

So You Want to Paint Plastics?

Coating for plastics, regulatory considerations, application methods. . .

By **BILL BALLWAY**
Chemical Coatings Market Manager
The Sherwin-Williams Company
Cleveland, Ohio

When establishing specifications for painting plastic parts, the type of plastic, how it was manufactured and the product's end use all play a role in coating selection. Additional considerations include government regulations, how the coating will be applied and various cost factors.

Coatings for plastic parts are specified to protect the substrate and/or enhance the appearance of a product or its components. Coatings protect plastic substrates by providing a chemical barrier that retards degradation of the plastic polymer. Plastic substrates frequently do not have good chemical resistance to certain solvents, acids, bases, and other organic and inorganic compounds.

Prolonged exposure to ultraviolet light causes degradation of the plastic polymers as well as discoloration. Coating plastics allows them to be used in applications where they would otherwise be poorly suited.

Uniform color can be produced on plastic parts that have been made using different plastics or manufacturing techniques or on plastic and metal combination parts. For example, color matching a vacuum-formed part coupled with a molded-plastic part is difficult. Even when the same material is used but processed differently, a good color match is difficult. The proper coating can solve this problem.

Filling and texturing are two ways coatings enhance the appearance of



CONTEMPORARY ABS plastic telephone has a high-gloss polyurethane finish.

plastics. Plastic substrates often have swirl patterns, porosity, knit lines and other surface defects that result from processing. Filling refers to a coating's ability to level these surface defects.

Texture refers to the pattern created when paint spatters into a variety of droplet sizes and shapes and gives the substrate a mottled yet attractive appearance. Texturing or spattering minimizes surface irregularities and gives a three-dimensional appearance to the coating. Differences are clearly recognizable and serve almost as a signature on some manufacturers' products.

In most cases, a two-coat process is required to achieve the texturing effect. The first is a smooth coat that

provides complete coverage. After the recommended flash off or drying of the first coat, the second coat is applied to obtain the desired spatter effect.

The texture effect can be varied by altering the atomizing and fluid pressure of conventional spray systems. The lower the atomizing pressure, the larger the pattern. Reversing the pressure results in fine patterns. The height of the pattern also can be adjusted by varying the viscosity. The lower the viscosity, the flatter the pattern. In most cases, no reduction or a slight reduction is required to achieve the texture effect. Once these variables are set, it is relatively simple to obtain a consistent and reproducible texture.



FOOTBALL HELMET, constructed of ABS plastic, has a high-gloss polyurethane finish directly applied to the substrate.

After painting, the coating must be allowed to dry or cure, sometimes for more than a week, while the chemical reaction completes itself. Using heat (force drying) accelerates this process, but the curing temperature must never exceed the heat-distortion temperature of the plastic substrate.

During the curing process, coated plastic parts should never be stored in airtight containers such as plastic bags. The build-up of organic solvents and reaction by-products could cause improper cure and adhesion failure.

Coating Types. Coatings can be categorized according to their solvent systems, either solvent-based or water-borne. The solvent is either a compound or a mixture of compounds

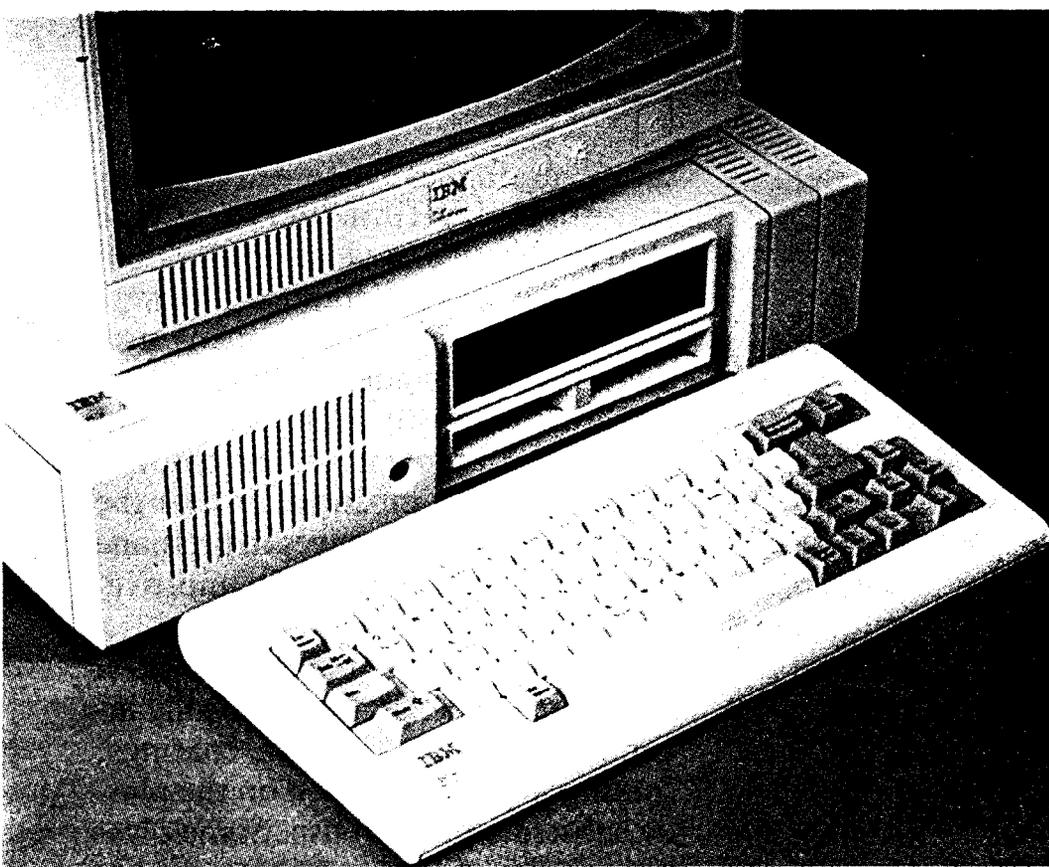
that evaporate as the coating dries or cures. Solvent-based coatings provide a tough, durable paint film because the solvent that dissolves the paint resin will often penetrate the substrate, stimulating a cross-linking reaction between the plastic and the coating.

Urethane Coatings. As plastics technology has advanced, so have coatings systems used by the plastics industry. For example, the introduction of polyurethane plastics led to the development of urethane coatings. Urethane coatings involve the reaction of an isocyanate and a hydroxyl compound to achieve a high degree of cross-linking. The result is a finish with excellent chemical resistance, hardness, corrosion resistance and abrasion resistance.

When the correct hydroxyl polymers and isocyanate prepolymers are used, urethane coatings having excellent elastomeric qualities and outstanding adhesion to flexible substrates result. Urethane coatings also have the higher-solids required to fill surface defects.

These properties can be obtained by air drying or force drying urethane coatings at low temperatures on plastics having low heat-distortion temperatures.

Most urethane coatings used on plastic substrates are two-component polyurethane systems. One component contains the hydroxyl polymer and the other the isocyanate prepolymer. When the two packages are mixed the cross-linking reaction be-



**LOW-BAKE,
WATER-BORNE**
textured
enamel
provides a
durable,
low-cure finish
on this video
display
terminal.

gins and continues until the mixture becomes too viscous to spray.

Water-borne coatings are used by the plastics industry for a number of reasons. The low amount of solvent reduces the possibility of solvent attack on the plastic substrate. Also, water-borne coatings may be air or force dried at extremely low temperatures to avoid heat distortion. And, the high flash point of water-bornes, due to the water and small amount of co-solvent, helps reduce insurance premiums.

Although water-borne coatings tend to have slightly weaker physical and chemical properties than solvent-based systems, they have excellent chemical, solvent and abrasion resistance. They are typically single-component systems that can be used with or without reduction, depending on the coating.

Because water-bornes evaporate slowly, they perform best when a longer flash-off time is allowed. This helps prevent blistering and water entrapment. Water-borne coatings are not recommended when painting under hot and humid conditions on hygroscopic plastics, due to the likelihood of water absorption. Also, water-borne coatings often do not have the solids required to fill major surface defects inherent in many plastics.

Regulatory Compliance. In recent years federal, state and local regulatory agencies, including OSHA and EPA, have limited solvent emissions. These Volatile Organic Compound (VOC) regulations affect the type and amount of solvents used in coating compositions. Coatings in compliance with these requirements include medium-solids coatings using most

So You Want to Paint Plastics? . . .



pH METER, constructed of polycarbonate, is coated with a low-gloss polyurethane finish.

chlorinated solvents, water-borne coatings and high-solids coatings.

Most chlorinated solvents are exempt from the regulations because they form negligible amounts of oxidants, which contribute to ozone formation. However, some states have not exempted 1,1,1-trichloroethane and methylene chloride.

High-solids urethanes provide an excellent way to achieve compliance. These newer coatings combine basic urethane technology with new polymers to produce a coating that provides superior filling, increased transfer efficiency and lower unit cost. The coatings also coat more parts per gallon than other types of compliance coatings for plastic. The new high-

solids urethanes also deliver outstanding dry-film performance characteristics traditionally associated with urethane finishes.

Because the two-component urethanes have a higher solids content, pot life is relatively short. Special application equipment has been developed to provide mixing at or near the spray gun. New advances in urethane technology have resulted in improvements in these areas.

Matching Coatings and Substrates. Since some plastics are chemically incompatible with certain coatings, coatings should be tested on the plastic substrate prior to use. Some plastics require special pretreatment before coating.

Structural foam plastics should be allowed sufficient time to outgas. Coating this plastic before all the blowing agent has dissipated from the substrate will cause blistering. The outgassing time varies with different plastics and blowing agents.

During the manufacture of structural foam, plastic surfaces are often contaminated with a mold-release agent used by manufacturers to keep the plastic from adhering to the mold. Contamination causes the coating to adhere poorly to the plastic. Mold release agents can be removed using alcohol solvents such as ethanol, propanol, isopropanol or butanol. A 10 pct solution of methyl ethyl ketone in water can be used whenever mold release is difficult to remove.

Structural foam plastics are often available in injection-molded ver-

sions. Injection-molded polyphenylene oxide, polycarbonate, ABS and polystyrene normally do not require a filler, sealer, or barrier coat because they already have a smooth surface. In most cases, a topcoat can be directly applied.

Thermosetting plastics require stronger solvents, including aromatic hydrocarbons such as methyl ethyl ketone or methyl isobutyl ketone, for cleaning. These plastics have a chemically inert surface that makes strong adhesion difficult to achieve. Consequently, two-component polyurethanes are recommended for their strong bonding properties.

Reaction Injection Molding (RIM) manufacturing processes in some cases create a plastic surface that is not chemically complete and, consequently, is sensitive to solvent attack. Certain solvent systems can rupture the surface of a RIM part, causing the painted surface to appear pitted.

Application Methods. Coating a product may involve several operations, all adding to the product's production or unit cost. These operations include cleaning, chemically treating and coating the substrate, which may include priming and applying one or more topcoats.

Paint can be applied using conventional, airless, electrostatic spray, dip, flow-coat and brush methods. The most common application method for plastics is conventional air spray. Electrostatic methods are sometimes used but to a limited degree. Dip, flow-coat and brush applications are

not recommended for plastics finishing.

In conventional spray applications compressed air is used to atomize a fluid coating. The coating is then sprayed through a siphon-suction-feed or pressure-feed gun, the latter being more common. Pressure-feed guns are equipped with an air cap that does not create a vacuum, so the coating is forced to the spray gun by pressure from a supply tank. Suction-feed systems typically require more reduction (a thinner liquid) than do pressure-feed systems. Because of this, they are not recommended for texture coats.

Some two-component coatings require equipment that mixes the materials at the gun. Each component is fed into the spray gun through separate metering devices. Flow control valves and metering valves prevent the materials from coming in direct contact with each other until mixed at or near the spray gun.

Coating plastics is more complicated than simply applying a coating to a plastic substrate. When coating plastics the substrate must be considered. What type of plastic is it? How was it manufactured? What is its end use? In addition, the coating must be carefully considered not only for its VOC content and cost, but how it reacts with the substrate and how it will be applied. Once these factors have been thoroughly examined, you are ready to paint plastics.

For more information on plastic coatings, circle 286 on Postpaid Card.