Physical Properties of The AROCLORS

AROCLOR # 1242
AROCLOR # 1248
AROCLOR # 1254
AROCLOR # 1262
AROCLOR # 1269
AROCLOR # 4465
AROCLOR # 2565

CHEMICALS OF QUALITY
Monsanto
ST LOUIS, U.S.A.

Manufactured by

Monsanto Chemical Company
St. Louis, U.S.A.

New York—Boston—Chicago—San Francisco
Cleveland—Birmingham—Montreal—London

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Attachment 3-4

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The Aroclors

THE Aroclors have won a prominent place in the field of synthetics with unique properties to fill requirements not met quite perfectly by materials heretofore available. They have found wide usefulness in fields where their properties are of especial value.

Following is a description of the properties of seven Aroclors, each of which is representative of a series. There are other Aroclors with slightly different characteristics in each of these series.

A study of this brief description will suggest means of employing the Aroclor in perfecting still other products, development of which has been delayed by the lack of a material that exactly fulfills particular requirements.

A Description of the Aroclors

The Aroclors vary from water-white mobile oils and pale yellow viscous oils to light amber resins and opaque crystalline solids. For each of these light-colored Aroclors there is a corresponding gray or brown-black grade.

The Aroclors are produced exclusively by Monsanto Chemical Company.

Non-Flammability

The viscous Aroclor oils and the resins do not support combustion when heated alone even at their boiling points—temperatures above 350°C. Most of the Aroclors flux readily with resinous and pitch-like materials to give a product having a decreased fire hazard. When incorporated in nitrocellulose films the Aroclors retard the rate of burning.

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Electrical Properties

The Aroclors have extremely interesting electrical characteristics; high dielectric constant, resistivity and dielectric strength, and low power factor.

Solubility

The Aroclor oils and resins are easily soluble in most of the common organic solvents and drying oils. The hard crystalline materials are in general less soluble than the Aroclor oils or resins. All Aroclors are insoluble in water. For more complete information see the attached table. Compatibility data on Aroclors in nitrocellulose lacquers will be sent on request.

Adhesiveness

The Aroclor resins adhere strongly to smooth surfaces — to glass and metal or to smooth varnished or lacquered surfaces.

The softer Aroclors are suggested for difficult adhesive problems where a flexible non-drying waterproof material is necessary.

The Aroclor adhesives are thermoplastic; are readily applied hot without solvent; do not require high temperatures for easy application, and are set immediately upon cooling.

Thermoplasticity

The Aroclors are permanently thermoplastic. They apparently undergo no condensation or hardening upon repeated melting and cooling. The clear Aroclor resins are now being produced with softening points up to 110°C. The opaque crystalline solids are produced with initial melting points up to approximately 180°C.

Non-Drying Properties

The Aroclors are non-drying, and when they are exposed to the air, even in thin films, no noticeable oxidation or hardening takes place. However, when used as ingredients of lacquers, they do not retard the rate of drying of the lacquer films. Quick drying varnishes and paints may be made with Aroclor resins.

Vaporization Loss

The Aroclors have low vaporization losses as shown in the data in the table of physical properties.

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Table of Physical Properties of the Aroclors

	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1262	Aroclor 1269	Aroclor 4465	Aroclor 2565
Description (at room temperature)	Practically Water-White Mobile Oil	Practically Water-White Mobile Oil	Pale Yellow Viscous Oil	Light Yellow Soft Sticky Clear Resin	Cream-Colored Opaque Hard Crystalline Solid	Pale Amber Transparent Resin	Brown Black Opaque Resin
Color (1" depth of Aroclor)—Lovibond yellow No. 510	0.1 to 0.5	0.1 to 0.6	0.5 to 1.0	0.5 to 1.2		4.3 to 6.4	
Pour Point °C., (A. S. T. M. Method)	—17.7 to —20.7	—9	8.0 to 12.6	34.9 to 38.0			
Softening Point °C.; (A. S. T. M.)						60 to 66	68 to 72
Initial Hold Point in Freezing Curve (°C.)					235 to 245		
Condition at 0°C.	Viscous Liquid	Viscous Liquid	Soft Sticky Resin	Hard Brittle Resin	Same as at Room Temperature	Same as at Room Temperature	Same as at Room Temperature
Distilling Range (°C.; A. S. T. M. Method)	311 to 356	330 to 350	352 to 381	373 to 404	Too High for A. S. T. M. Method; Can Be Distilled at Atmospheric Pressure	Too High for A. S. T. M. Method; Requires Vacuum for Distillation	Too High for A. S. T. M. Method; Requires Vacuum for Distillation
Specific Gravity At 25°C./25°C.	1.374 to 1.393	1.445 to 1.456	1.543 to 1.550	1.646 to 1.653	1.870 to 1.876	1.713 to 1.733	1.723 to 1.740
Per Cent Increase in Volume Upon Heating from 25°C. to temperature specified	2.71 25° to 65°C.	25° to 65°C.—2.82% 25° to 250°C.—18.56%	2.64 25° to 65°C.	4.16 25° to 90°C.		2.45 25° to 65°C.	2.62 25° to 65°C.
Approximate Average coefficient of Expansion over range specified (cc./cc./°C.)	0.000678 25° to 65°C.	0.000702 25° to 65°C.	0.000661 25° to 65°C.	0.000640 25° to 90°C.		0.000611 25° to 65°C.	0.000656 25° to 65°C.
Pounds per Gallon at 25°C. (Average)	11.50	12.06	12.86	13.71	15.60	14.28	14.41
Decimal Part of Gallon Bulked by One Pound	0.0869	0.0829	0.0778	0.0729	.0641	0.0700	0.0693
Viscosity (Seconds Saybolt) at 210°F.	34.0 to 34.6	36.0 to 37.0	46.0 to 47.7	90.0 to 103.0	Solid	Too Viscous to Determine with Saybolt Apparatus	Too Viscous to Determine with Saybolt Apparatus
Viscosity (Seconds Saybolt) at 100°F.	81.1 to 93.1	200.0 to 210.0	1800 to 2400		Solid		
Flash Point °C., (Cleveland Open Cup)	176 to 180	196	None	None	None	None	None
Fire Point °C., (Cleveland Open Cup)	334 to None at Boiling Point of Liquid	None	None	None	None	None	None
Refractive Index for D-Line at 20°C.	1.627 to 1.629	1.630 to 1.631	1.6407 to 1.6410	1.6501 to 1.6517		1.664 to 1.667	
Maximum Acidity (Milligrams KOH per Gram)	0.01	0.01	0.01	0.02		0.02	1.26
Per Cent Loss on Heating (A. S. T. M.)	3.04 to 3.64	3.0 to 4.0	1.06 to 1.28	0.48 to 0.56	0.10 to 0.20	0.23 to 0.29	0.21 to 0.24

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Toxicity

Experimental work in animals shows that prolonged exposure to Aroclor vapors evolved at high temperatures or by repeated oral ingestion will lead to systemic toxic effects.

Repeated bodily contact with the liquid Aroclors may lead to an acne-form skin eruption.

Suitable draft ventilation to control the vapors evolved at elevated temperatures, as well as protection by suitable garments from extensive bodily contact with the liquid Aroclors, should prevent any untoward effect.

Odor and Taste

The solid Aroclor resins are almost without odor and taste at ordinary temperatures.

Stability

The Aroclors are remarkably resistant to the action of either hydrolyzing agents or high temperature. They are not affected by boiling with sodium hydroxide solution. Because of their stability to heat, the Aroclors are useful heat-transfer media. Aroclor 1254 and particularly the less viscous Aroclor 1248 are recommended for this purpose because they may be heated at temperature up to 325°C. (617°F.) in a closed system for long periods without appreciable decomposition and are at the same time nonflammable.

Action on Metals

The Aroclors are non-corrosive. Mild steel exposed to the action of Aroclor 1254 or Aroclor 1248 in a closed system at 325°C. (617°F.) for 848 hours showed no pitting and the corrosion rate, as measured in inches of penetration per year, was 0.0021.

Water and Moisture Proofness

The Aroclors are water proof. When impregnated into porous rigid bodies they are effective water and moisture proofers. Special Aroclor compounds are available for moisture-proofing such articles as paper and radio resistors and for water-proofing articles such as abrasive wheels.

STANDARD CONTAINERS

		50 gal. Drums
Aroclor	1242	500 lbs. net
Aroclor	1248	500 lbs. net
Aroclor	1254	500 lbs. net
Aroclor	1262	500 lbs. net
Aroclor	4465	500 lbs. net
Aroclor	2565	drums, 395 lbs. to 426 lbs. net.
Aroclor	1269	bags, 200 lbs. net. barrels, 400 lbs. net.

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Solubility of the Aroclors In Various Solvents

(Figures Represent Grams of Aroclor per 100 cc. Solvent)

Type of Solvent	Aroclor 1242 Cold	Aroclor 1242 Hot	Aroclor 1254 Cold	Aroclor 1254 Hot
Chloro Derivatives				
Chloroform	S*	S*	S*	S*
Carbon Tetrachloride	S	S	S	S
Ethylene Dichloride	S	S	S	S
Trichloro Ethane	S	S	S	S
Tricholoro Ethylene	S	S	S	S
Tetra Chloro Ethane	S	S	S	S
Mixed Amyl Chlorides	S	S	S	S
Mono Chlorobenzene	S	S	S	S
Ketones				
Acetone	S	S	S	S
Aldehydes				
Formaldehyde (40%)	I*	I*	I*	I*
Furfural	S	S	S	S
Amines				
Aniline	S	S	S	S
Pyridine	132.5@30°C.	440@99°C.	114@31°C.	425@100°C.
Drying Oils				
Tung Oil	S	S	S	S
Linseed Oil	S	S	S	S
Acids				
Acetic Acid	S	S	S	S
Oleic Acid	S	S	S	S
Miscellaneous				
Nitro Benzene	S	S	S	S
Carbon Disulfide	S	S	S	S
Water	I	I	I	I

*Note: S signifies very soluble or miscible in all proportions.
I signifies insoluble.
P.S. signifies partially soluble.

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Solubility of the Aroclors In Various Solvents

(Figures Represent Grams of Aroclor per 100 cc. Solvent)

Type of Solvent	Aroclor 1242 Cold	Aroclor 1242 Hot	Aroclor 1254 Cold	Aroclor 1254 Hot
Hydrocarbons				
Mineral Spirits	S*	S*	S*	S*
Gasoline	S	S	S	S
Kerosene	S	S	S	S
Paraffin	—	S@50°C.	—	S@50°C.
Benzene	S	S	S	S
Toluene	S	S	S	S
Xylene	S	S	S	S
Turpentine	S	S	S	S
Pine Oil	S	S	S	S
Hydroxy Derivatives				
Methyl Alcohol	42.5@29°C.	88.5@60°C.	15@26°C.	22.2@65°C.
Ethyl Alcohol (Formula 3A)	23.3@29°C.	80.0@70°C.	10@27°C.	28 @75°C.
Normal Butyl Alcohol	S	S	S	S
Amyl Alcohol	S	S	S	S
Glycerine	I*	I	I	I
90% Phenol	194@30°C.	S@99°C.	P.S.*	Slowly Soluble
Ethers				
Ethyl Ether	S	S	S	S
Cellosolve Acetate	S	S	S	S
Ether Alcohols				
Cellosolve	S	S	S	S
Carbitol	224@31°C.	307@99°C.	173@26°C.	259@ 98°C.
p-p' Dihydroxy Ethyl Ether	16.9@23°C.	19@99°C.	8@30°C.	10@100°C.
Esters				
Castor Oil	S	S	S	S
Methyl Acetate	S	S	S	S
Ethyl Acetate	S	S	S	S
Butyl Acetate	S	S	S	S
Amyl Acetate	S	S	S	S
Ethyl Lactate	S	S	S	S
Diethyl Phthalate	S	S	S	S
Dibutyl Phthalate	S	S	S	S
Tricresyl Phosphate	S	S	S	S
Cotton Seed Oil	S	S	S	S
Ethylene Glycol Diacetate	S	S	S	S

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