

PRACTICAL EMULSIONS

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Volume II

Applications

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Foreword

The first volume of *Practical Emulsions* has attempted to convey a general impression of the science of the formulation and manufacture of emulsions. Salient points have been presented in as simple a manner as possible, while detailed examination of specific points of the theory has been left to those whose qualifications and interests better fit them for such tasks.

In this volume, I have compiled basic formulations of many types of emulsion. This compilation is intended to provide graphic illustration of the breadth of emulsion technology. The formulations can also provide a starting point for the development of new and improved emulsion products and represent the types of product that can be made and their major constituents.

These formulations are provided by manufacturers to illustrate the use of their products. The suitability of any product for marketing, or the determination of the patent position regarding any formulation, is the responsibility of the person who manufactures and/or sells the product.

Many firms have generously provided formulation suggestions, and they merit my sincere appreciation for their help. Their contributions are acknowledged by appropriate references at the end of each chapter.

July 1967

J. L. Bishop, Jr.

Contents

1. AGRICULTURAL EMULSIONS	1
2. BITUMINOUS EMULSIONS	7
3. CLEANERS	15
4. COSMETICS	31
5. EMULSION POLYMERIZATION	63
6. FOAMS AND ANTIFOAMS	75
7. GASOLINE EMULSIONS	79
8. FOOD EMULSIONS	83
9. LEATHER AND PAPER TREATMENT EMULSIONS	97
10. MEDICAL EMULSIONS	103
11. CUTTING OILS, SOLUBLE OILS, MISCIBLE OILS	115
12. PAINT	127
13. POLISHES	141
14. RESIN AND RUBBER EMULSIONS	153
15. TEXTILE EMULSIONS	165
APPENDIX	
Conversion Tables	176
Viscosity Comparison Chart	178
Color Standards Comparator	182
Temperature Conversion Table	183
Rate of Flow Chart	184
List of Emulsifying Agents	185
Suppliers of Emulsifying Agents	197
INDEX	201

chapter 1

AGRICULTURAL EMULSIONS

The formulation of an agricultural emulsion requires unique considerations. The emulsion must possess sufficient stability to carry the active ingredient to the surface of the leaf, but must not allow re-emulsification of the active ingredients. The typical agricultural emulsion is comprised of a concentrate that contains the active ingredient (pesticide, herbicide, etc.), a surface-active agent, and a solvent. The emulsion is formed when the concentrate is mixed with water immediately prior to use. Therefore, the concentrate must immediately form an emulsion upon dilution with water.

The surfactant in a typical agricultural emulsion should provide an emulsion of small particle size. The surfactant should also aid wetting of the leaves by the spray. The surfactant can not permit re-emulsification of the spray on the leaf by rain water. Some investigators have found that anionic-nonionic blends of surfactants are more effective at a lower concentration and cost than unblended nonionic surfactants.¹ Cationic surfactants are often used as emulsifying and wetting agents in agricultural emulsions. If the spray contains a cationic rather than a nonionic wetting agent, more of the oil phase will be deposited on the leaves. The type and concentration of the cationic surfactant also influences the deposition of the oil phase on the leaves. Generally, the higher the efficiency of the emulsifying agent the lower the deposition of the oil phase on the leaf.²

A solvent is often found in the oil phase of an agricultural emulsion and is used to keep the active ingredients (pesticide, herbicide, etc.) and emulsifying agent in solution. The solvent should have a high flash point to avoid shipping restrictions.³

The adhesion of the oil-phase droplet to the leaf is affected by mechanical action as well as by the type and amount of surfactant and

solvent. The size of the droplet and its velocity affect the amount of the oil phase that will remain on the leaf. The evaporation rate of the emulsion is often lowered by the addition of saturated fatty acids to change the retention characteristics of the oil droplets.⁴

Agricultural sprays that are applied from low flying aircraft create special formulation problems. Aerial application of pesticides or herbicides is greatly affected by wind induced spray drifting. Although mechanical means of reducing drifting are occasionally used, most aerial agricultural sprays are water-in-oil emulsions rather oil-in-water emulsions. These "invert" emulsions form large droplets that are less affected by wind drifting.⁵

Aldrin Formulations		Chlordane Formulations	
Formula No. 1 ⁶		No. 2 ⁶	
Aldrin	26.8*	Chlordane	72.0
Xylene	31.6	Kerosene	20.0
Kerosene	31.6	Alkapent TD 100	3.0
Alkapent TD 100	4.0	Alkapent D NP 100	5.0
Alkapent D NP 100	6.0	<i>8 lb/gal</i>	
	<i>2 lb/gal</i>		
<hr/>			
No. 3 ¹			
	<i>Soft water</i>	<i>Hard water</i>	
Chlordane	45.0	45.0	
Triton X-151		1.3	
Triton X-171	4.0	2.7	
Kerosene	51.0	51.0	
	<i>8.9 lb/gal</i>		
<hr/>			
DDT Formulations			
	No. 4 ⁸		
DDT	25.0	Dowfax 9N9	5.0
		Xylene	70.0
<hr/>			
No. 5 ⁹			
	<i>Soft water</i>	<i>Hard water</i>	
DDT	25.0	25.0	
Triton X-151	0.9	2.5	
Triton X-171	2.1	0.5	
Xylene	72.0	72.0	
	<i>8.0 lb/gal</i>		

* Throughout this volume all figures are parts by weight, except where otherwise indicated.

Dieldrin Formulations		Dowfax 9N9	5.0
No. 6 ¹⁰		Kerosene	75.0
Dieldrin	20.0	No. 9 ¹³	
Dowfax 9N9	5.0	Lindane	20.0
Xylene	75.0	Emulsifier C	7.5
No. 7 ¹¹		Velsicol AR-50	32.5
Dieldrin	19.0	Isophorone	40.0
Heavy aromatic Naphtha	77.0	No. 10 ¹⁴	
Alkapent TD 100	4.0	Malathion Wettable Powder	
Alkapent D NP 100	6.0	Malathion (97% active)	25.8
1.5 lb/gal		Celite 209	28.7
Lindane Formulations		Barden clay	42.5
No. 8 ¹²		Sodium lignosulfonate	2.0
Lindane	20.0	Dowfax 9N9	1.0
No. 11 ¹⁵			
Malathion-Xylene			
		<i>Soft water</i>	<i>Hard water</i>
Malathion (95%)		52.7	52.7
Triton X-152			4.0
Triton X-172		5.0	1.0
Xylene		42.3	42.3
8.6 lb/gal			
No. 12 ¹⁶		No. 14 ¹⁷	
Methyl Parathion Emulsion		Toxaphene Formulation	
Concentrate		Toxaphene	60.0
Technical Methyl Parathion	31.40	Dowfax 9N9	5.0
Xylene	63.60	Kerosene	35.0
Atlox 3335	4.25	No. 15 ¹⁷	
Atlox 8916P	0.75	Toxaphene-DDT Formulation	
8.05 lb/gal		Toxaphene	40.0
No. 13 ¹⁷		DDT	20.0
Ronnel Formulation		Dowfax 9N9	5.0
0, 0-Dimethyl, 0-2, 4, 5-		Xylene	35.0
Trichlorophenyl Phos-		2, 4-D Formulations	
phorothioate (<i>Ronnel</i>)	24.0	No. 16 ¹⁷	
Dowfax 9N9	2.5	Isooctyl Ester of 2, 4-D	
Petroleum Sulfonate	2.5	Formulation	
Xylene	71.0	Isooctyl Ester of 2, 4-D	65.0

Dowfax 9N9	2.2		
Petroleum Sulfonate	1.8		
Heavy Aromatic Naphtha	31.0		
No. 17 ¹⁷			
Butyl Ester of 2, 4-D		Dowfax 9N9	2.4
Formulations		Petroleum Sulfonate	1.6
Butyl Ester of 2, 4-D	56.0	Heavy Aromatic Naphtha	40.0
No. 18 ¹⁸			
		<i>Soft water</i>	<i>Hard water</i>
2,4-D Butyl Ester		57.0	57.0
Triton X-152		0.6	2.0
Triton X-172		3.4	2.0
HAN-132		39.0	39.0
8.95 lb/gal			
No. 19 ¹⁸			
		2,4,5-T Isooctyl Ester	
		<i>Soft water</i>	<i>Hard water</i>
2,4,5-T Isooctyl Ester		65.8	65.8
Triton X-152		0.4	1.6
Triton X-172		3.6	2.4
Diesel Oil		30.2	30.2
8.82 lb/gal			
No. 20 ¹⁹			
2-Ethylhexyl-2, 4, 5-		Shellac	100
Trichlorophenoxyacetate		Water	2000
		<i>Dilute before use</i>	
2-Ethylhexyl-2, 4, 5-Trich-		No. 22 ²¹	
lorophenoxyacetate	64.2	Paraffin Wax	553
Monazoline O	5.3	Carnauba Wax	68
Monopal T	2.7	Cottonseed Oil	98
Xylene	27.8	Oleic Acid	183
		Triethanolamine	98
		Water (containing Soda Ash)	<i>q.s.</i>
No. 21 ²⁰			
Fruit Coating Wax Emulsions			
No. 21 ²⁰			
Caustic Soda	6	Paraffin Wax	168.0
Triethanolamine	20	Beeswax	42.0
Stearic Acid	42	Oleic Acid	22.0
Paraffin Wax	165	Sodium Bicarbonate	6.6
Carnauba Wax	55	Salt	2.2
		Water	599.2

CATTLE DIPS		XA	27.4
Toxaphene Formulations		Atlox 3404	6.0
No. 24 ²³		Atlox 3403	9.0
Toxaphene (90%)	66.6	No. 27 ²³	
Kerosene	18.4	Soil Fumigant*	
Atlox 3404	6.0	Nemogon® (3)	83.7
Atlox 3403	9.0	Xylene	11.3
No. 25 ²³		Atlox 3404	1.0
Toxaphene (90%)	55.3	Atlox 3403	4.0
Malathion (95%)	5.3	No. 28 ²³	
XA	24.1	Miticide*	
Atlox 3404	6.0	Aramite (93%)	91.0
Atlox 3403	9.0	XA	2.0
No. 26 ²³		Atlox 3409	7.0
Toxaphene (90%)	55.6	* For longer shelf life, add 0.5% Epichlorhydrin to these formulas.	
Lindane	2.0		

References

1. J. K. EATON, "General Requirements of Pesticide Emulsions," *Chem. Ind.* Nov. 10, 1962, pp. 1914-6.
2. C. G. L. FARMIDGE, "Retention of Emulsion Sprays on Leaf Surfaces," *Chem. Ind.* Nov. 10, 1962, p. 1917.
3. EATON, *op. cit.* p. 1915.
4. FARMIDGE, *op. cit.* p. 1917.
5. "New Pesticide Spray Methods Due This Spring," *Chem. Engr. News*, March 28, 1966, p. 42.
6. Wayland Chemical Corp.
7. Rohm and Haas Co.
8. The Dow Chemical Co.
9. Rohm and Haas Co.
10. The Dow Chemical Co.
11. Wayland Chemical Corp.
12. The Dow Chemical Co.
13. H. BENNETT, *Chemical Formulary*, vol. 11, p. 155, Chemical Publishing, New York.
14. The Dow Chemical Co.
15. Rohm and Haas Co.
16. BENNETT, *op. cit.* vol. 11, p. 155.
17. The Dow Chemical Co.
18. Rohm and Haas Co.
19. Mona Industries, Inc.
20. US Patent 2 153 487.

21. MACRILL, US Patent 2 019 758 (1935)
22. TROUT, *J. Coun. Sci. Ind. Res.* 15: 26 (1942).
23. Atlas Chemical Industries, Inc.

chapter 2

BITUMINOUS EMULSIONS

Bituminous emulsions are generally used as surface coatings. These emulsions are used in addition to fibers for protection of roads and highways. They are characterized by a low concentration of a relatively inexpensive surfactant.

Cationic surfactants are used for bituminous emulsions. The cationic material is strongly adsorbed at negatively-charged mineral surfaces. The mineral surface becomes water repellent because of the adsorbed cationic surfactant. The bitumen will adhere better to this water repellent surface and therefore can more effectively fulfill its purpose of holding together the mineral particles in the road surface. Thus, the cationic surfactants are often referred to as adhesion promoters. In use, the cationic bitumen-in-water emulsion is applied to the stone road surface. It breaks upon contact with the road surface and the bitumen follows the cationic surfactant to adhere to the stone surface, while the water runs away.²²

Various anionic surfactants are also used for surface dressing of roads. Based upon the bitumen, 0.5 to 2.5% surfactant is added to asphalt and tar macadam basecourses and fine cold asphalt to protect the binder-to-stone bond from water action. Britain and Sweden make use of this technique to prevent stripping of oiled gravel surfaces, in addition to the above road surfaces.²³

Asphalt Emulsions		Green Acid Soap (Dry	
Formula No. 1 ¹		Basis)	0.23
Asphalt	64.05	The asphalt for use in this	
Water	35.00	formula may be produced from	
Caustic Soda	0.08	Mid-Continent petroleum, melt-	
Corn Gluten (or Soya		ing point about 110°F, penetra-	
Bean Meal)	0.64	tion about 130 at 77°F.	

Green acid soap may be prepared by the neutralization of green acids, which are well known in the petroleum industry. If the green acid soap contains appreciable amounts of oil, a harder asphalt should be emulsified to produce a residue of given penetration.

The caustic, farinacious emulsifier, and green acid soap are mixed with water and heated to a temperature of about 200°F. This hot solution or mixture is placed in a suitable stirrer, agitator, or mixer and is beaten by paddles, circulated by centrifugal pumps, or dispersed between suitable rotors moving at high velocities.

The melted asphalt at about the same temperature is slowly stirred into the solution and further agitated until complete emulsification has taken place. When high melting point asphalts are used, it may be necessary to increase the temperature at which the asphalt is added, but it is desirable to keep the temperature of the emulsion below the boiling point of water so that the foaming due to the production of steam may be prevented.

No. 2²

A sodium oleate solution is made up to a concentration of 20% by the addition of oleic acid and caustic soda to water at 90°C. This is then diluted with

nine times its volume of water heated to 90°C. The 2% soap solution is run through a colloid mill with an equal amount of asphalt heated to a temperature not exceeding 100°C. The resultant emulsion contains equal parts of asphalt and water with 1% by weight of soap.

No. 3³

A hot dilute aqueous solution of alkali, such as a solution of caustic soda of about 0.5% strength, is prepared. An approximately equal weight of asphalt is melted; part of the melted asphalt is slowly stirred into the hot solution until scum begins to form on the surface; then a small quantity (about 0.5% of the final product) of oleic acid is added, followed by addition of the rest of the asphalt, while the temperature and agitation are maintained and a small proportion of clay added to give desired stability and adhesiveness.

No. 4⁴

A. Rosin	100	} C
Slaked Lime	3 $\frac{3}{4}$	
B. Fuel Oil	103	

Heat A at 140°C and mix until uniform. Add B while mixing. Take 4 lb of C and add to 100 lb of melted bitumen or asphalt. Disperse the mixture in 0.05 N potassium rosinate solution to give a 57% bitumen

content.

No. 5⁵

Asphalt	48-52
Water	46-48
Oleic Acid	1
Sodium Hydroxide	<1
Bentonite	1

No. 6⁶

Nine parts of soap are dissolved in 78 parts of warm water. About 20 parts of a low-grade fuel oil or a crude oil with an asphaltic base are added slowly, with vigorous agitation.

No. 7⁷

Asphalt	500
Water	500
Bentonite	30
Quebracho	30
Soda Ash	10

The bentonite, quebracho, soda ash, and water are mixed and heated to 200°F. While stirring, the asphalt, which has been heated to approximately 200°F, is added. The stirring is continued until the asphalt is dispersed.

No. 8⁸

Asphalt	2800
Water	2800
Rosin Soap (50%)	118
Pine Oil	40

The rosin soap is added to the water and is heated to 200°F. The asphalt is also heated to 200°F and the pine oil added. While agitating, the asphalt is slowly poured into the water.

The mixture is agitated until a smooth emulsion is formed.

No. 9⁹

Hydrous Magnesium Silicate	8-10 lb
Water	20 gal

Mix well and heat to boiling; then mix in an emulsifying machine with

Asphalt, melted	36 gal
Acetic Acid (0.1 N)	250-240 cc
Water, boiling	10 gal

No. 10¹⁰

Adhesive for Sound-Deadening Pads

Asphalt	50-60
Bentonite	2-3
Oxalic Acid	0.02
Kerosene	3-10
Water	To make 100

The asphalt is warmed in the kerosene until dissolved. The bentonite and oxalic acid are dissolved in water and heated to boiling. The solutions are vigorously mixed and run through a colloid mill, if necessary.

No. 11¹¹

Millboard Adhesive

Asphalt	100
Tall Oil Soap (50% water)	30
Kaolin	30

The tall oil soap and kaolin are mixed while heating and the molten asphalt slowly added, with stirring.

Before use, hot water in the desired quantity is added.

No. 12 ¹²		
Soft Asphalt Emulsion		
Water		400
Carbopol 941	1.5 (0.19%)	
Sodium hydroxide (10% solution)		4.5
Ethomeen C-25		0.75
Soft Asphalt*		400

* Sohio 180-200 asphalt, Standard Oil Co. of Ohio, Cleveland, Ohio.

Carefully disperse the Carbopol 941 in the water. After thorough dispersion, neutralize with the sodium hydroxide followed by addition of the Ethomeen C-25. Heat this mucilage to 65-70°C. (The water can be heated prior to the addition of

the Carbopol 941 and neutralizer as this will assist dispersion of the Carbopol 941.) Separately heat the asphalt to 85°C. Utilizing moderately high shear mixing, slowly add the molten asphalt to the water mucilage. Add the asphalt no faster than the rate of dispersion. If the asphalt is added too rapidly, the emulsion will invert and separate.

When the asphalt has been added, continue mixing for a short time to insure uniformity. Shock cool the emulsion without mixing and allow it to remain undisturbed until its temperature falls to 30-35°C.

	No. 13 ¹³	No. 14 ¹³
A. Asphalt†	65	65
B. Water	35	35
C. Diam 26	0.1-0.2	-----
Diam 11-C	-----	0.25-0.30
D. Conc. Hydrochloric Acid††	0.05-0.15	0.15-0.20

For optimum stability and minimum processing costs, the emulsion should be formed inside a colloid mill with the water and asphalt fed to the mill separately. Two methods of accomplishing this follow. The first method leads to somewhat better emulsions but requires HCl-resistant processing equipment. The amine salt used in Method II is noncorrosive.

METHOD I

- (1) Dilute D in B
- (2) Add C to A. The asphalt and water should be in separate tanks and independently connected to the mill through pumps.

† 150-200 or 200-250 penetration paving grade asphalt, 60 to 70 parts of asphalt, may be used provided the emulsifying agent concentration is adjusted to correspond.

†† pH is usually adjusted to 6.0-6.5.

- (3) Simultaneously pump AC and BD into the colloid mill, at a proportion of 65/35.

METHOD II

- (1) Melt C and add a portion of the water; finally, add D.
- (2) Recycle with the pump to emulsify CD.
- (3) Pump BCD into another tank containing the remainder of the water, agitate or recirculate.
- (4) Heat BCD to 80-90°C and the asphalt to 115-120°C.
- (5) Pump the asphalt and BCD into the colloid mill in proportions of 65/35.

No. 15¹⁴

1000 g of bitumen (preferably asphalt) are heated to 90°C. 60 g of Swedish resin at 80-90°C are then added, and finally, a solution of 20 g of caustic potash in 120 g of water, cooled to 60-70°C. Vigorous stirring is needed throughout. 1000 g of hot water are poured in and when soap formation is ended, 800 g of water are added.

No. 16¹⁵

Add 15 parts by weight of oleic acid to 250 parts by weight of asphalt flux oil, heating the mix to about 100°C. Add this to 750 parts of water to which have been added 34 parts of aqueous ammonia, to form an emulsion of the asphalt flux oil, which has a viscosity substantially greater than that of water. Add 1500 parts by weight of coal tar, specific gravity of about 1.18 or more, heated to a temperature of about 70°C, to which has been added 45 parts of oleic acid. Vigorously agitate the tar with the emulsion

of asphalt flux oil and subject the resulting mixed emulsion to intensive mechanical disintegration—for example, by passage through a colloid mill.

No. 17¹⁶

Emulsion for road making

Spramex Bitumen	48.0
Water	49.5
Sodium Carbonate (calcined)	0.5
Oleic Acid	2.0

The bitumen is warmed at 95-98°C and the oleic acid added. The water is heated separately with the sodium carbonate and the two liquids are introduced into the emulsifier.

No. 18¹⁶

Spramex Bitumen	50.0
Mineral Oil	2-2.5
Resin Soap	1.5-2.0
Caustic Potash	1.0
Water	45.0

The bitumen is melted and the mineral oil added during agitation. The water is heated to boiling and in it are dissolved the soap and the caustic potash. The liquids are mixed at 95°C.

With more bitumen, 1-2% of blue starch, gelatin, or sodium silicate must be added during or after emulsification.

No. 19¹⁷

Melt 100 parts of bitumen, softening point 45-50°C, and add 10.8 parts of rosin; heat to 100-125°C. Then add 20 parts of kaolin (soaked in equal parts by weight with water) and 1.2 parts of sodium hydroxide, preheated to 70-80°C. Raise the temperature of this mixture to 100°C and dilute with water to produce an emulsion containing 20-25% solids.

No. 20¹⁸

Bitumen	35
Coal, powdered	15
Carrageen	1
Water	50

No. 21¹⁹

Pitch Emulsion

A. Coal Tar Pitch	180
Stearin Pitch	20
B. Casein Solution*	45
Water	35
Caustic Potash	1
C. Water, boiling	120

Melt A together and add to B at 100°C. Add C.

* Casein Solution

Casein	56
Caustic Potash (50%)	10
Water	494
Cresylic Acid	11

Tar Asphalt Emulsion

No. 22²⁰

Shale Tar	38.15
Water	49.60
Mexican Asphalt	7.63
Casein	1.15
Rosin	1.15
Potato Starch	0.76
Anthracene Oil	1.34

Tar Emulsions

No. 23²¹

Water	50.000
RT-12 tar	50.000
Carbopol 941	0.125
A. Sodium hydroxide (10% solution)	0.375
Ethomeen C-25	0.625

Carefully disperse the Carbopol 941 in the water in a jacketed vessel, and add A. Heat both the water mucilage and the tar to 65°C. Slowly add the molten tar to the hot mucilage with vigorous mixing (a mixer such as a medium-speed Eppenbach homogenizer is recommended). After the last of the tar has been added, mix briefly to ensure homogeneity. Rapidly cool the emulsion without further mixing.

The mixing step is critical. With very high shear mixing, the tar particles are extremely small and the emulsions are very smooth. Films deposited from such emulsions are difficult to dry, however, because an impermeable layer forms on the top. In contrast, emulsions formed with moderate shear have rela-

tively large tar particles but dry evenly and rapidly.

No. 24 ²¹	
Water	50.000
RT-8 tar	50.000
Carbopol 941	0.125
Sodium hydroxide (10% solution)	0.250
Ethomeen C-25	0.063

Carefully disperse the Carbopol 941 in the water. When dispersion is complete, add the sodium hydroxide and then the amine. Lastly, slowly add the RT-8 tar in a thin, continuous stream (so that the rate of addition is no greater than the rate of dispersion) with good mixing. Fairly high shear, such as that

provided by a medium-speed Eppenbach homogenizer, forms the best (smallest droplet-size) emulsion. Excessively rapid addition of the tar results in a grainy emulsion.

No. 25 ²¹	
Creosote Emulsion	
Water	200.00
Carbopol 934	0.60
Sodium Hydroxide (10% solution)	0.55
Creosote	200.00

Carefully disperse the Carbopol in the water and add the sodium hydroxide. Add the creosote in a slow stream while vigorously agitating the mix. Stir to uniformity.

References

1. H. BENNETT, *Chemical Formulary*, vol. 2, p. 187, Chemical Publishing, New York, 1935.
2. H. BENNETT, *Ibid.* vol. 1, p. 163, Chemical Publishing, New York, 1933.
3. Personal Communication.
4. BENNETT, *op. cit.* vol. 4, p. 97, Chemical Publishing, New York, 1939.
5. *Ibid.* vol. 2, p. 186.
6. *Ibid.* p. 186.
7. *Ibid.* vol. 1, p. 155.
8. *Ibid.* p. 155.
9. *Ibid.* vol. 4, p. 96.
10. US Patent 2,333,779.
11. BENNETT, *op. cit.* vol. 7, p. 39 Chemical Publishing, New York, 1945.
12. B. F. Goodrich Chemical Co.
13. General Mills.
14. BENNETT, *op. cit.* vol. 4, p. 39 Chemical Publishing, New York, 1945.
15. *Ibid.* p. 97.
16. *Ibid.* vol. 1, p. 329.

17. *Ibid.* vol. 5, p. 72.
18. *Ibid.* p. 72.
19. *Ibid.* vol. 4, p. 97.
20. *Ibid.* vol. 5, p. 73.
21. B. F. Goodrich Chemical Co.
22. D. H. MATHEWS, "Surface Active Agents in Bituminous Road Materials," *J. App. Chem.* 12:56-64 (1962).
23. *Ibid.*

Suppliers of Emulsifying Agents

1. Aceto Chemical Co.
2. Air Reduction Co., Inc.
3. Alabama Binder and Chemical Corp.
4. Alco Chemical Co.
5. Alcolac Chemical Corp.
6. Amalgamated Chemical Corp.
7. American Can Co., Marathon Products Division
8. American Cholesterol Products, Inc.
9. American Cyanamid Co.
10. American Dyewood, Inc.
11. American Lecithin Co.
12. Amoco Chemicals Corp.
13. Apex Chemical Co., Inc.
14. Archer Daniels Midland Co.
15. Ardmore Chemical
16. Arizona Chemical Co.
17. Arlen Chemical
18. Armour Industrial Chemical Co.
19. Arol Chemical Products
20. Atlas Chemical Industries, Inc.
21. Atlas Refinery, Inc.
22. Baker Castor Oil Co.
23. Barrett Chemical
24. BASF Colors and Chemicals, Inc.
25. Beacon Chemical Industries, Inc.
26. Berkshire Color and Chemical Co.
27. Boler Petroleum Co.
28. Burkart - Schier Chemical Co.
29. Bryant Chemical
30. Bryton Chemical Co.
31. Calgon Corp.
32. California Chemical Co.
33. Canada Packers Ltd.
34. Cargill, Inc.
35. Chemical Corp.
36. Carlisle Chemical Works, Inc.
37. Central Soya Co.
38. Chapman Chemical Co.
39. Chemactants, Inc.
40. Ciba Chemical and Dye Co., Inc.
41. Cindet Chemicals, Inc.
42. Clintwood Chemical Co.
43. Clough Chemical Co., Ltd.
44. Colgate-Palmolive Co.
45. Colloidal Products Corp.
46. Colloids, Inc.
47. Colonial Sugars Co.
48. Commercial Solvents Corp.
49. Continental Chemical Co.
50. Crest Chemical Corp.

51. Croda, Inc.
52. Crown Chemical Corp.
53. Crown Zellerbach Corp.
54. Culver Chemical Co.
55. DePaul Chemical Co.
56. Dexter Chemical Corp.
57. Diamond Alkali Co.
58. Distillation Products Industries
59. Dixo Company, Inc.
60. C. B. Dolge Co.
61. Dominion Products, Inc.
62. The Dow Chemical Co.
63. Drew Chemical Corp.
64. DuBois Chemicals, Inc.
65. E. I. du Pont de Nemours and Co.
66. Eastern Color and Chemical Co.
67. Emery Industries, Inc.
68. Emkay Chemical Co.
69. Essential Chemicals Corp.
70. W. F. Fancourt Co.
71. Far-Best Corp.
72. Fine Laboratories, Inc.
73. Fine Organics, Inc.
74. Finetex, Inc.
75. R. E. Flatow and Co., Inc.
76. Foremost Chemical Products Co.
77. Geigy Industrial Chemicals
78. General Aniline and Film Corp.
79. General Mills
80. Georgia-Pacific Corp.
81. Goldschmidt Chemical Corp.
82. Glidden Co.
83. Glyco Chemicals, Inc.
84. B. F. Goodrich Chemical Co.
85. Greenwood Textile Supply Co.
86. Guardian Chemical Corp.
87. C. P. Hall Co.
88. Hart Products Corp.
89. Henkel International Gmbh, A. H. Carnes Co., agent
90. Hercules Powder Co.
91. Hexagon Laboratories Inc.
92. Hodag Chemical Corp.
93. Hooker Chemical Corp.
94. Hope Chemical
95. E. F. Houghton and Co.
96. Humble Oil and Refining Co.
97. I. C. I. Organics, Inc.
98. International Selling
99. Intex Chemical Corp.
100. IonacChemical Co.
101. Isochem Corp.
102. Jefferson Chemical Co.
103. Andrew Jergens
104. Jersey State Chemicals
105. W. H. and F. Jordan, Jr., Mfg. Co.
106. Kali Mfg. Co.
107. Kalide Corp.
108. Kehew-Gradley and Co.
109. Kessler Chemical Co., Inc.
110. Knapp Products, Inc.
111. H. Kohnstamm and Co.
112. Laurel Soap Mfg.
113. Leatex Chemical Co.
114. Lever Brothers Co.
115. Leyda Oil and Chemical Co.
116. Maher Color and Chemical Co.
117. Malmstrom Color and

- Chemical Corp.
118. Marden-Wild Corp.
119. Mathe Chemical Co.
120. Merix Chemical Co.
121. Metro-Atlantic, Inc.
122. M. Michel and Co.
123. Harry Miller Corp.
124. 3M Company
125. Miranol Chemical Co., Inc.
126. Mona Industries, Inc.
127. Monsanto Chemical Co.
128. Moretex Chemical Products
129. Murphy-Phoenix Oil Co.
130. National Lead Co.
131. Nopco Chemical Co.
132. Northwestern Chemical Co.
133. Nostrip Chemical Works, Inc.
134. Onyx Chemical Corp.
135. Ottol Oil Co.
136. Patent Chemicals
137. Pecks Products, Co.
138. Pennsalt Chemicals Corp.
139. Pennsylvania Refining Co.
140. Perry Brothers, Inc.
141. Pilot Chemical Co.
142. Charles Pfizer and Co.
143. Pro-Chem. Inc.
144. Proctor and Gamble, Co.
145. Proctor Chemical Co.
146. Proven Products
147. Rohm and Haas Co.
148. Relly-Whiteman-Walton Co.
149. Retzloff Chemical Co.
150. Richardson Co.
151. Robeco Chemicals, Inc.
152. Robinson Wagner Co., Inc.
153. Rozilda Laboratories
154. Ryco, Inc.
155. Sher Brothers
156. Scholler Brothers, Inc.
157. Seaboard Chemicals, Inc.
158. Shawinigan Resins Corp.
159. Shell Oil Co.
160. George F. Siddall, Co.
161. Werner G. Smith, Inc.
162. Sole Chemical Corp.
163. Solvol Chemical Co., Inc.
164. Sonneborn Chemical and Refining
165. Southern Sizing Co.
166. Fredrick A. Stresen-Reuter, Inc.
167. A. E. Staley Manufacturing Co.
168. Standard Chemical Co.
169. Standard Chemical Products
170. Stauffer Chemical Co.
171. Stepan Chemical Co.
172. Sun Chemical Corp.
173. Suffact Co., Inc.
174. Swift and Co.
175. Synthetic Chemicals, Inc.
176. Synthron, Inc.
177. Tanatex Chemical Corp.
178. Textilana Corp.
179. Textron, Inc.
180. Thompson Chemical Corp.
181. Thompson-Hayward Chemical Co.
182. Titan Chemical Products, Inc.
183. Arthur C. Trask Co.
184. Treplow Chemicals, Inc.
185. Trylon Chemicals, Inc.
186. Union Carbide Corporation (Chemicals and Silicones Divisions)
187. United Merchants and

- Manufacturers, Inc.
188. Universal Chemicals Corp.
189. Van Dyk and Co.
190. Varney Chemical Corp.
191. Verona-Pharma Chemical Corp.
192. Wasco Laboratories
193. Washine Chemical Corp.
194. Wayland Chemical Corp.
195. Wilson and Co., Inc.
196. Witco Chemical Co., Inc.
197. W. A. Wood, Co.
198. Woonsocket Color and Chemical Co.
199. Wyandotte Chemicals Corp.
200. General Electric Silicones Division
201. Dow Corning Corp.
202. Allied Chemical Corp, National Aniline Division
203. Chevron Chemical Co., Oronite Division
204. Tennessee Corp.

INDEX

	wax-wash	144, 145
A	Azoic printing emulsion	171
Acne cream		106
Acriflavine ointments		106
Acrylic ester, emulsion polymerized		64
Acrylic ester-styrene, emulsion polymerized		66, 67
Adhesive, emulsion polymerized		67, 68
Adhesives		9, 160, 162
Aerosol furniture polishes		148, 149
After-shampoo rinses		53, 54
After-shave collapsible foam		48
Alcohol emulsions		79, 80
Alcoholic lotions		46
Aldrin		2
Alkaline cleaners		27
All-purpose cleaners		15
Almond oil emulsion		86
Aluminum acetate lotion		106
Aluminum cleaners		26
Analgesic balm		111
Anesthetic emulsion		107
Anionic cream, lotion bases		45
Ammoniated cleaner		16
Aniline-black emulsion		171
Antibiotic emulsion		107
Anti-dandruff shampoo		52
Antifoams		76
Antihistamine ointment		110
Anti-inflammatory emulsions		107
Antiperspirant, foam		48
lotion		48
Anti-pruritic emulsion		107
Antiseptic emulsion		170, 171
Anti-static textile dressing		166
Asphalt		7, 8, 10
emulsions		154
Automobile, cleaner-polish		142, 143
polish		143
	B	
	Baby lotion	47
	Bath oils	49, 50
	Belt dressing	169
	Benzyl benzoate ointment	107
	Bitumen emulsion	11, 12
	Boric acid ointment	108
	Bottle washing compounds	28
	Bowl cleaners	22
	Bubble baths	50, 51
	Burn cream	107, 108
	Burow's emulsion	106
	Butadiene-styrene emulsion	159
	Butterscotch icing	83
	Butter substitutes	86, 87
	C	
	Calamine cream	108
	Car cleaners	25
	Cationic lotions	45, 46
	Cattle dips	5
	Cellulose ester emulsion	157
	Chest-rub balm	108
	Chilblain ointment	108
	Chlordane	2
	Chlorinated rubber emulsion	160
	exterior paint	138
	Chocolate milk	83
	Cheese stabilizer	84
	Cleansing creams	40, 41
	Cocoa icing	83
	Cod-liver oil ointment	109
	Coffee, cream	90
	whiteners	91, 92
	Cold creams	39
	Cold-forming plastic lubricant	123

Cold wave base	54	Food cleaner	28
neutralizer	54	Foundation creams, lotions	42-45
Copper cleaner	26	Frostbite ointment	109
Cotton piece-good dying	171	Fruit coating wax	4
Cream, artificial	83, 84	Fulling oil	167
bleach	54	Fur cleaning	101
hair oil	56, 57	Fur glazing	101
hair rinses	53, 54	Furniture polishes	148, 149
makeup	42	Fur skin softener	100
sachet	47		
Creosote emulsions	13	G	
Cutting oils	115-124	Gasoline emulsions	79-82
		Gelva emulsion	155
D		Germicidal, hand soap	52
Day cream	48	shampoo	52
DDT	2, 3	Glass cleaner-polish	150
Degreasers	26, 27, 167	Glass cleaners	22
for pickled leather	100	Glass fiber lubricant	170
Deodorant creams	49	Gloss oil	167
Detergents, disinfectants	25, 26	Glycol monosalicylate ointment	110
general	18	GR-S rubber, emulsion polymerized	72
tablets	19		
Dieldrin	3	H	
Dishwashing, liquids	17	Hair, conditioning cream	55
powder	17	cream	55-57
Disinfectants	25, 26	dressing	55, 56
Dog shampoo	23	pomade	55
Dry-Bright floor polishes	145, 146	rinses	53, 54
Dry skin creams	37	waving lotion	54
		Hemorrhoids ointment	109
E		Hand, cleaners	23, 24
Edge filler	100	creams	33, 34
Electrolytic cleaner	28	lotions	32
Emollient creams, lotions	36, 37	Heavy-duty liquid cleaners	15-28
ointments	109	Herbicide emulsions	2-4
Engine cleaners	25	Hexachlorophene, solubilized	109
Enriched skin cream	46	Household, cleaners	16, 18
Ethyl cellulose emulsion	156	detergents	18
		Housepaint primer	138
F		Hydrogen peroxide emulsions	20
Face creams	43, 44	Hydroquinone bleach cream	54
Fat-liquoring leather treatment	100		
Fat-liquors	97, 98	I	
Fine fabric detergents	20	Ice-cream, mixes	92
Flash-aging emulsion	171	stabilizer	84
Flat wall paints	132	Industrial cleaner	16
Floor, rug care products	21, 22	Infants' milk, synthetic	85
cleaners	21	Insect repellent creams, lotions	58, 59
polishes	145-147		
wax removers	21		

Insole cement	160	Nipple balm	112
Interior paint, flat tint base	137	Nutritive cream	47
latex	133		
white	132, 136		
		O	
K		Ointment bases	103-105
Kerosene emulsions	79	Orange oil emulsion	86
Kier penetrant oil	166	Oven cleaners	17
		Oxyquinoline sulfate ointment	110
L		P	
Laundry, compounds	19	Paints	127-140
softener	20	Paper, coatings	101
Leather, cleaner	23	machine felt cleaner	28
dressing	98	Paste polishes	149
finishes	98, 100	Paraffin emulsions	154
pasting	100	Parathion emulsions	3
polishes	98-100	Penicillin ointment	110
softener	100	Pentaerythritol abietate emulsion	155
Lemon oil emulsion	85, 86	Peroxide emulsions	20
Light-duty liquid cleaner	15-28	Pet shampoo	23
Lindane	3	Pickle-flavor emulsion	93
Liquid makeup	42	Piccolyte oil paint	131, 132
		Pine oil cleaner	16
M		Pitch emulsions	12
Makeup, bases	43	Plastic cleaner	23
creams, lotions	42-45	Polishing cloth	150
Malathion emulsions	3	Polystyrene emulsion	158
Mayonnaise	87, 88	Polyurethane foams, rigid	75, 76
Mercerization cleaner	28	Polyvinyl acetate paints	134, 136
Meringue stabilizers	92, 93	Pomade	55
Metal, cleaners	26	Primer-sealer paint	138
drawing compounds	121	Protective hand creams, lotions	35, 36
polish	150	Protein conditioning cream	46
Methyl methacrylate emulsion	156		
Methyl parathion emulsions	3	R	
Methyl salicylate ointment	111	Rayon, delustering emulsion	170
Millboard adhesive	9	oils	170
Mineral oil polishes	150	waterproofing emulsion	170
Miscible oil	115-124	Resin oil emulsion	130
Moisture cream	37	Rinse aids	17
Mold release	124, 162	Ronnel emulsion	3
Mothproofing	170	Rope preservative	169
		Rosin emulsions	153, 154
N		Rot-proofing emulsion	166, 167
Naphthenic miscible oils	122, 123	Rubber, dressing	162, 163
Naphthol dying after-treatment	171, 172	emulsion polymerized	72, 73
Natural resin emulsions	157	emulsions	159, 160
Night creams	41, 42	Rug, cleaners	21
		shampoos	21

Rustproofing emulsions	123	Textile dressings	165-173
		Texture paint	136
S		Thread lubricant	169
Salad, dressing	88, 89	Tire cleaner	25
starch paste	93	Toilet bowl cleaners	22
stabilizer	84	Toothpastes	58
Salicylic acid lotion	111	Toxaphene emulsions	3, 5
Sanitizers	25, 26	2,4-D emulsions	3, 4
Scalp lotion	111		
Screen-printing emulsion	171	V	
Scouring emulsion	167, 169	Vanishing creams	37, 38
Semi-gloss latex paint	137	Varnishes	128-130
Semi-paste paints	131	Vinyl acetate-acrylic ester emulsion	65
Shampoos	51-53	Vinyl acetate-dibutyl maleate emulsion	70, 71
Shaving creams	57, 58	Vinyl acetate, adhesive emulsion	67
Shellac emulsions	128	emulsion	68, 70
Shoe, adhesive	161	Vinylite emulsion	158
cleaners	22	Vitamin E ointment	112
Silicone, oil emulsion	162		
ointment	111	W	
polishing cloth	150	Water repellants	172
Silver polish	150, 151	Water-in-oil emulsions, medical	106
Skin abrasion ointment	111	Waterless hand cleaners	23, 24
Solidified gasoline	81	Wax-wash products	25
Softeners	167, 172	White-wall tire cleaner	25
Soil fumigant	5	Windshield washer concentrate	25
Solubilized oils	115-124	Woolen cleaner	20
Soluble oils, textile	168	Wound medicant	107, 108
Sound-deadening pads, adhesive for	9		
Spinning oil	169	Y	
Starching, luster emulsion	166	Yarn finish emulsion	167
Staybelite ester emulsion	155		
Steam cleaners	27	Z	
Steroidal emulsion	104	Zinc oxide, cream	47
Stipple paint	136	ointment	112
Styrene-butadiene emulsion	72		
Sulfadiazine ointment	112		
Suntan creams, lotions	58, 59		
T			
Tar emulsions	12, 13		

