



# Chemistry & Resin Types

## Thermosetting Powder Coatings

**Polyester powder coatings.** Polyester resins are, for the most part, the workhorses of the North American powder coatings market. More than 60 percent of the market uses polyester-based powder coatings, which hold up very well to standard outdoor exposure. Polyesters give the coater a broad application field, but let's not confuse this with oceanfront exposures in one coat or elevated levels of weatherability.

**Polyester/TGIC (triglycidyl isocyanurate).** If we look at chemistry, the primary choice is still polyester TGIC, although polyester TGIC-free powder coatings are gaining ground more and more. Polyester TGIC is a very robust powder system with a huge spectrum of application possibilities and effects.

**Polyester/TGIC-free.** These powder coatings are the primary chemistry that has been in use for more than 15 years in Europe.

They have some distinct advantages and disadvantages. Advantages include easy application with high first-pass transfer efficiency, excellent storage stability, very smooth surface and low-temperature-cure applications. Disadvantages include film thickness limitations because of the small percentage of water that needs to evaporate during cure. This is part of the chemical reaction occurring and, with smart formulation, a lot of this can be counteracted. It tends to appear in applications requiring very heavy film builds.

**Polyester/isocyanate. Polyurethane coatings,** as they are best known, are used for exterior applications. One of their major benefits is that they allow the formulation of more stabilized low-gloss powder coatings (low flat and matte) for exterior application. Polyurethanes also show better chemical resistance than standard polyester TGIC products and are used for anti-graffiti coatings. Slower cure is part of this chemistry because of de-blocking of the isocyanate hardener. Unfortunately, that results in some VOCs during evaporation of the blocking agent.

**Super-durable polyester resins** have grown immensely in the U.S. coatings market throughout the past 5–10 years. They now command much of the Coastal and Southern U.S. markets because of their elevated color and gloss retention. In harsh conditions, these materials can out-perform standard polyester resin systems in terms of color stability and gloss retention.

When considering super-durable technology, be sure you are comparing apples to apples, and check the specifications of the technologies offered. A super-durable polyester powder coating requires a special polyester resin and must meet AAMA 2604-05 (five-year Florida weathering specification). The mechanical properties of these coatings are a little lower than those of standard polyester powder materials, but much is gained with outdoor durability and robustness.

**Fluoropolymer powder coatings.** Fluoropolymer resins are considered the “Cadillac” in exterior weatherability and UV stability in the powder coatings world. Most often, these materials go head to head with liquid Kynar-type coatings

with extended warranties. Specifically tailored for the architectural market with exceptional outdoor durability and high chemical resistance, these coatings give long-life protection to any substrate on which they are applied.

**Epoxy powder coatings.** Epoxy is an interior-only formulation, and yes, that means even with an exterior-rated clear coat on top.

The epoxy resin system does not even hold up to basic UV testing and exposure, and will chalk very quickly. The strength of epoxy lies in its ability to hold up well to chemical exposures, salts and other normally corrosive exposures that other coatings have a hard time combating.

One of the primary functions of epoxy powder coatings is to add a strong protective primer layer under a polyester coating to dramatically increase salt spray resistance. Other applications for epoxy systems include pipeline and concrete rebar because of their flexibility and corrosion-protection properties.

**Hybrid powder coatings** are a mixture of both polyester and epoxy resins or polyester and acrylic resins. Hybrids are mainly for interior applications, most commonly applied to furniture. One common misunderstanding is that the polyester added to the epoxy/polyester hybrid makes the powder more weather-resistant. This is not the case. The epoxy-coated part will start chalking very quickly with loss of gloss and change in color.

**Acrylic powder coatings** are used primarily in the automotive sector as clear coat materials. Acrylics make for a very smooth clear coat with exceptional clarity. They also provide a very hard surface that is highly chip-resistant. These types of glycidyl methacrylate (GMA) acrylics are highly contaminating and should not be sprayed side by side with other powder coatings. Separate powder booths and air are a must in an enclosed area to avoid contamination, which will result in craters in the finish of parts using the other powder chemistries.

**Silicone powder coatings.** Silicone resins are a complicated matter. Most often, this resin system is used for high-heat applications. There are different levels of silicone technology.

The first levels of silicone resins are often not silicone-based at all, but rather modified polyester resins. This level typically gives the resin a stabilized exposure temperature as high as 400–600°F (204–316°C). It will allow spike temperatures in the area of 800°F (427°C) for a short period of time.

The second level of silicone resins can range in exposure from 600 to 800°F (316–427°C) and will allow spikes to temperatures around 900–1,000°F (482–538°C). The third level would be a 100-percent-silicone system that can be used with decent success at 1,000–1,200°F (538–649°C). It must be understood that these coatings are critical in their adhesion to the substrate.

A common issue with silicone powder systems is failure of the pretreatment during curing. Iron and zinc phosphate pretreatments often fail at temperatures higher than 400°F (204°C). Most silicone powder coatings require curing at temperatures above 400°F (204°C) for an extended amount of time.