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CHLORINATED POLYOLEFIN *is the basis of a new primer that offers finishers of high and low density polyethylene and EPDM rubber a pretreatment that imparts excellent adhesion to a wide variety of industrial finishes, lacquers and enamels.*

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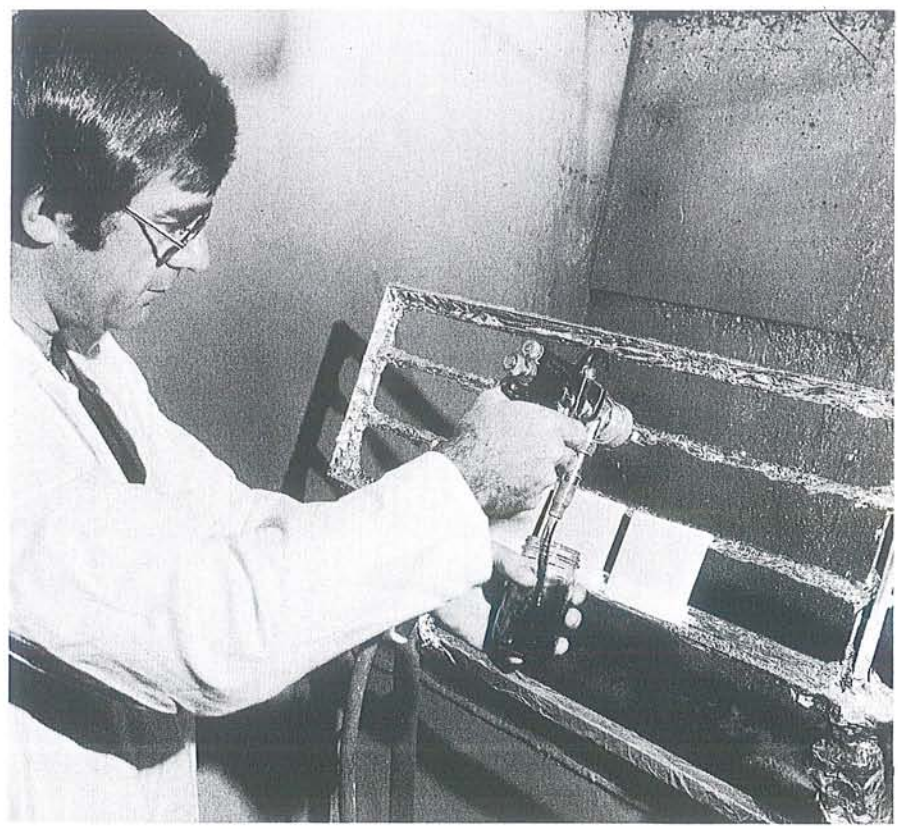
POLYETHYLENE probably tops almost everyone's list of plastics considered tough to coat. It has naturally poor wettability, and its non-porous and generally smooth molded surface resists the development of good paint adhesion. Decorative or protective topcoatings can, usually, be applied only after the surface of the plastic has been treated to make it more receptive to the coating. Methods of treatment vary, though all procedures either chemically or mechanically alter the surface of the plastic. Conventional treatments include flame, electronic or corona discharge, solvent and acid etching procedures.

New Alternative

Eastman Chemical Products, Inc., has recently introduced a new alternative method — a chlorinated polyolefin (CPO) primer that can be applied by either spraying or dip coating. It has also proved effective on some types of ethylene-propylene-diene terpolymer (EPDM) rubbers, another group of materials noted for their poor receptivity to paint. EPDM rubber surfaces are conventionally prepared by applying a benzophenone treatment that is subsequently irradiated.



A primer based on CP-153-2 is shown here being applied to the surface of clean, untreated high density polyethylene panels. The tests were conducted in the Technical Service Laboratory of Eastman Chemical Products, Inc.

Table I — Adhesion of Topcoats to Primed Polyethylene and EPDM Rubber Plaques

Type of Topcoat	High-Density Polyethylene	Low-Density Polyethylene	EPDM Rubbers
Conventional oil-base enamel	Excellent	Excellent	—
Modified acrylic lacquer	Good	Excellent	—
Unmodified acrylic lacquer	Excellent	Excellent	Excellent
Acrylic enamel	Excellent	Excellent	—
Alkyd enamel	Excellent	Excellent	—
Nitrocellulose lacquer	Fair	Fair	—
2-Part urethane system	Excellent	Excellent	Excellent

Table II — Suggested Rule 66 Exempt Solvent Blends for CP-153-2

Solvent	Volume (%)	Weight (%)
Methylene Chloride-Based Blend		
Toluene	11.9	8.34
Xylene	7.9	5.54
Methylene chloride	80.2	86.12
	100.0	100.00
Solubility parameter	9.682	
Hydrogen bonding	2.222	
Dipole moment	1.359	
Lbs/gal	10.337	
Evap. time	9.9	
Cyclohexane-Based Blend		
Solvent		
Toluene	11.9	12.92
Xylene	7.9	8.58
Cyclohexane	80.2	78.50
	100.0	100.00
Solubility parameter	8.326	
Hydrogen bonding	0.858	
Dipole moment	0.565	
Lbs/gal	6.671	
Evap. time	3.6	
Tetrahydrofuran-Based Blend		
Solvent		
Toluene	11.9	11.68
Xylene	7.9	7.76
Tetrahydrofuran*	80.2	80.56
	100.0	100.00
Solubility parameter	9.056	
Hydrogen bonding	10.081	
Dipole moment	1.359	
Lbs/gal	7.377	
Evap. time	3.567	

NOTE: When using any of the above blends, especially the cyclohexane-based blend, heat plus agitation will facilitate dissolving the resinous ingredients.
*THF is a peroxide former and should be handled with care.

The new CPO, designated CP-153-2, offers finishers of high and low density polyethylene and EPDM rubber a new method of pretreatment with correspondingly new characteristics and benefits. Eastman supplies it as a 25 per cent solution in xylene.

In evaluation tests conducted in Eastman technical service laboratories, the primer provided excellent adhesion for a wide variety of commonly used topcoats when a thin (0.1-mil dry solids) coating of a five per cent CP-153-2 solution was applied to properly cleaned untreated polyethylene and some EPDM rubber plaques. The test materials included conventional oil-based enamels, two-part urethane systems, modified and unmodified acrylic lacquers and enamels, and alkyd enamels.

It was found that proper cleaning of the polyethylene surface was necessary to obtain maximum adhesion. Before the primer was applied, the test panels were thoroughly cleaned, using oil-free cloths moistened with xylene or toluene. A five per cent solution of CP-153-2 was sprayed on the panels and fully dried.

Adhesion Test

After the topcoat was applied and dried by conventional means, an adhesion test was conducted by scoring a cross-hatched pattern in the coating, applying No. 600 cellophane tape firmly across the scored area, and then removing the tape by pulling it rapidly and evenly from the surface. The results were arbitrarily rated on a scale of excellent-good-fair-poor, based on the proportion of the coating remaining after the tape was pulled. The ratings are shown in Table I.

Unlike some surface preparation procedures, notably flame-treating, no time limit need be observed between the application of the primer and the application of the topcoat; the only requirement is that the primer coat must be at least 0.1-mil dry solids thick and completely dry prior to topcoating.

Post-Assembly Decorating

Primed molded parts may be stored prior to topcoating. This feature is of special interest to decorators and such end-users as automotive, appliance and lawn furniture manufacturers, who prefer to decorate after the molded item has been assembled with metal materials. CP-153-2 primed polyethylene and EPDM rubber parts can be painted with the entire assembly — receiving the same paint as the metal components.

Post-assembly decorating offers important advantages. Lower pigment costs are possible since less pigment is employed when only the surface is colored. And, color adjustment can be accomplished at the point of final finishing, thereby eliminating color matching problems and shade differences.

Yet another application, suggested by the durability of CP-153-2, is a primer for polyethylene coated wall

coverings. Oil-based enamels show improved adhesion to polyethylene coated panels when a one-tenth-mil coating has been applied to the panels. This feature offers the possibility of manufacturers producing polyethylene coated wallboards that can be redecorated.

Texture Unaffected

When applied in a five per cent solution, the primer will not affect the surface texture of most substrates — an important feature in the decorative finishing of substrates that have textured or other molded-in surface features desirable in the final product.

Where surface detail is important, such as matte finished housewares and blow-molded bottles, the heat of flame-treatment can, under some conditions, undesirably alter the surface texture. In these circumstances, CP-153-2 can offer an alternative that does not physically change the desired surface quality.

CP-153-2 may also be used as a spot-primer, a benefit that is not practical with many other pretreatment methods. Spot-priming offers the advantage of limiting priming only to the area that is to be decorated or labeled.

The imprinting of identification on extruded polyethylene wire and cable jacketing and piping appears to be another promising market for the new primer. By simply compounding a pigment, such as titanium dioxide or carbon black, into a solution of the primer, an imprinting coating can be formed that will adhere directly to the polyethylene extrusion. In effect, the CPO becomes both the vehicle and the film former for the pigment.

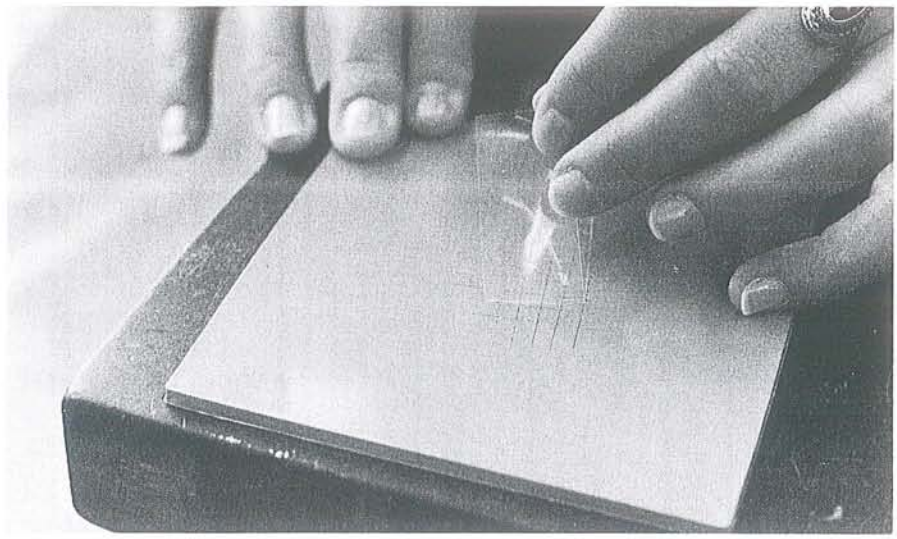
Inks formulated in this manner can be used to mark hot extruded polyethylene surfaces coming directly from the extruder or extrusion coating equipment, thereby providing an economical means of compliance with regulations that require pipe and wire and cable jacketing to carry continuous identification and specification markings.

Though the solubility of CP-153-2 is limited to aromatic hydrocarbons and chlorinated solvents, such as methylene chloride, it may be blended into Rule 66 exempt solvent formulations (Table II) by lowering the nonvolatile level of the CPO and through the incorporation of modifying resins. Limited solubility prevents the primer from redissolving when the topcoat is applied. Table III lists typical solution and resin properties.

Table III — Typical Properties of CP-153-2*

Solution Properties (25% CP-153-2 in Xylene)	
Specific gravity, 25°/25°C.	0.970
Viscosity (Brookfield), 25°C. (cp)	500-800
Flash point, Tag Open Cup, °F. (°C.)	86 (30)
Tag Closed Cup, °F. (°C.)	81 (27)
Fire point, °F. (°C.)	86 (30)
Color (Gardner)	12-15
Resin Properties	
Specific gravity, 25°/25°C.	1.105
Hardness (Tukon), Khn	<2
Solubility in:	
Xylene	Soluble
Toluene	Soluble
Trichloroethylene	Soluble
Methylene chloride	Soluble
Heptane	Insoluble
Ethyl alcohol	Insoluble
Ethyl acetate	Insoluble
Methyl ethyl ketone (MEK)	Insoluble

*These typical properties are reported for information only.



Adhesion test is conducted. See Table I for results.

Topcoating high density polyethylene primed with CP-153-2.

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