes were observed for irritation for three days. Three formulations caused mild irritation at 24 h in one rabbit, and the fourth caused mild irritation after 48 h in one rabbit.[95-97,102]

A foot cream containing 15% Paraffin, tested as above, caused mild irritation in three of six animals at Day 1.[103]

Two foot care formulations with 16% Paraffin were also similarly tested, one causing mild irritation in one animal at 48 h,[98] and the other causing irritation in two rabbits at 24 h[104] (see Table 14).

Subchronic

Dermal toxicity

An eye shadow formulation containing 8% Paraffin was applied daily, five days per week for 13 consecutive weeks, to groups of female albino rats at "exaggerated dosage levels" of at least 100 times the normal human use concentration. The compound produced neither systemic toxic effects nor abnormal cumulative dermal effects.[108]

TABLE 14. Ocular Irritation: Paraffin.

Wax conc. (%)	*Dose*	*Solution/ formulation*	*Species and number*	*Observ. time (days)*	*Comments*	*Ref.*
50	0.1 ml	Solution	6 albino rabbits	3	Mild irritation in 1 rabbit at 24 h	91
50	0.1 ml	Solution	6 albino rabbits	3	Mild irritation in 1 rabbit at 24 h	101
50	0.1 ml	Solution	6 albino rabbits	3	No irritation	99
50	0.1 ml	Solution	6 albino rabbits	3	No irritation	100
5	0.1 ml	Formulation-eye shadow	6 rhesus monkeys	7	No irritation	109
5	0.1 ml	Formulation-eye shadow	6 rhesus monkeys	7	No irritation	109
5	0.1 ml	Formulation-eye shadow	9 albino rabbits	7	Minimal conjunctival redness in 4/6 with unwashed eyes and 2/3 with washed eyes to 48 h	107
8	0.1 ml	Formulation-eye shadow	6 albino rabbits	3	Mild irritation in one rabbit at Day 1	95
8	0.1 ml	Formulation-eye shadow	6 albino rabbits	3	Mild irritation in one rabbit at Day 1	96
8	0.1 ml	Formulation-eye shadow	6 albino rabbits	3	Mild irritation in one rabbit at Day 1	97
8	0.1 ml	Formulation-eye shadow	6 albino rabbits	3	Mild irritation in one rabbit at 48 h	102
15	0.1 ml	Formulation-foot cream	6 albino rabbits	3	Mild irritation in 3/6 rabbits at Day 1	103
16	0.1 ml	Formulation-foot cream	6 albino rabbits	3	Mild irritation in 1 at 48 h	98
16	0.1 ml	Formulation-foot cream	6 albino rabbits	3	Mild irritation in 2 at 24 h	104

Special Studies

Carcinogenicity

Tumorigenicity: The tumorigenic properties of Paraffin and its intermediate products were studied in mice, rats, and rabbits. Paraffin, in distillate, filtrate, oil, raw, and purified forms, was applied repeatedly to the skin of the mice and rabbits and subcutaneously to the rats. After nine months, the distillate caused hyperkeratosis, followed by the development of benign papillomas in nearly all animals. The tumorigenic effects decreased according to the sequence of Paraffin products listed above, with pure Paraffin being practically without effect. The tumorigenic effect of raw petroleum is not attributable to Paraffin, but rather to its intermediate products.[110]

Five petroleum waxes were tested for carcinogenicity by repeated skin application of a 15% mixture in benzene, as well as in a year-long feeding study in rats. In neither test were the waxes positive for carcinogenic activity.[111]

Bladder Cancer: Chapman et al.[112] surgically implanted pellets of Paraffin waxes as artificial stones into rat bladder with prepared pouches and reported that the presence of urine was necessary for tumor induction. The investigators suggested that the pellets have a possible cocarcinogenic effect. They stressed, however, that the calculi growing around the pellets were the reason for the tumor enhancing effect. Studies by Ball et al.,[113] Bonser et al.,[114,115] Allen et al.,[116] and Podilchak[117] demonstrated also that foreign objects including Paraffin and glass beads may lead, by local irritation, to tumors in the urinary bladder of mice and rats. Clayson[118] concluded that "if a foreign body in the presence of urine is all that is needed for tumor formation in the rat or mouse urothelium, chemicals provoking urinary calculus formation need careful scrutiny before being accepted as directly carcinogenic" (or tumorigenic).

Jull[119] also studied the effects of Paraffin implants as carriers of carcinogenic chemicals in the mouse bladder. The author concluded that even though tumors may be produced by foreign bodies alone, the effect was not unique to Paraffin. These findings then are analogous to the induction of sarcomas by subcutaneous implants of various waxes and other inert materials.[111]

Clinical Assessment of Safety

Intradermal effects

A mixture of liquid and solid Paraffin injected into the breasts for cosmetic purposes caused foreign body granuloma and calcification.[110] Similar effects occurred after injection into the penis, scrotum, bridge of nose, cheeks, and eyelids.[120]

Skin Irritation/Sensitization

The results of these tests are summarized in Table 15.

Single 24-hour patch test

The acute irritation to human skin by Paraffin and products containing Paraffin was tested by the patch test method. A single insult of the material was applied under occlusion for 24 h to the forearm or the upper back. Readings were taken immediately after patch removal.

TABLE 15. Clinical Data: Paraffin.

TEST						
Wax conc. (%)	*Pure or formulation*	*No. of subjects*	*Days on test*	*PII/ Max. score*	*Comments*	*Ref.*
24-h patch test						
100	Pure	20	1	—	1/20 barely perceptible erythema	121
100	Pure	20	1	—	1/20 pink uniform erythema	122
8	Formulation-unspecified	18	1	0	No irritation	125
8	Formulation-unspecified	19	1	0	No irritation	123
8	Formulation-unspecified	20	1	0	No irritation	124
15	Formulation-foot cream	19	1	0	No irritation	126
16	Formulation-foot cream	17	1	0.15	1/17 had mild pink erythema	127
16	Formulation-foot cream	18	1	0.24	2/18 pink-red erythema	128
16	Formulation-foot cream	18	1	0.75	9/18 pink to pink-red erythema	129
16	Formulation-foot cream	10	1	0.35	—	130
Repeat insult patch test						
15	Formulation-smoothing cream	48	—	0	No reactions	131
Maximization test						
5	Formulation-eye shadow	25	—	0	No irritation or contact sensitization	132
5	Formulation-eye shadow	30	—	0	No irritation or contact sensitization	133
5	Formulation-eye shadow	29	—	0	No irritation or contact sensitization	134
21-day cumulative irritancy test						
5	Formulation-eye shadow	10	21	18/630	Essentially nonirritating	106
In-use test						
5	Formulation-eye shadow	187	14	0	No irritation from use	135

Two samples of 100% Paraffin were patch tested on 20 people per sample. The first caused barely perceptible erythema in one person. All others were negative.[121] The second caused uniform erythema in one of 20 subjects.[122]

Three formulations containing 8% Paraffin produced no irritation in panels of 18, 19, and 20 people.[123-125]

A formulation containing 15% Paraffin produced no irritation in 19 panelists.[126]

Four products containing 6% Paraffin were tested. One formulation produced a mild erythema over the test sites in one of 17 subjects.[127] A second formulation caused erythema in 2 of 18 subjects.[128] The third formulation caused erythema in nine (PII = 0.75).[129] The fourth product had an irritation score of 0.35 out of a possible maximum score of 40.[130]

Repeated insult patch test

A repeated insult patch test on a formulation containing 15% Paraffin was conducted on 48 panelists. The undiluted formulation was applied under occlusion to the skin of the back or the arm every other day for a total of 9–15 induction results. After a rest of 10–21 days, a challenge patch was applied to an adjacent, untreated site. Reactions were scored immediately after patch removal, and after 24, 48, and 72 hours this formulation caused no irritation and no sensitization in the 48 panelists.[131]

Maximization test

The contact sensitization of a formulation containing 5% Paraffin was tested on three different panels of 25, 30, and 39 people. The material was applied under occlusion to the same site on the volar forearm of all subjects for five 48 h periods. The patch sites were pretreated for 24 h with 2.5% aqueous sodium lauryl sulfate under occlusion. A challenge patch was applied after a 14-day rest and the sites were read on removal of the patch and 24 h thereafter. No irritation and no sensitization were observed.[132-134]

21-day cumulative irritancy test

A 21-day cumulative irritancy test of a formulation containing 5% Paraffin was conducted on 10 people. Patches containing the material were applied daily to the same site on the backs of each panelist for four consecutive days. The patches remained in contact with the skin for 23 h and scores were read just before the next patch application. There was a score of 18 out of a maximum possible irritation score of 630 indicating that the formulation was nonirritating.[106]

In-use test

An in-use test of a product containing 5% Paraffin was conducted to determine irritancy on 187 women. After two weeks of daily use there was no irritation.[135]

MICROCRYSTALLINE WAX: CHEMICAL AND PHYSICAL PROPERTIES

Structure/Composition

Microcrystalline Wax, like Paraffin, is a distillation product of crude petroleum; however, this wax is distinctly different from Paraffin.[1,2] The name "micro-

crystalline" refers to the small, needle-like crystalline manifestations of the hydrocarbons in the wax. These crystals consist of long-chain, saturated hydrocarbons of high molecular weight. The molecules possess from 41 to 50 carbon atoms, with respective molecular weights of 580–700 mass units.[1,2,6,90,136]

Properties

Microcrystalline Wax is a tough, flexible substance, with a high tensile strength and melting point, and a high penetration value and refractive index. It is adhesive (tacky), nonlustrous, somewhat greasy, plastic, and tends to flow under compression. This wax is compatible with other mineral waxes and with most vegetable waxes and resins.[1,2,4-6,15,90,136] See Table 10 for specific properties.

Reactivity

No information was available.

Refining and Analytical Methods

Microcrystalline Wax is separated from the residue of crude petroleum left in the still after distillation and removal of the oil fraction containing Paraffin. The residue also contains heavy residual lubricating oil and asphalt. The asphalt is removed by treatment with concentrated sulfuric acid. The residue may then undergo one of several dewaxing processes, which involves dilution with organic solvents, chilling, and centrifugation to remove the wax. The oil is then removed by further organic solvent dilution, heating and filtering. The oil content of refined wax may vary from 2% to 12%.[1,2,136]

The analytical methods used to determine the composition of Microcrystalline Wax include the following. Differential thermal analysis and molecular sieving procedures determine the total amount of normal paraffins in the wax and the solid hydrocarbons can be studied by differential thermal analysis; gas and gel permeation chromatography may also be used to determine the chain length of major constituents and the overall carbon chain number.[137-139]

Impurities

The natural hydrocarbon waxes may contain traces of benzopyrenes,[140] acids or alkalies, sulfur compounds, heavy metals, and arsenic.[1,2,6]

USES

Noncosmetic Uses

Microcrystalline Wax is used in electrical insulation, waterproofing paper, box-board, textiles, leather and wood polish, and laminating paper and cloth, in rubber compounding, pattern making, binding for pipe covering, filter for packing, as a moulding wax base, and in miscellaneous polishes.[1,2,6]

Purpose and Use in Cosmetics

The cosmetic uses of Microcrystalline Wax include facial and eye makeup preparations, fragrance products, coloring and noncoloring hair care preparations, manicuring products and skin care preparations.[1,2,4-6,15,90]

In cosmetics, Microcrystalline Wax imparts firmness to makeup, fragrance products, hair grooming products, lipsticks, and solid stick-form deodorants.[15,90]

Microcrystalline Wax may come into contact with the face, hands, and general body surface, around the eyes, scalp, and hair.[16,20]

The 1976 FDA submission of cosmetic data reports Microcrystalline Wax in 868 formulations; the 1979 formulation data list 889 uses. It is used in concentrations of less than 0.1% in some preparations, and greater than 50% in others. The wax may be in contact with the body for several hours daily as in fragrance and makeup preparations, to several continuous days, as in hair conditioners[16,20] (see Table 11).

BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Oral toxicity

A 20% Microcrystalline Wax–corn oil suspension was given by stomach tube to five groups of five albino rats. Each group received doses of either 0.464, 1.0, 2.15, 4.64, or 10.0 g/kg. After 14 days, the rats in the 0.464, 1.00, 2.15 and 4.64 g/kg dosage groups remained normal, but those in the 10 g/kg group showed progressive excessive salivation, decreased righting and placement reflexes, bloody discharges around the nose and mouth, unkempt hair and coats, and diarrhea; in the latter part of the observation period they were emaciated. Necropsy findings of the animals of the first four dosage groups were negative for abnormalities. Rats ingesting 10.0 g/kg showed congestion of lungs and kidneys, hyperemia of the large and small intestines, and solid wax in the stomach. No animals died from administration of the four lower dosage levels, but three died in the highest dose group. The LD_{50} was estimated to be approximately 10 g/kg.[141]

The acute oral toxicity of a blusher formulation containing 4.35% Microcrystalline Wax was tested on five male and five female Sprague–Dawley rats. A 25 g/kg dose, administered by gavage, produced neither toxic effects nor deaths.[142]

Skin irritation

A single 0.5 g application of 100% Microcrystalline Wax administered to the intact and abraded skin of six albino rabbits for 24 h caused slight erythema and edema in intact and abraded sites. The PII was 0.48 out of a possible maximum score of 8.0.[143]

Three 0.5 g applications of a blusher product containing 4.35% Microcrystalline Wax were made at 24 h intervals under open patch conditions to intact and abraded skin of six New Zealand rabbits. After the third application, the intact sites of three animals and the abraded site of one animal had mild erythema. The product was considered to be practically nonirritating to the skin of rabbits.[142]

Ocular irritation

A 0.1 g sample of 100% Microcrystalline Wax was applied to the left eye of each of six albino rabbits and the right eye was left untreated. After 24, 48, and

72 h, five of the six animals showed no irritation. One animal showed slight conjunctival erythema and edema after 24 h.[144]

A 0.1 g volume of blush formulation containing 4.35% Microcrystalline Wax was instilled in one eye of each of six New Zealand white rabbits. After 72 h, all animals were free from irritation.[142]

A 0.1 ml volume of a lipstick containing 15% Microcrystalline Wax was instilled into one eye of each of nine albino rabbits. Three of the treated eyes were washed with 20 ml of water 30 sec after treatment. After 24, 48, and 72 h and four and seven days, both washed and unwashed eyes had an irritation score of 3.3 out of a possible 110, indicating that the compound was a nonirritant.[145]

Clinical Assessment of Safety

Skin Irritation/Sensitization

The results of these tests are summarized in Table 16.

Modified Draize–Shelanski–Jordan patch test

A blusher product containing 4.35% Microcrystalline Wax, when applied under occlusion to the skin of 205 men and women, caused mild erythema in three persons. The author concluded that the irritant reactions were insignificant.[142]

21-day cumulative irritancy test

Microcrystalline Wax, tested in a 21-day cumulative irritancy test on eight subjects, produced no irritation.[146]

A lipstick formulation containing 15% (0.3 ml) Microcrystalline Wax was applied under occlusion to the backs of 10 subjects. After 23 h, the patches were removed, the sites evaluated, and the next patch was applied. After testing for 21 days, the formulation produced an irritation score of 130 out of a possible 630. This score indicates a slight potential for mild cumulative irritation under these test conditions.[147]

Maximization test

A lipstick formulation containing 15% (0.3 g) Microcrystalline Wax was applied under occlusion to the volar forearm surface of 25 subjects for five consecutive 48 h periods. After a rest of 10 days, an adjacent untreated site was pretreated with 10 percent sodium lauryl sulfate for 1 h, and then a patch of the test material was applied to the challenge site for 48 h under occlusion. This material caused no contact sensitization immediately after patch removal or 24 h later.[148]

Phototoxicity test

A lipstick formulation containing 15% Microcrystalline Wax was applied under occlusion to the lower backs of 10 panelists for 24 h. The patches were then removed and the sites were irradiated for 12 min with filtered light from a Xenon Arc Solar Simulator emitting in the range of 320–400 nm. An untreated site was also irradiated as a control. After 24 and 48 h, both test and control sites showed minimal reactions. This product did not produce phototoxicity.[149]

A similar test of a blusher formulation containing 4.35% Microcrystalline Wax produced no reaction in the 26 men and women tested.[142]

TABLE 16. Clinical Data: Microcrystalline Wax.

TEST							
Wax conc. (%)	*Dose*	*Pure or formulation*	*No. of subjects*	*Days on test*	*PII*	*Comments*	*Ref.*
Modified Draize–Shelanski–Jordan patch test							
4.35	—	Formulation-blusher	205	—	1+1 and 2+2 reactions	1+1 reaction of mild, pink, uniform erythema 2+2 reactions of pink to red erythema	142
21-day cumulative irritancy test							
100	—	Pure	8	21	0.0/4	No irritation	146
15	0.3 ml	Formulation-lipstick	10	21	130/630	Slight potential for very mild cumulative irritation	147
Maximization test							
15	0.3 g	Formulation-lipstick	25	22	0/5	No instances of contact sensitization	148
Phototoxicity test							
4.35	—	Formulation-blusher	26	—	—	No reactions. Product exhibits no indication of phototoxicity or photoallergenicity	142
15	—	Formulation-lipstick	10	3	—	Minimal reaction. No greater than the reaction to light alone, not phototoxic	149
In-use test							
4.35	—	Formulation-blusher	26	—	—	Safe for intended use	142

In-use test

A blusher containing 4.35% Microcrystalline Wax caused no reactions in the 26 men and women using it.[142]

SYNTHETIC WAXES
EMULSIFYING WAX N.F.: CHEMICAL AND PHYSICAL PROPERTIES

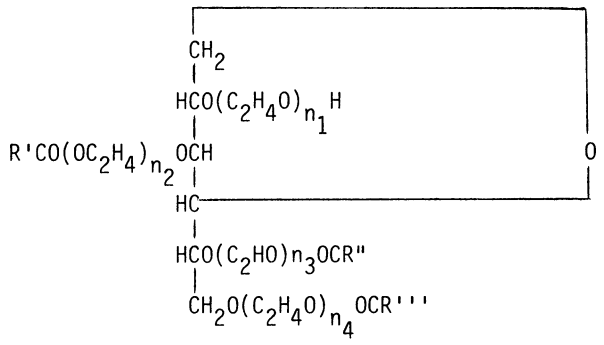
Structure/Composition

Emulsifying Wax is wax manufactured from a mixture of cetyl and stearyl alcohol and polyoxyethylene derivatives of fatty acid esters of sorbitan:

1. $C_{16}H_{33}OH$
   Cetyl Alcohol

2. $C_{18}H_{37}OH$
   Stearyl Alcohol

3.



R', R",R''' = Fatty radicals

$n_1+n_2+n_3+n_4$ = N = total moles of ethylene oxide.

The method of manufacture is confidential.[150]

Properties

The properties of Emulsifying Wax N.F. are listed in Table 17.[150,151] This is a creamy-white solid with a characteristic odor, soluble in most hydrocarbon solvents, ether, chloroform and alcohol, and insoluble in water.[151]

Analytical Methods

The National Formulary[151] lists the methods to determine the melting range, pH, and saponification and sodium value of Emulsifying Wax N.F. Thin-layer, column, and gas–liquid chromatography are used to characterize the various synthetic waxes.[152]

TABLE 17. Properties: Nonnaturally Occurring Waxes.

Properties	*Emulsifying Wax N.F.*	*Ref.*	*Synthetic Wax*	*Ref.*	*Synthetic Beeswax*	*Ref.*
Melting range	48°–52°C	151	52°–74°C	153	60°–67°C	154
Congealing point			94°–98°C	153		
pH (at 2.9% w/w dispersion)	5.5–7.0	151				
Saponification value	14.0 Max.	151				
Iodine value	3.5 Max.	151			15 Max.	154
Hydroxyl value	178–192	151			25 Max.	154
Soluble in	Ether	151			Chloroform	154
	Chloroform				Volatile silicone	
	Alcohol				Fixed oils	
	Most hydrocarbons		Cold alcohol			

USE

Noncosmetic Uses

Emulsifying Wax N.F. is used as a pharmaceutic aid, an emulsifying agent and a stiffening agent.[151]

TABLE 18. Product Formulation Data.

Product category	*Total no. containing ingredient*	*No. of product formulations within each concentration range (%)*							
		Unreported concentration	*>50*	*>25–50*	*>10–25*	*>5–10*	*>1–5*	*>0.1–1*	*≤0.1*
Emulsifying Waxes									
Skin care preparations	12	—	—	—	—	7	3	2	—
1979 TOTALS	12	—	—	—	—	7	3	2	—
Synthetic Wax									
Blusher	1	—	—	—	—	—	1	—	—
Foundation	1	—	—	—	—	—	1	—	—
Lipstick	3	—	—	—	—	2	1	—	—
1981 TOTALS	5	—	—	—	—	2	3	—	—
Synthetic Beeswax									
Eye shadow	119	—	—	—	—	—	—	119	—
Blushers (all types)	14	—	—	—	—	—	—	14	—
Face powders	10	—	—	—	—	—	—	10	—
Makeup foundations	1	—	—	—	—	—	1	—	—
Rouges	2	—	—	—	—	—	2	—	—
1976 TOTALS	146	—	—	—	—	—	3	143	—
1979 TOTALS	108								

Data from Refs. 16, 20, 155.

Cosmetic Uses

Emulsifying Wax N.F. is an emulsifying and stiffening agent in cosmetics. The 1976 FDA data report that it has 12 uses, and the 1979 voluntary submission of data to the FDA reports two uses in concentrations of >0.1%–1%, three uses in concentrations of >1%–5%, and seven uses in concentrations of >5%–10%[20] (see Table 18).

BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Oral toxicity

The acute oral toxicity of Emulsifying Wax N.F. was studied in rats. Forty and 50% suspensions, and formulations containing 8%–8.5% were tested; the LD_{50} of the wax was greater than 7.9 g/kg. Methods and results are presented in Table 19.

Ocular toxicity

The ocular irritation of Emulsifying Wax N.F. was studied in rabbits according to the Draize method. For concentrations of 100%, 5.0%, and 2.5% (raw ingredient), and 8%–8.5% for Emulsifying Wax N.F. formulations, only very mild irritation was reported. See Table 20 for results and methods.

Dermal irritation

Emulsifying Wax N.F. as a raw ingredient and in formulations was tested on rabbits by the Draize method for dermal irritation. Concentrations of 50% and 100% of one sample of an Emulsifying Wax N.F. were applied with and without occlusion. The mixtures of wax and water caused no irritation to very mild irritation (PII = 0.0–1.4). A different sample of Emulsifying Wax N.F. was tested in a similar manner at concentrations from 2.5% to 25% and produced only very mild irritation (PII = 0.3, 0.4, and 0.5). Irritation was reported for the formulations containing 8.0% wax with PIIs of 3.0 and 2.8. See Table 21 for methods and results.

Clinical Assessment of Safety

Skin Irritation/Sensitization

Patch testing

Patch tests of Emulsifying Wax N.F. were conducted on one solution of the raw ingredient and on two formulations. A concentration of 10% wax in peach kernel oil produced no irritation in 98 subjects.[156] A formulation containing 8.0%, and another 8.5% wax produced no irritation in the 101 and 100 subjects, respectively[157,158] (see Table 22).

Repeated insult patch test

An Emulsifying Wax N.F. solution, 15% in avocado oil, was applied to 52 subjects for 48 h under occlusion, for a total of 10 applications. Sites were graded

TABLE 19. Acute Oral Toxicity: Emulsifying Wax N.F.

Conc. (%)	Dose/kg of test Solution	Pure/ Solution/ Formulation	Species and No.	Route	LD_{50}/kg	Comments	Ref.
25	12.5 g 15.6 g 18.75 g 21.85 g	Solution in corn oil	CFW Carworth farm mice-10	Single dose-oral intubation	15.0 g	95% confidence limits of 12.0 to 18.75 g/kg of test solution.	159
25	40 ml	Solution	Albino rats-10	Single oral dose	>10 ml	25% solution of wax. LD_{50} of solution is >40 ml/kg and of wax is >10 ml/kg. Responses included slight depression in 5/10 animals for first 6 hrs after dosing. 14-day observation, 0/10 dead.	160
40	40 ml solution = 16 ml wax	40% suspension in corn oil	CFY rats-10	Single dose-oral intubation	>16 ml	No deaths. Reactions afer dosing included slight lethargy, decreased respiratory rate, hunched posture. Animals normal within 8 days. Body weights and autopsy normal.	161
50	15.8 g	50% suspension	Sprague-Dawley rats-5	NA[a]	>7.9 g	50% suspension of wax in oil. LD_{50} of suspension is >15.8 g/kg and of wax is >7.9 g/kg.	162
8.0	14.7 g	Formulation-skin cream	Sprague-Dawley rats-5	NA		Dose of product was 14.7 g/kg. 8% of product is wax. LD_{50} was not reached.	163
8.0	7.0 ml	Formulation-moisture cream	Harlan-Wistar rats-10	Single dose by gavage		Fasted rats. No deaths or signs of toxicity were observed during the two-week study. 8% of dose is wax; LD_{50} was not reached.	164
8.5	14.7 g	Formulation-skin cream	Sprague-Dawley rats-5	NA		8.5% of dose is wax. No deaths.	165

[a] NA = Not available.

TABLE 20. Ocular Toxicity: Emulsifying Wax N.F.

Conc. (%)	*Dose*	*Pure or formulation*	*No. of rabbits*	*Comments*	*Ref.*
2.5	0.1 ml	Solution	9	Draize scoring. No wash in 3 animals; wash after 30 sec in 3 rabbits; wash after 4 sec in 3 rabbits. Draize score of 0.0 in all rabbits at all times.	166
5.0	0.1 ml	Solution	9	Draize scoring. No wash in 3 animals; wash after 30 sec in 3 animals; wash after 4 sec on 3 animals. Draize score of 0.0 in all rabbits at all times.	167
100	0.1 ml = 59 mg	Pure	5	16 CFR 1500.42 Method. 14-day observation. Mild redness to Day 2 in 4/5 which persisted to Day 7 in 1 of these 4 rabbits. No irritation in 1/5. Negative result for eye irritation.	168
100	0.1 ml = 25 mg	Pure	6	21 CFR 191.1; 191.12 Method. Observed for 3 days. Compound produced very mild conjunctival irritation in 2/6 rabbits which cleared by Day 2.	169
100	0.1 ml	Pure	3	Mild conjunctival irritation which cleared by Day 2.	162
8.0	0.1 ml	Formulation-moisturizing cream	3	Draize Method. No irritation in cornea or iris. Minimal conjunctival irritation. Eye normal on Day 3.	170
8.0	0.1 ml	Formulation-moisturizing cream	6	Reactions scored after 1 h and after 1, 2, 3, and 7 days. Slight conjunctival hyperemia occurred in 4/6 animals. All normal in 24–48 h.	171
8.0	0.1 ml	Formulation-moisturizing cream	6	Reactions scored after 1 h and 1, 2, 3, and 7 days. Slight conjunctivitis in 4/6 animals 1 h after treatment. All normal at 24 h.	171
8.5	0.1 ml	Formulation-moisturizing cream	3	Draize Method. No irritation.	158

TABLE 21. Dermal Irritation: Emulsifying Wax N.F.

Conc. (%)	*Dose*	*Solution/ formulation*	*No. of albino rabbits*	*Route*	*PII*	*Comments*	*Ref.*
2.5	0.5 ml	Water solution	6	Single application occlusion	0.3	Wax was melted and dissolved in water. Observation at 24 h showed mild redness. No irritation at 72 h.	172
5.0	0.5 ml	Water solution	6	Single application; abraded and intact	0.4	Occluded patch test of wax showed mild redness at 24 h. Wax melted and dissolved in water.	173
25	0.5 ml	Water solution	6	Single application; abraded and intact	0.5	Irritation scored after 24 and 48 h. Mild redness at 24 h. Wax melted and dissolved in water.	174
50	NA[a]	Solution	6	Clipped flanks of each animal	1.4	50% solution in corn oil under occlusion.	162
100	0.5 g in 0.5 ml water	Solution	6	Clipped intact and abraded skin of flank	<0.1	0.5 g wax mixed with 0.5 ml distilled water applied to clipped, abraded and intact skin. Very slight erythema observed in intact skin of 1/6 at 24 h only. No other irritation.	175
100	0.5 g in 0.5 ml water	Solution	6	Clipped intact and abraded skin of flank	0.0	0.5 g wax applied to each intact and abraded area under occlusion for 24 h. Skin evaluated after 24 and 48 h. No irritation.	176
100	0.5 g in distilled water	Solution	6	Clipped intact and abraded skin of flank	0.0	0.5 g wax applied to intact and abraded skin for 24 h. No irritation seen at observation times of 24 and 48 h.	177
8.0	0.5 ml	Formulation-moisturizing cream	3	Clipped flanks of each animal	2.8	4 daily applications. Irritation evaluated daily for 7 days. Slight erythema at 24 h. Erythema and edema at 3 days. Mild desquamation at 7 days.	171
8.0	0.5 ml	Formulation-moisturizing cream	3	Clipped flanks of each animal	3.0	7 daily applications. Irritation evaluated daily for 7 days. Erythema at 24 h. Erythema and edema at 3 days. Desquamation at 7 days.	171

[a] NA = Not available.

TABLE 22. Clinical Data: Emulsifying Wax N.F.

TEST							
Wax conc. (%)	Dose	Pure/ solution/ formulation	No. of subjects	Days on test	Irrit. Score Max. score	Comments	Ref.
Patch test							
10.0	NA[a]	Solution in peach kernel oil	98	—	0	No irritation	156
8.0	NA	Formulation-moisturizing lotion	101	—	0	No irritation	157
8.5	NA	Formulation-moisturizing cream	100	—	0	No irritation	158
Repeated insult patch test							
15	NA	Solution	52	—	—	Neither irritation or sensitization	162
100	0.5 g	Pure	50	—	0.0/8.0	Neither irritation or sensitization	178
8.0	0.2 ml	Formulation-moisturizer	10	20	2/630	"Mild Material"	179
8.0	NA	Formulation-moisturizer	110	34	NA	No primary irritation; no sensitization.	180
8.0	NA	Formulation-moisturizer	205	6 weeks	NA	One subject developed erythema and edema. Essentially nonirritating.	181
8.0	NA	Formulation moisturizer	108	—	—	Neither irritation or sensitization	182
8.0	NA	Formulation moisturizer	152	—	—	Neither irritation or sensitization	183
8.0	NA	Formulation moisturizer	189	—	—	Neither irritation or sensitization	184

[a]NA = Not Available

immediately after patch removal. After a two-week nontreatment period, a challenge application caused neither primary skin irritation nor allergic sensitization.[162]

A 0.5 g amount of undiluted Emulsifying Wax N.F. tested as above on 50 people scored 0.0 out of a maximum possible score of 8.0.[178]

A moisturizing product containing 8% Emulsifying Wax N.F. was evaluated in 110 women. Patches impregnated with the material were affixed to the alcohol-cleansed backs for 10 repeated 48 h patches. Reactions were observed immediately after patch removal. A challenge was applied 14 days after the last patch was removed. No primary irritation occurred after the removal of the 48 h patch, and no sensitization occurred after the 14-day challenge.[180]

Four other repeated insult patch tests were carried out on formulations containing 8.0% Emulsifying Wax N.F. One test used 231 subjects, only 205 of whom completed the study. Patches impregnated with a 0.1 g sample of the product were attached to the upper back or flexor arm for 24 h. The procedure was repeated nine times. A tenth and final 48 h patch was applied to the test site and to a fresh site, and inspected 48 and 72 h after application. Only one of the 205

people developed erythema and edema, but this subject had developed "irritation" from cosmetics in the past. No other reaction occurred.[181]

Three 8.0% wax formulations were tested with the modified Draize–Shelanski procedure on 108, 152, and 189 subjects, respectively. None of the three test products was a primary irritant or a contact sensitizer[182-184] (see Table 22).

Cumulative irritation test

A cumulative irritation patch test was performed on each of six formulations containing 8.0% Emulsifying Wax N.F. One test used 12 subjects, 10 of whom completed the test. A 0.2 ml volume of the moisturizing lotion was applied under occlusion to the backs for 20 consecutive days, 23 h each day. The sites were scored 1 h after patch removal and a composite total score for the 10 panelists was 2 out of a maximum possible irritation score of 630.[179]

SYNTHETIC WAX: CHEMICAL AND PHYSICAL PROPERTIES

Structure/Composition

Synthetic Wax (CAS number 8002-74-2), a blend of low molecular weight homopolymers of ethylene, has a molecular weight of 500–700 (C_{40}–C_{50}).[153]

Snythetic Wax is sometimes referred to as Fisher–Tropch hydrocarbon wax or synthetic paraffin. It is produced by the catalytic reaction of hydrogen and carbon monoxide at high pressures (300–450 psi) and temperatures (230°–250°C). Homopolymerization of ethylene also produces Synthetic Wax.[153]

Properties

The properties of Synthetic Wax are listed in Table 17. Although this is sometimes called synthetic paraffin, it is less transparent, has a finer crystalline structure, and produces a higher gloss than paraffin. It congeals at 94°–98°C, and melts between 52°C and 74°C.[153,185]

Analytical Methods

Thin-layer, gas–liquid, and column chromatography are used to characterize Synthetic Wax.[152]

USE

Noncosmetic Uses

Synthetic Wax is used as a melting point extender and a hardner for soft waxes.[185]

Cosmetic Uses

Synthetic Wax imparts gloss and structure to cosmetics, and hardens soft waxes.[185,186] It is reported to be used in 5 cosmetic formulations[155] (see Table 18).

BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Oral toxicity

A single 20 ml/kg dose of a lipstick formulation containing 6.0% Synthetic Wax (1.2 ml/kg wax) given by gavage to five male and five female Sprague–Dawley rats, produced no toxic effects.[186]

Ocular irritation

The eyes of six New Zealand rabbits were instilled with a single 0.1 g amount of a lip formulation containing 6.0% Synthetic Wax. No irritation was observed during the next three days.[186]

Skin irritation

A dose of 0.5 g of a lip formulation containing 6.0% Synthetic Wax caused mild to moderate irritation when applied to intact and abraded skin of six New Zealand white rabbits for three 24 h intervals.[186]

Clinical Assessment of Safety

Skin Irritation/Sensitization

Patch test

In a modified Draize–Shelanski–Jordan patch test, 209 men and women were exposed to a lip conditioner containing 6% Synthetic Wax, under occlusion. There were no significant reactions, and the product was found to be a nonirritant and a nonsensitizer.[186]

In-use test

A controled use test of the lip product by 25 adult volunteers produced no reactions in four weeks.[186]

SYNTHETIC BEESWAX: CHEMICAL AND PHYSICAL PROPERTIES

Structure/Composition

Synthetic Beeswax is a blend of fatty esters (C_{32}–C_{62}), fatty acids (C_{16}–C_{36}), fatty alcohols (C_{16}–C_{36}), and high molecular weight hydrocarbons (C_{21}–C_{34}). Esters are the most abundant, the hydrocarbons next, the acids, and then alcohols.[154]

Properties

The properties of Synthetic Beeswax are listed in Table 17.

Analytical Methods

The analytical methods used to detect and characterize natural beeswax may also be used for Synthetic Beeswax. See "Beeswax, Analytical Methods," in "Waxes: Plant and Insect."[52]

Cosmetic Use

Synthetic Beeswax is used in skin and hair care products to provide lubricity, emolliency, gloss, and film formation. It is used to provide rigidity of structure, gloss and feel, produce emulsions, and mold release characteristics[154] (see Table 18).

BIOLOGICAL PROPERTIES

Animal Toxicology

Acute

Oral toxicity

Dosage levels of 5.0, 7.12, 10.14, and 14.43 g/kg Synthetic Beeswax were each given to 10 fasted male Wistar rats. Toxicity and pharmacological effects were recorded 3–4 h later and once daily for 14 days. Isolated instances of chromorhinorrhea and chromodacryorrhea were reported for all groups, and diarrhea, ptosis, bulging eyes, and sniffling in the three lower doses. At the highest dose, one animal died on Day 1, and one on Day 6. No other deaths occurred.[187]

Ocular irritation

The instillation of 0.1 ml of a 3.0% Synthetic Beeswax in mineral oil into the right eye of each of three albino rabbits showed no irritation after 1, 2, 3, 4, and 7 days.[188]

A 0.1 ml volume of Synthetic Beeswax was instilled into the right eye of each of six New Zealand white rabbits. Reactions were recorded at 24, 48, and 72 h after dosing. Out of a possible irritation score of 110, this compound scored 6.3, 3, and 2 on Days 1, 2, and 3, respectively. It was minimally irritating on Days 1 and 2, and practically nonirritating on Day 3.[189]

Dermal irritation

A patch impregnated with 5 g of Synthetic Beeswax in 1 ml of corn oil was applied to abraded and intact skin of six New Zealand white rabbits and left in place for 24 h. After 24 and 72 h, the Draize score was 2.08/8.0.[190]

In another test, a 0.5 ml volume of Synthetic Beeswax was applied under occlusion to the intact and abraded skin of three albino rabbits. After 24 and 48 h, the Draize score (PII) was 0.0/8.0.[191]

Skin sensitization

A 50% solution of Synthetic Beeswax in distilled water with 1% Carboxymethyl Cellulose and 0.2% Tween 80 was applied to the clipped back of guinea pigs for three consecutive days, for three weeks, and once on the fourth week.

The first application was 0.05 ml, and the remaining nine, 0.1 ml. Fourteen days after the last application, the animals were challenged at a previously untreated site. Dermal reactions were scored 24 h after each treatment by the Draize Method. On a scale of 0–4, there was 0.16 erythema and 0.05 edema. The compound was neither sensitizing nor irritating.[192]

Clinical Assessment of Safety

Skin Irritation/Sensitization

Repeated insult patch test

A lipstick formulation containing 7.2%–9.4% Synthetic Beeswax was assayed in a repeated insult patch test on 896 subjects. Formulation-impregnated patches were applied to the upper backs of the panelists three times per week, for 48 h, for three consecutive weeks. Sites were inspected before patch replacement on the next day. After 14 days, challenge patches were applied for 48 h to sites adjacent to the original patch site. None of the subjects showed irritation after 48 and 76 h.[193]

Photosensitivity

A lipstick containing 7.2%–9.4% Synthetic Beeswax was applied under occlusion for 24 h to 83 subjects. The patches were then removed, the sites evaluated for irritation and then irradiated for 2–3 min with a Xenon Arc Solar Simulator (150 W) with a continuous emission in the UVA-UVB range (290–400 nm). Sites were inspected 48 h later, and the entire procedure was repeated for a total of six exposures. A challenge was applied 10 days later, and there were no reactions.[193]

SUMMARY

Ozokerite, Ceresin, and Montan Wax are mineral waxes found in deposits of shale and coal.

Ozokerite is a wax found in areas of soft shale, and consists of an aliphatic series of straight-chain, branched chain, cyclic hydrocarbons and some oxygenated resinous bodies. The refined wax melts from 61.0°–88°C, and is soluble in benzene, turpentine and kerosene, and insoluble in ethyl and methyl alcohol and water. In cosmetics, it is used in baby products, eye and facial makeup preparations, hair, skin, nail, fragrance and suntan preparations, in concentrations of $<0.1\%$–50%.

The acute oral toxicity of Ozokerite as a raw ingredient and in formulation was studied in mice, rabbits, and rats. Doses up to 200 mg/kg of a 2.0% concentration of the raw ingredient Ozokerite and 5 g/kg formulations containing up to 29% Ozokerite were nontoxic.

In primary irritation tests, eight samples of 50% Ozokerite in petrolatum applied to groups of nine animals produced erythema and edema in one to four rabbits per group. Formulations containing 4.5%, 5%, 13%, 28%, and 29% Ozokerite have, at most, a potential for mild irritation. A product containing 19.1% Ozokerite caused no irritation.

Five of eight samples of 50% Ozokerite in petrolatum tested for ocular irrita-

tion in rabbits produced no irritation and the remaining three were minimally irritating. Formulations containing 4.5%, 5%, 13%, 19.1%, 28%, and 29% Ozokerite caused mild or no irritation.

Human clinical studies include 24 h patch tests of Ozokerite alone and in formulation. Six samples of 100% Ozokerite were tested; one sample caused no irritation, and the other five caused barely perceptible to definite erythema in a small percentage of the test subjects. Formulations containing 5%, 13%, 28%, and 29% Ozokerite caused no irritation, but one formulation with 13% caused barely perceptible erythema in one person. Repeated insult patch tests of 4.5% Ozokerite and a contact allergy patch test of 13% Ozokerite in a formulation produced no reaction. A 21-day cumulative irritancy test of 13% Ozokerite in a formulation had an irritation score of 2 out of a possible total score of 756.

Ceresin is a microcrystalline mixture of complex hydrocarbons, which is produced from, and has chemical and physical properties similar to, Ozokerite.

A formulation containing 2% Ceresin given orally in a 5 g/kg dose did not produce toxic effects in rats. Dermal irritation tests in rabbits of the same product produced a potential for minimal irritation. Five other products, one containing 5%, and the other four containing 6% Ceresin, caused only mild irritation.

A 2.0% Ceresin concentration in a formulation produced no ocular irritation in rabbits. Mild irritation was produced by formulations containing 6.0% Ceresin Wax.

In clinical studies, one formulation containing 2.0% Ceresin produced virtually no reactions in both a Schwartz–Peck prophetic patch test and a Draize–Shelanski repeated insult patch test.

A formulation containing a mixture of 6% Beeswax and 6% Ceresin was tested in both animals and humans. No deaths were produced in rats given 80.0 ml/kg orally. Minimal ocular irritation was produced by the mixture in the nonirrigated rabbit eye after 24 h, but not in irrigated eyes. Clinical studies of the mixture in formulation include the prophetic patch test under UV light. The formulation caused neither irritation nor sensitization. A repeated insult patch test of the formulation caused neither irritation nor sensitization. Ultraviolet testing produced no reaction in the prophetic patch test areas. A 21-day cumulative irritancy test caused an irritancy score of 6.4 out of a possible total score of 630. No allergic or irritant reactions were caused by the formulation in a contact sensitization test and a two-week in-use test of the mixture caused no reactions.

Montan Wax, a bituminous wax extracted from lignites with volatile solvents, consists of monohydric alcohol esters, high molecular weight acids, and free alcohols. The wax melts between 72°C and 90°C, and is insoluble in water and soluble in carbon tetrachloride, benzene, and chloroform. Montan Wax is used in polishes, finishes, greases, waterproofing agents, rubber manufacture, and as a substitute for Carnauba Wax. In cosmetic formulations, Montan Wax is used in eye and facial makeup, fragrances, and skin care preparations at concentrations of 0.1%–25%.

Montan Wax when applied in 2 and 3 g/kg doses caused no irritation to intact rabbit skin. The single minimum toxic dose of the wax administered to mice by intraperitoneal injection was 7.5 g/kg. Animals fed 1 g/kg Montan Wax daily for four months had only an increase in the weights of the adrenal glands and kidneys. It caused no dermal toxicity to rabbits at a concentration of 200 g/kg, and inhalation for three months of an atmosphere containing 0.11–0.36 mg/l of wax caused no behavioral changes.

In repeated insult patch test clinical studies, lipsticks containing 1.61%, 1.93%, 1.81%, and 2.53% Montan Wax, were nonirritating and nonsensitizing.

Paraffin is a solid mixture of hydrocarbons, principally of the methane series, derived from high boiling fractions during the destructive distillation of petroleum. It consists of saturated and unsaturated hydrocarbon chains, naphthalenes and aromatics, and has both plate and needle crystalline shape. Refined Paraffin is a white, tasteless, odorless solid and melts between 43°C and 65°C. It is insoluble in water and cold alcohol, but soluble in most organic solvents.

Paraffin is used in candlemaking, lubrication, waterproofing, food, fruit and vegetable protection, pharmaceuticals, waxed paper, crayons, and polishes. In cosmetic ingredients, Paraffin is used in baby products, eye and facial makeup, and in fragrance, hair, nail, skin, shaving, and suntan preparations in concentrations of less than 0.1% to 50%.

In doses up to 5 g/kg, ingested Paraffin caused no toxic effects in rats. In tests with dogs and rats no toxic effects were produced by products containing 5%, 8%, and 16% Paraffin.

Three samples of 50% Paraffin in petrolatum caused erythema in rabbits, but an undiluted sample caused no irritation. Formulations containing 8%, 15%, and 16% Paraffin produced minimal to severe irritation. An acute dermal test of 50% Paraffin in petrolatum was negative for systemic toxicity.

Two 50% Paraffin solutions in petrolatum caused mild eye irritation in rabbits, but another two samples produced no irritation. Formulations containing 5%, 8%, 15%, and 16% Paraffin caused mild or no irritation in rabbit eyes.

Subchronic dermal toxicity studies of Paraffin in rats were negative for toxic effects.

The carcinogenic and cocarcinogenic effect of Paraffin was studied by placing implants into the urinary bladder of rodents. It was found that the wax implants acted as foreign bodies and caused local irritation which led to urinary calculus formation, and hence to bladder tumors.

In human studies, patch tests of two samples of undiluted wax caused minimal erythema in two of 40 subjects. Formulations containing 8%, 15%, and 16% Paraffin caused mild to no erythema. A repeated insult patch test of a formulation containing 15% Paraffin was negative for toxic reactions. In maximization tests, 5% Paraffin in a formulation caused no irritation or sensitization. A 21-day cumulative irritancy test, and an in-use test of 5% Paraffin in a product, were negative for irritation.

Microcrystalline Wax is a mixture of long chain, saturated hydrocarbons of high molecular weight. It is derived from the distillation residue of crude petroleum after the Paraffin Wax fraction is removed. Microcrystalline Wax is tough, nonlustrous, and greasy, with high tensile strength and a melting point of 63°C to 90°C.

Microcrystalline Wax is used in insulation, waterproofing, polishes, lamination, and rubber compounding. As a cosmetic ingredient, it is used in eye and facial makeup, and hair, nail, skin, and fragrance preparations in concentrations of less than 0.1% to greater than 50%.

In animal toxicology studies, 20% Microcrystalline Wax at doses of 0.464, 1.0, 2.15, and 4.64 g/kg were nontoxic to rats, but three of five rats in the group given doses of 10.0 g/kg, died. A formulation containing 4.35% Microcrystalline Wax was nontoxic when fed to rats.

In a skin irritation study, 100% Microcrystalline Wax produced slight

erythema and edema in intact and abraded rabbit skin. A formulation containing 4.35% wax caused mild erythema over the contact site.

In acute eye irritation studies, 100% Microcrystalline Wax produced slight irritation. Tests on products containing 4.25% and 15% were negative for ocular irritation.

In clinical studies using a Modified Draize–Shelanski–Jordon patch test, Microcrystalline Wax caused three mild reactions out of 205 individuals. A 21-day cumulative irritancy test of 100% wax and of a formulation containing 15% wax was negative for irritation and these materials had only a slight potential for mild cumulative irritation. In a maximization test, 15% wax in a product caused no reactions. Two formulations containing 4.35% and 15% Microcrystalline Wax caused no phototoxic reactions, and an in-use test of 4.35% Microcrystalline Wax in a product was negative for irritation.

Emulsifying Wax is a mixture of cetyl and stearyl alcohol and polyoxyethylene derivatives of fatty acid esters of sorbitan. It is a creamy-white solid with a characteristic odor. It is insoluble in water, soluble in hydrocarbon solvents, and has a melting-point range of 48°–52°C.

Emulsifying Wax is used in pharmaceuticals and cosmetics as an emulsifier and stiffener. In cosmetics, its concentrations range from 0.1% to 10%.

In acute oral toxicity studies, a 25% solution and 40% and 50% suspensions of Emulsifying Wax in oil produced no deaths in rats. Two products containing 8.0% Emulsifying Wax and one with 8.5% wax were likewise nontoxic. A 25% solution of Self-Emulsifying Wax was nontoxic.

In ocular irritation studies, three 100% samples of Emulsifying Wax caused mild to no irritation. Three formulations containing 8.0% Emulsifying Wax caused minimal irritation, while one containing 8.5% wax produced no irritation. Two solutions containing 2.5% and 5.0% Self-Emulsifying Wax were nonirritating.

A 50% solution of Emulsifying Wax in corn oil produced mild cutaneous irritation in rabbits. Two 100% samples of the wax produced no irritation, while a third produced minimal erythema in one of six rabbits. Solutions of 2.5%, 5.0%, and 25% Self-Emulsifying Wax produced minimal irritation.

In clinical studies using patch tests, 10% Emulsifying Wax in peach kernel oil and formulations containing 8.0% and 8.5% wax produced no irritation.

Repeated insult patch tests of a 15% solution and a 100% concentration of Emulsifying Wax were negative for irritation and sensitization. Of six products containing 8.0% Emulsifying Wax, one produced erythema and edema in one of 205 individuals, and the other five produced no irritation or sensitization.

Synthetic Wax is a blend of low molecular weight homopolymers of ethylene produced by the Fisher–Tropsh process. It melts between 52°C and 74°C, has a high gloss, and a fine crystalline structure. Synthetic Wax is used as a melting point extender and hardener for soft waxes. In cosmetics, it is used to create gloss, impart structure, and harden soft waxes.

In acute oral toxicity tests in rats, a product containing a 6% concentration of Synthetic Wax was nontoxic. This same product caused neither ocular nor skin irritation in rabbits. In clinical studies, a patch test and an in-use test of a product containing 6.0% Synthetic Wax were negative for adverse reactions.

Synthetic Beeswax is a blend of fatty esters, fatty acids, fatty alcohols, and high molecular weight hydrocarbons. Its properties and methods of analysis mimic the natural product. Synthetic Beeswax is used in cosmetics to produce emulsions, lubricity and gloss, and provides a structure for the formulation.

Synthetic Beeswax was tested for acute oral toxicity in rats. No animals died at doses up to 10.14 g/kg. In ocular irritation studies, a sample of pure Synthetic Beeswax was practically nonirritating, and a 3.0% solution in mineral oil solution caused no irritation. Pure Synthetic Beeswax, and a sample of wax dissolved in corn oil were nonirritating to rabbit skin. Neither irritation nor sensitization occurred when 50% Synthetic Beeswax was applied to guinea pig skin.

In a human clinical patch test study, a formulation containing 7.2%–9.4% Synthetic Beeswax produced no irritation and was not phototoxic.

CONCLUSION

The Panel concludes that on the basis of the available information presented in this report, Ozokerite, Ceresin, Montan Wax, Paraffin, Microcrystalline Wax, Emulsifying Wax N.F., Synthetic Wax and Synthetic Beeswax are safe as cosmetic ingredients in present practices of concentration and use.

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