Powder Coatings A Comparison of the European I United States Approaches

# By John Birch

Powder coatings continue to be success stories in the worldwide coatings industry. From a slow start, the U.S. market is now embracing powder coating in numerous applications. In this article, some of the differences between Europe and the U.S., particularly with respect to certain types of raw materials and end-use applications, are presented. Architectural aluminum, for example, is one of the largest market segments in Europe, yet one of the smallest in the U.S. The role of bonding in metallic powder coatings is also discussed.

**P**owder coatings have been around for more than 30 years, with some of the major developments occurring in the '60s and '70s with the introduction of extruders to the manufacturing process, electrostatic spray to the application process, and numerous new raw materials that make powder coating a more attractive option.

During the same period, there were significant differences in the growth of the European and U.S. markets. Each went its separate way. From the beginning, the American market was dominated by functional coatings. In these, color and appearance are not as important as the chemistry, stoichiometry and curing, so that the desired degree of corrosion and insulative protection can be achieved. Typical examples of functional coatings include pipe coatings, rebars and electrical insulation applications.

By contrast, the Europeans concentrated on the decorative market, with extensive development taking place initially in Germany and the Benelux countries. In the U.K., many of the early companies that entered the market had continental partnerships with either licensing or joint venture agreements. The decorative market encompasses areas in which color and appearance are usually critical. The coating usually affords a degree of protection as well. Here, typical examples include domestic appliances, automotive components, architectural aluminum and a general industrial category that involves office furniture, partitions, racking and miscellaneous domestic items.

#### The U.S. Market

While Europe was concentrating on decorative powders, the U.S. was very much a late starter, seeming to feel that powder coatings were little more than just an experiment that would not last. Happily, this situation is changing fast. Growth in the decorative thermoset area projected to the end of the millennium suggests annual increases of 10-15 percent, set against the normal increases in the coatings industry of 0-2 percent for the bulk of the technologies, including water-based and high solids. This pattern makes powder coating the fastestgrowing finishing technology in the U.S. and mirrors the European situation of 5–10 years ago. Current growth is being fueled on both sides of the Atlantic by increasing environmental pressures.

Overall, there are between 65-70 current powder producers in the U.S. The number fluctuates as a result of new starts and mergers. The major players are Morton, Ferro and O'Brien, accounting for more than 50 percent of the market. Of these three companies, only Ferro is represented in Europe. The appliance and automotive industries are the two largest segments, accounting for more than one-third of the market. The excellent detergent resistance and film integrity properties make powder coatings easy choices for domestic appliances. Their post-forming capabilities, along with the introduction of blanks, will continue the trend toward powder. The automotive industry uses powder coatings on wheels, bumpers, hubcaps and door trim, as well as numerous engine parts.

According to 1994 figures, the chemistry split shows that hybrids and urethanes each have approximately 28 percent of the market total, with less than three percent for acrylics. Much of the small amount of acrylic is being used in the automotive area, for primer surfaces and black trim parts. New developments with clear topcoats are likely to significantly affect the percentage of acrylic in the total. TGIC polyesters have been increasing each year, despite some concerns about the toxicological nature of TGIC. Much of this market is for outdoor furniture, and, increasingly, for architectural aluminum, following the European experience. Hybrids of polyester and epoxy are also growing in numbers and are put to a myriad of uses in the general industrial sector. The urethanes are used extensively in the light fixture area, domestic appliances, lawn and garden, and for some exterior automotive trim.

Currently, the market for architectural aluminum is dominated by a liquid multi-coat PVDF system usually associated with a limited color range involving the use of mixed metal oxide pigments. The stringent Florida requirement of five years has made it difficult for TGIC polyesters to compete. In fact, two standards apply in this area: AAMA 603.8, with a one-year Florida specification; and AAMA 605.2, which stipulates a five-year performance requirement. Although powder coatings found the one-year specification straightforward, the extended version was more difficult. Other factors that have limited the use of TGIC polyesters include the

20–30-year warranties commonly associated with PVDF and offered by several companies. The introduction of super-durables that can accommodate the five-year Florida requirement means that companies can now offer these systems with greater confidence.

### The European Market

The growth of the European market can be charted from the early '70s. Several polyester manufacturers, including Scado (which became DSM) and UCB did much to fuel the early growth. Both introduced polyester resins designed for cure with bisphenol A epoxies, and, during 1973, polyesters designed for cure with TGIC. Hybrids, while lacking the degree of chemical resistance compared with some epoxies, were found to have better heat stability compared with epoxies and much better application properties. They quickly found uses in a whole host of applications, including domestic appliances and light fixtures. These were mostly indoor-use coatings, however, that would quickly chalk outside.

The introduction of TGIC polyesters in the mid-'70s represented a significant step forward. At that time, they were competing with polyurethanes. Although TGIC polyesters exhibited more orange peel, the polyurethanes were not well-liked because of the blocking agent, caprolactam. Even the introduction of internally blocked isocyanates has not changed the situation today.

One key area in which urethanes have found a use is for two-component matte black polyesters. Used extensively by all leading car manufacturers (Ford, British Leyland, Nissan, Mercedes and BMW), the product was originally developed for bumper bars, but later was also used for door trim and windshield wipers. The formulation was typically TGIC in the one-component and polyurethane in the other, blended together at the post-extrusion stage to give a gloss of 15–20 gloss units on a 60° head.

Of the 77 powder producers in Europe, almost one-third belong to four main groups (Akzo, Courtaulds, Ferro and Herberts). The major market for TGIC polyesters is for architectural aluminum. Currently, this represents approximately twenty percent out of a total of 190,000 metric tons and is the single largest segment. Most European countries have buildings with powder coated aluminum on them. Apart from

the U.K., the bulk of Europe is controlled by two quality labels—GSB and Qualicoat. These organizations approve and regulate the coating of aluminum. By contrast, the U.K. is regulated by companies that provide self-certification to a British standard. Considerable work is currently taking place to produce a European standard. This is in line with a substantial European harmonization program.

One of the key raw material differences between Europe and the U.S. is the situation with regard to lead chromates. Used extensively in all aspects of powder coating formulations for the past 20 years, they contribute to most of the bright reds and yellow shades found in architectural aluminum. These are pigments that allow good flow and provide excellent opacity at reasonable cost. Extensive guarantees offered in Europe are testament to this.

Unfortunately, with the introduction of the criteria for "toxic to reproduction" hazard classification, the European Community has classified all lead compounds as causing development toxicity in humans. Lead pigments, although of relatively low solubility and bioavailability, are included in this classification. It is difficult to argue that powder coatings are an environmentally sound option when they have to be labeled with a skull and crossbones. Considerable work is underway to try to replace lead chromates with organic alternatives. By comparison, of course, there would appear to be little or no lead chromates used in the U.S.

One significant difference between the two market places is the area of metallic powder coatings. The introduction of bonded metallics changed considerably the way companies viewed them. Before bonding, there was a reluctance to offer metallics because of the variability associated with blending both aluminum and bronze pigments. Apart from the handling difficulties with the various metallic pigments, the major problem with blending concerned separation during application and reclaim resulting from differential charging rates. In addition, the free aluminum can cause the charge to track back to the gun. The introduction of a bonding service gave customers the confidence to offer metallics.

A crucial advantage with bonding is the ability to produce much brighter finishes because the process allows better utilization of pigments. Further work has continued to refine the process and successfully bond mica-based pigments. Once again, bonding has introduced consistency to the product range so that it is possible to achieve high quality pearlescent finishes. Products that are being coated with bonded powders in Europe include aluminum road wheels, bicycle frames, television stands, architectural aluminum and outdoor furniture.

#### Current Developments

In the U.S., Ferro has recently introduced a new method for powder coating manufacture, using supercritical carbon dioxide. This company is to be applauded for its R&D efforts. Equally commendable is the work being carried out by many resin manufacturers on automotive topcoat technology. In Germany, BMW has installed a pilot line for powder clearcoats in one of its plants in Munich. Following extensive evaluation, a U.S. manufacturer has been selected as the powder supplier. This is a clear example of how the U.S. and European markets are converging.

Raw materials certainly provide much of the momentum for powder development with new resins, pigments and additives being introduced with regularity all over the world. With the involvement of multinational companies in all aspects of powder coatings, we're beginning to realize a truly global technology, with continual narrowing of the differences. **Pasf** 

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## About the Author

John Birch of John Birch Associates, Le Chateau Station Road, Claverdon, Warwickshire CV358HF, U.K., has been a independent powder coating consultant for the past two years. He started his career in the powder coating industry in the early '70s, and in 1979 joined Postans, which was then a small wet paint company in the UK that wanted to get into powder. Postans was taken over by Evode, an adhesives manufacturer. The company became a prominent leader in the industry in the late '80s, when Birch was employed as the technical director of the Industrial Coatings Division.