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AROCLOR® 1221, 1232, 1242

for polyvinyl acetate-emulsion adhesives

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Monsanto

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INTRODUCTION

Monsanto *Aroclor** chlorinated polyphenyls are a series of compounds serving a variety of needs. Each *Aroclor* can serve as a plasticizer for many of the synthetic resins. Properties imparted vary with the *Aroclor* chosen. In this respect the family of *Aroclor* compounds is analogous to a series of phthalate esters.

Aroclor 1221, 1232 and 1242 are three compounds especially suited for plasticizing polyvinyl acetate (PVA) emulsion adhesives.

These are important advantages of the Aroclor plasticizers specified —

1) Excellent tack and strong bonding power are imparted to PVA adhesives.

2) The compounds are low in cost.

3) The plasticizers are light colored.

4) *Aroclor* 1221, 1232 and 1242 are mobile liquids at room temperature. Plant handling is simplified since no pre-melting is required.

5) The plasticizers are readily blended with PVA emulsions by simple stirring.

6) The hardness desired in various adhesive applications can be varied by choice of *Aroclor* plasticizer without materially changing other properties of the adhesive.

7) The three *Aroclor* plasticizers recommended for PVA emulsion adhesives are comparable to *ortho*-Nitrobiphenyl, which has been displaced by these *Aroclor* plasticizers in PVA emulsions, with regard to tack and fiber-tear, as indicated by tests on a porous yellow paper and a melamine-coated Kraft stock.

8) *Aroclor* compounds are readily available.

*Aroclor: Monsanto Chemical Company Trademark. Registered in U. S. Patent Office.

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COMPATIBILITY

Tests conducted by Monsanto show *Aroclor* 1221, 1232 and 1242 are each compatible with PVA at the evaluation level of 11 parts of plasticizer in 100 parts of polyvinyl acetate emulsion.

LABORATORY DATA

Several PVA adhesive formulations using different plasticizers were made up and evaluated in our laboratories. The basic formulation consisted of 11 parts of plasticizer in 100 parts of polyvinyl acetate emulsion. Data tabulated below will allow the adhesive formulator to choose the most suitable plasticizer for the adhesive properties desired.

COMPARISON OF POLYVINYL ACETATE PLASTICIZERS
(100 parts polyvinyl acetate emulsion; 11 parts plasticizer)

Formulation Properties		ortho-Nitro-biphenyl	Dibutyl Phthalate	Aroclor 1221	Aroclor 1232	Aroclor 1242
Shore Hardness, A-scale		82	69	66	86	97
Low Temp. Flex., ° C		+2.2	−10.2	−5.9	+4.0	+5.3
Volatility (% plasticizer lost after 24 hrs. at 86° C)		3.8	4.0	4.8	4.3	4.0
Kerosene Extraction, (% plasticizer lost after 24 hrs. at room temperature)		3.2	4.1	4.5	3.8	4.2
Viscosity of Formulation*						
(Centipoises)	Initial	2160	2420	2240	2160	.....
	1 day	.....	2460	.....	.....	.....
	3 days	2200	.....	2200	2060	.....
	4 days	.....	2520	.....	.....	.....
	5 days	2280	.....	2200	2040	.....
	7 days	2340	.....	2180	2020	.....
	10 days	2460	.....	2260	2060	.....

*Initial viscosity of the polyvinyl acetate emulsion tested was 1500 centipoises.

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TYPICAL PROPERTIES AND SPECIFICATIONS

Tests conducted by Monsanto show Aroclor 1221, 1232 and 1242 are each compatible with

Property	Aroclor 1221	Aroclor 1232	Aroclor 1242
Appearance	Mobile, Colorless, clear liquid	Practically colorless, mobile oil	Practically colorless, mobile oil
Refractive Index @ 20° C	1.617 - 1.618	1.620-1.622	1.627-1.629
Chlorine, %	21.0±0.5	32.0±0.5	
Density, lbs. per gal. @ 25° C	9.85	10.55	11.50
Boiling Point, 760 mm Hg	275°-320° C	290°-325° C	325°-366° C
Pour Point (ASTM D-97)	Crystals at 1° C.	—35.5° C	—19° C
Flash Point (C.O.C.)	286°-302° F. 141°-150° C.	305°-310° F. 149°-152° C.	348°-356° F. 176°-180° C.
Fire Point (C.O.C.)	349° F. 176° C.	460° F. 238° C.	None, to boiling point
Viscosity, S.U.S. @ 37.8° C	38-41	44-51	80-93
54.4° C	35-37	39-41	49-56
98.9° C	30-31	31-32	34-35
Distillation Range ASTM-D-20 (modified)	275°-320° C	295°-355° C	325°-360° C

COMPARISON OF PLASTICIZED ADHESIVE FORMULAS

(100 parts polyvinyl acetate emulsion; 11 parts plasticizer)

Formulation Properties	Aroclor 1221	Aroclor 1232	Aroclor 1242
Shore Hardness, initial	82	81	81
Viscosity, Brookfield, 6 rpm, #3 spindle, 25° C	2160	2400	2240
Tensile Strength, psi	1100	1100	1100
Elongation, %	240	240	220
Water Resistance, 24 hrs. at 25° C	Softens	Softens	Softens
Kerosene Resistance, 24 hrs. at 25° C	Softens	Softens	Softens
Plasticizer lost after 24 hrs. at room temperature	3.2	4.1	3.8

MONSANTO SPECIFICATIONS

Property	Aroclor 1221	Aroclor 1232	Aroclor 1242
Color, APHA max.	100	100	100
Specific Gravity A 25/155° C	1.182-1.192	1.270-1.280	1.381-1.392
Acidity, mg. KOH/gm. max.	0.014	0.014	0.015
Viscosity @ 100° F., S.U.S. (37.8° C)	38-41	44-51	80-93

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ODOR MASKING FOR SPECIAL APPLICATIONS

When necessary, the slight odor imparted to PVA adhesives by these *Aroclor* plasticizers can be completely and economically masked. One drum of adhesive is effectively masked by the addition of only 6 grams of either Odormasque* 1004 (camphor odor) or Odormasque 1066 (fruity odor). Thus one pound of Odormasque is enough to treat 75 drums of adhesive. Even after 40 hours' aging at 150° F, the maskant odor was retained by dried adhesive films containing 0.005 per cent Odormasque (based on resin).

**Odormasque*: Registered Trademark of Polak & Schwarz, Inc., New York, N. Y.

TOXICITY AND SAFE HANDLING

The oral LD_{50} of Aroclors 1221, 1232, and 1242 in rats is approximately 4.0 grams, 4.5 grams, and 8.5 grams per kilogram respectively. This indicates that the compounds are not particularly toxic following single oral ingestion.

When the Aroclor compound is applied undiluted to the skin of rabbits the minimum lithal dose is 2 to 3.1 grams per kilogram for "1221", 1.25 to 2.0 grams per kilogram for "1232", and 0.8 to 1.25 grams per kilogram for "1242". In this range of skin absorption doses, the compounds can be classified as "slightly toxic", "mildly toxic", and "moderately toxic" respectively. It is recommended that repeated or prolonged skin contact be avoided.

In animal inhalation studies, Aroclor vapors do not present a hazard if the compounds are used at ambient air temperatures. When used at elevated temperatures, the inhalation of vapors should be avoided.

SHIPPING

Shipping Classification	— Chlorinated Diphenyl/Synthetic resin, Liquid N.O.I.B.N.
Shipping Regulations	— None
Standard Containers	— Aroclor 1221 Tank car, 520 lb. steel drum
	Aroclor 1232 Tank car, 550 lb. steel drum
	Aroclor 1242 Tank car, 600 lb. steel drum

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Furthermore, nothing contained herein shall be construed as a recommendation to use any product in conflict with existing patents covering any material or its use.

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