**Powder Coating Competitiveness in North America: The Role of Effecting Pigments**

The North American powder coatings market is mature and expected, along with the European sector, to lose market share to Asia in coming years. Competition is therefore fierce, and coating manufacturers are eager to formulate products that offer advantages over other products on the market. Customers, particularly manufacturers of consumer goods—from automobiles to appliances to smartphones, want paints and coatings that create unique and differentiating looks and set their products apart. Special pigments that interact with light in different ways to create sparkle, pearlescent, iridescent, color shifting and other effects have therefore increased in popularity. There are challenges to using effect pigments in powder coatings that do not exist for liquid systems, however. Effect pigment producers that can facilitate the use of effect pigments in powder coating can thus provide significant competitive advantage to these customers.

The global powder coatings market is growing in volume terms at an annual compound growth rate of 7.2%, according to Grand View Research, due to increasing regulation of VOCs in paints and coatings and growing consumption of consumer products, particularly cars, appliances and consumer electronics. The growth rate in North America, which falls behind Asia in terms of market share, is slower than the global average, however, as manufacturers continue to move operations to emerging regions where consumer demand is increasing the fastest. Similarly, the North American market for effect pigments used in powder coatings is expanding at a slower rate of approximately 4%/year, according to Michael D. Brown, President of StrategyMark. He pegs the current value of this market at $40-50 million. Jim Fotiou, a Technical Service Representative with Silberline Manufacturing, also notes that the demand for metallic effects in powder coatings tends to be cyclical in nature.

Powder coatings are used for a wide variety of applications, largely those involving metal substrates that can withstand the higher curing temperatures, although lower-thermal-curing and radiation-cured systems are available today for use on plastics, wood and wood products. In North America, powder coatings are very popular in lawn and garden applications, and some manufacturers have signature colors that create a metallic appearance, according to Fotiou. Outdoor furniture manufacturers, for instance, often use effect pigments for vein or hammertone appearances. He adds that it is also not uncommon for coatings containing metallic pigments to be used as base coats in order to hide substrate imperfections; chromatic topcoats are then

applied over these base coats. Indoor office furniture manufacturers also use significant quantities of metallic pigments, but generally to create more subtle effects. “In short,” says Fotiou, “effect pigments can conceivably be used in almost any application where customers desire to make their products standout from the competition.”

Common effect pigments used in powder coatings are the same as those used in liquid systems and include aluminum, mica-type (pearlescent) and gold/bronze pigments. Less common pigments include stainless steel, nickel and copper flakes. There are also two forms of effect pigments—leafing and nonleafing. Leafing (generally only aluminium) pigments arrange themselves parallel to the substrate surface and tend to migrate to the surface of the coating, while non-leafing pigments are randomly and evenly distributed throughout the entire coating. The choice of pigment type is largely driven by the type of look that is desired, but other factors can come in to play. Metallic pigments, for instance, can impart added corrosion resistance and opacity. Aluminium can be used not only to add a decorative effect, but to provide a barrier to UV radiation or to illuminate an object when exposed to light, according to Fotiou. Mica pigments can be used to create a variety of very interesting and desirable appearances, but they don’t add opacity to coatings.

Unlike with liquid coatings, in which the effect pigments can be uniformly dispersed and do not affect the application process, with powder coatings, many aspects of the coating process can be impacted due to the incorporation of effect pigments. First, the specific gravity of effect pigments is much higher than that of powder coating resins. As a result, during collection of overspray material that is a simple blend of the resin and pigments, the percentage of effect pigments increases, which results in an undesired shift in the color of the reclaimed coating. This phenomenon thus reduces one of the main advantages of powder coatings (beyond no VOCs)—minimal product losses due to the ability to reclaim and recycle virtually all overspray. Second, “picture framing” during application of powder coatings that are simply mixed with effect pigments can occur. Since metallic pigments are conductors and organic powder coating resins act as insulators, the electrostatic behavior during spray application is different; the pigments tend to migrate to the edges of coated article, resulting in an unsightly “picture frame” effect. Third, the addition of too much effect pigment may negatively impact the smoothness of a coating, detracting from its overall appearance. There is a fourth concern with aluminiun in

particular. Powder coatings by themselves present explosion hazards, and the addition of aluminium pigments above a certain level can increase their explosivity.

Simple mixing of pigments with the formulated coating is desirable because the blending process involves low-energy mixing that does not damage the effect pigments. The appearance created by effect pigments depends largely on the shape and size of the pigment flakes/particles. Therefore, processes that change the physical properties of effect pigments, such as coextrusion with resins at very high shear, lead to powder coatings with less-than-desirable appearances. However, while simple mixing retains flake integrity, it is clearly not an effective solution.

Fortunately, Fotiou notes that several advances in pigment technology are helping powder coating manufacturers overcome these issues. Organic and inorganic coatings have been developed that reduce the specific gravity of effect pigments and also lower the conductivity of metallic pigments, providing better results with respect to overspray recover, application properties and the final appearance of post-blended powder coatings. Extrudable grades of effect pigments, which were originally developed for the plastics market, are now offered for use in powder coatings. The pigment is formed into a pellet with a small amount of wax, polymer or hydrocarbon resin that is compatible with the powder coating resin. They are mixed with powder coating raw materials and co-processed to generate formulations whose overspray can be recovered and that exhibited improved electrostatic application properties. Some damage to the pigments does still occur, however. Formulators generally compensate for the damage by starting with a pigment grade higher than what is actually desired in the coating, according to Fotiou. Pigment manufacturers have also introduced low aspect ratio pigments (pigments with specific flake geometries) that are more degradation resistant under high shear conditions. Certain inorganic treatments have also been shown to improve degradation resistance. Tailored distribution metallic pigments in which very fine particles have been removed are also provide enhanced brightness.

A process that is gaining increasing popularity with coating manufacturers involves addition of the effect pigment to the finished coating after it heating due to friction in a high shear mixer. The pigment is added once the coating resin is tacky and the two are mixed together very briefly. The pigment particles stick or “bond” to the resin, which allows complete reclamation of overspray and better response during electrostatic application. The damage to the pigments is

also reduced due to the very short mixing time. The main disadvantage to the bonding process is its higher cost.

As yet no perfect solutions have been developed that prevent all damage to special effect pigments when subjected to high shear processes—whether co-extrusion or bonding. Both the special effect pigment and powder coating manufacturers continue to seek new technologies that will overcome this problem. “In addition to looking for additives and other techniques for enhancing properties ranging from brightness to electrostratic response, Silberline is also developing new multifunctional effect pigments in order to expand their applicability into other markets, such as exterior architectural coatings, where weathering and chemical resistance are paramount,” Fotiou states.