

AROCLOR 1254
CO-PLASTICIZER WITH DOP FOR VINYL
ORGANOSOLS AND PASTES

Monsanto Chemical Company

Phosphate Division

St. Louis 4, Mo.

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Aroclor 1254* (chlorinated biphenyl) is used commercially as a co-plasticizer with DOP (dioctyl phthalate) in vinyl organosols and pastes because Aroclor offers the following advantages:

1. Attractive reduction in costs.
2. Aroclor is a superior pigment grinding and pigment dispersing medium.
3. Incorporation of Aroclor 1254 markedly reduces the flammability of the finished plastic.
4. Aroclor offers outstanding electrical properties.
5. Aroclor offers toughness and strength and in other respects the over-all qualities of the plastic such as "hand", flexibility and gloss are maintained.
6. Aroclor 1254 resists attack by biological influences.

*Reg. U. S. Patent Office

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I. INTRODUCTION

Polyvinylchloride organosols are dispersions of the plastics resin in plasticizer and solvent-diluent mixtures. Organosols are high in solids content and therefore overcome expensive solvent loss and multiple coating operations associated with the older solution type of coating methods.

A further step leading to almost complete elimination of solvents is the use of plastisols or pastes which are dispersions of the vinyl resin in the plasticizers. Such pastes are particularly advantageous for coating paper and other materials where the use of inflammable solvents is prohibitive and a single pass coating operation is desired.

Organosols are used to make free films for shower curtains, rainwear and to coat fabrics used for upholstery, etc. Plastisols are especially useful for coating paper in making draperies, table clothes, etc.

This bulletin indicates the advantages of using Aroclor 1254 as a co-plasticizer with dioctyl phthalate in vinyl-chloride organosols or pastes. It has been found feasible to replace as much as 50 percent of DOP with Aroclor 1254. Since Aroclor is substantially less expensive than DOP or the vinyl resin, this practice offers attractive economies. It also offers substantial improvement in the flame resistance and electrical qualities of the plastic without altering its other desirable physical qualities. Moreover, Aroclor 1254 is outstanding as a medium for grinding and dispersing the pigments used in the coating.

II. PREPARATION

a. Grinding the Pigments:

For aesthetic reasons pigmented organosols are often required and the pigments are ground on a three-roll mill. We strongly recommend Aroclor 1254 as an unusually good grinding and dispersing medium for this purpose and believe it to be far superior in this respect to other plasticizers commonly used in organosols. The finished pigment grind is added to the main organosol formulation where allowance should be made for the Aroclor 1254 plasticizer added as a component of the pigment grind.

b. Grinding the Organosol:

A conventional type ball mill is used to grind the organosol. Unless the mill is water cooled, it is necessary to use flint pebbles instead of steel balls to grind the dispersion because the steel balls tend to build up heat, resulting in undesirable thickening of the organosol. It is the consensus that the temperature during the grinding should not exceed 110°F.

Although variations may be used in the order of adding the organosol ingredients to the mill, a suggested order is to add first the solvent-diluent mixture. Xylene is frequently used as the solvent and Apco or similar thinner as the diluents. Next the Aroclor 1254-DOP plasticizer combination is added and finally the vinyl resin.

The organosol is ground until a uniform paste is formed. Then the Aroclor 1254-pigment grind is added and the ball milling is continued until the final suspension is uniform. While the time of grinding will vary, usually 18 to 24 hours is sufficient.

III. FORMULATIONS

Organosols usually require special adjustments in formulating to accommodate the working characteristics of the specific use applications. Accordingly, the following formulation is given only to indicate a starting point in making an organosol for free film or coating work. It is a white pigmented product based on the use of 60 percent solids and 40 percent solvent-diluent mixture.

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Ingredients	Organosol	Film Solids
Polyvinylchloride (VYNV-1)	33.0%	55%
Aroclor 1254	7.2	12
Diocetyl phthalate	8.4	14
Victor Stabilizer 53 or 85	0.6	1
Pigments*	10.8	18
Xylene	25.0	
Apco Thinner	15.0	
	100 %	100%

*Titanium dioxide, basic lead sulfate and basic lead carbonate.

Referring to the working qualities of the organosol, Aroclor 1254 acts very similarly as DOP. Both materials are not strong solvents for the vinyl at room temperature but become active solvents at the elevated temperature used to fuse the organosol.

Aroclor 1254 is more viscous than DOP and may not be quite as strong in plasticizer action. Therefore, in using combinations of Aroclor 1254 and DOP, it may be desirable to adjust the xylene-Apco thinner ratio to use slightly larger amounts of xylene than is the case when DOP plasticizer is used alone. Where stronger solvent action is required relatively small amounts of diisobutyl ketone or methylisobutyl ketone may be used with the thinner.

In some applications it may be possible to use the Aroclor 1254-DOP plasticizer combination in larger amount than is the case when DOP is used alone as the plasticizer. This practice offers additional economies because the Aroclor is substantially less expensive than DOP or the vinyl resin. This practice also reduces the amount of solvent and thinner and frequently the solvent-thinner ratio to total solids is about 30 to 70.

IV. APPLICATION

a. Coating:

The organosol film is substantially discontinuous and can be applied very heavily using the same equipment commonly used for any other spread coating. In coating work, the first coat should be tight (2 to 3 dry ounces) to get good adhesion, but subsequently as much as 8 to 12 dry ounces per running yard may be applied in a single pass.

b. Drying:

The coating is dried at 180°F. to 250°F., using regular drying equipment.

c. Fusing:

Fusion will not take place below 350°F. and the most common fusing methods are to apply temperatures of 350°F. to 400°F. from three to five minutes, or 400°F. to 500°F. for one minute or less. The only time required at the fusing temperature is that necessary to bring the film to the fusing point; in many cases one minute or less is sufficient. To prevent discoloration of the film and weakening of the fabric, heat in excess of that required for fusing should be avoided. However, the highest practical fusing temperature should be used.

Hot air is the most common source of heat but infra-red is also used and direct contact with hot surfaces is effective. Familiar types of installations are gas-fired ovens, super-heated steam, electric coils, strip heaters, infra-red lights and heated cylinders.

Although Aroclor 1254 is noncombustible at the fusion temperatures, vapors from other plasticizers and especially residual solvent are inflammable and accordingly the fusing chamber equipment should not provide a source of ignition.

In light of the elevated temperatures used during fusion, it is pointed out that vapors which may be emitted when Aroclor 1254 is heated to high temperatures bear a degree of toxicity and should not be breathed. It is presumed that the organosol fusion is carried out in a closed system provided with suction fans to remove vapors, which precludes workers from coming in contact with them. The vapor pressure of Aroclor 1254 is relatively low and the values are given at 100°, 350°, 400°, and 450°F. as 0.00006, 4, 10 and 30 mm. Hg., respectively.

V. DECORATION

a. Embossing:

Either a flat plate or a roll press may be used for embossing before or after fusion. Care should be taken to avoid cutting through the coating if the embossing is done before fusion since the film is weak at this stage. The time of the embossing operation is usually 2 to 5 seconds at 160°F. to 200°F.

b. Stencilling:

Silk screen stencilling or printing must be done before fusing, and the drying time of the printing ink must be slow enough to avoid drying out on the screen, yet fast enough to permit reprinting with other colors in a reasonable time.

VI. PROPERTIES OF THE FREE FILM OR COATINGS

a. Dermatology:

A free film made up of polyvinylchloride containing about 12 percent by weight of Aroclor 1254 (about 25 parts of Aroclor 1254 based on 100 parts of vinyl resin used) and a similar amount of dioctyl phthalate along with standard white pigments such as titanium dioxide was found free from irritating or sensitizing the skin in accordance with standard skin patch tests. Moreover, similar studies made with Aroclor 1254 alone indicate that this plasticizer is neither a skin irritant nor sensitizer. While this indicates safety in using Aroclor 1254, we are not developing use of this plasticizer for items such as baby pants made from plastics materials.

b. Vaporization Rate of the Plasticizer:

The vaporization rates of Aroclors 1248, 1254 and 1260 compare most favorably with the similar values for DOP and other vinyl plasticizers selected for comparison because of their known low vaporization rates. This is indicated in the following table:

Plasticizer	Surface Area cm ²	Vaporization Rate gms/cm ² /hr./100°C.
Aroclor 1248	12.28	0.000152
Clorafin 42-S	12.28	0.000126
Flexol-DOP, dioctyl phthalate	12.28	0.000117
Dutrex 25	12.28	0.000087
Aroclor 1254	12.28	0.000053
Dutrex 20	12.28	0.000016
Aroclor 1260	12.28	0.000009

c. General Film or Coating Qualities:

From reliable sources in the trade using Aroclors with dioctyl phthalate to plasticize organosols, it is indicated that the light stability and heat stability of the free films and fabric or paper coatings compare most favorably with the similar values where DOP is used as the only plasticizer.

Usually Victor stabilizer 53 or 85 is used to improve light stability of the vinyl plastic. Basic lead carbonate, sulfate and silicate are commonly used as the heat stabilizers. Such properties as "hand", toughness, abrasion resistance, flexibility and gloss of the films and coatings derived from the Aroclor 1254-DOP plasticized organosols seem to compare most favorably with the similar qualities of the vinyl plastic containing DOP alone.

The use of Aroclor results in a substantial improvement in fire resistant qualities of the plastic. A vinyl composition plasticized with 50 parts of DOP showed a flame-out time of 75 seconds, whereas a similar plastic using a 50-50 mixture of Aroclor-DOP at 80 parts plasticizer showed a flame-out time of only 2 to 3 seconds. Aroclors are noted for their excellent electrical qualities. Vinyls plasticized with Aroclor-DOP combinations have very good electrical qualities and are somewhat better in this respect than similar plastics prepared with DOP alone.

Another point worthy of mention is that Aroclors are not susceptible to attack by fungi and have a pronounced repelling action against soil mites including termites. These factors are important where the finished plastic item must resist attack by microorganisms.

VII. SAVINGS ACCOMPLISHED BY USING AROCLOR 1254 IN COMBINATION WITH DOP

The following specific gravity values and selling prices (car lot quantity) of the various materials were used in making the cost calculations:

Material	Sp. G.	Selling Price/Lb.
PVC (VYNV)	1.35	\$.34
Aroclor 1254.	1.54	.18
DOP	0.980	.43

Comparative costs are given in terms of a cubic foot of the plastic material including only the vinyl resin and plasticizers. The saving possible by using various amounts of Aroclor 1254 in combination with DOP as compared with the use of 50 parts DOP per 100 parts resin are given:

Plastic Composition	Cost/Cu. Ft.	Saving/Cu. Ft.
1) 50 parts DOP — 100 parts resin	\$27.68	
2) 50 parts (50-50 Aroclor 1254-DOP — 100 parts resin	26.53	\$1.15
3) 70 parts (50-50 Aroclor 1254-DOP — 100 parts resin	26.07	1.61
4) 70 parts (60-40 Aroclor 1254-DOP — 100 parts resin	25.74	1.94

VIII. ADVANTAGES OF USING AROCLOR 1254 IN COMBINATION WITH DOP

1. Depending on the plasticizer ratios used as indicated above, it is possible to save from \$1 to \$2 per cubic foot of plastic.
2. Aroclor 1254 offers superior pigment grinding and pigment dispersing qualities in preparing the organosol.
3. The use of Aroclor 1254 in these plastics markedly reduces their susceptibility to burning.
4. Aroclor offers outstanding electrical properties and resistance to organism attack.
5. Aroclor offers toughness and tensile strength and in other respects the over-all qualities of the plastic such as "hand", flexibility and gloss are maintained.

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For further information about Aroclor 1254 Co-Plasticizer with DOP for vinyl organosols and pastes contact the nearest Monsanto office.

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