Resin Technologies
for Industrial Maintenance Coatings

Performance and Sustainability Drive Development

By Cynthia Challenge, Coatings+Tech Contributing Writer

Industrial maintenance coatings are used to protect a wide variety of generally large structures from process tanks in the oil and gas industry to critical infrastructure such as bridges and water tanks. In many cases, the structures are exposed to harsh environments—corrosive chemicals, high heat, and/or extreme cold. As a result, performance remains the top differentiator. Sustainability is becoming an increasingly important issue, due to both changing regulatory requirements and end user expectations. Cost, as always, is a factor as well.

GROWING MARKET

The market for industrial maintenance coatings varies from segment to segment and region to region, but overall appears to be growing. “We have seen a rebound in the industrial coating market from a rather sluggish 2016,” says Ahren Olson, marketing manager for Protective Coatings at Covestro. He points in particular to the oil and gas segment, which has seen a slight rebound from very poor years in 2015 and 2016. He notes that operators have found ways to reduce production cost, which has spurred renewed activity in drilling, and drill counts in North America are up drastically versus 2016. In the infrastructure segment in the United States, on the other hand, there is uncertainty, according to Olson. “The bridge and highway segment remains desperately underfunded by the federal government, and everyone continues to wait for new legislation and funding,” he says.

When you examine the market more closely from a technology perspective, different rates of growth are also notable for waterborne vs. solventborne coatings, with demand for water-based systems growing at a faster pace, according to Jon Cronin, sales director Coatings EMEA, DSM Coating Resins. “The market historically has been dominated by solventborne chemistries that provided superior corrosion protection, but market demand and environmental regulations have pushed chemistries toward lower VOC and waterborne technologies,” agrees Shuest Stewart, industry marketing manager for Transportation, Industrial, Furniture, and Floor Coatings with BASF.

Constantly changing VOC regulations, in fact, have a direct impact on the industrial coatings market, according to Olson. As one example, U.S. states participating in the Ozone Transport Commission have agreed to lower the allowable VOC content from 340 g/L to 250 g/L, and some have already begun to adopt the new rule. “Coating manufacturers have had to reformulate a multitude of coating systems in order to be within compliance,” Olson says.
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Worldwide, there are also movements to eliminate all potentially harmful ingredients from industrial maintenance coatings, according to Marco Heuer, director of applied technology for Industrial Coatings with Evonik. He notes that there is also increasing demand for broad application windows through the use of coatings with faster curing rates at lower temperatures and longer potlives, as well as various types of application equipment.

**MANY RESIN CHEMISTRY**

The industrial maintenance market relies on multiple resin technologies, including alkyd, acrylic, epoxy, polyurethane, polystyrene, and hybrids combining these various chemistries. Based on the type of performance criteria needed, “Resin selection is dependent on a variety of performance criteria driven by the end of the application but overall resistance to corrosion and UV degradation tend to be the primary drivers,” observes Stewart. She notes that alkyd and styrene-acrylic chemistries are often utilized in direct-to-metal (DTM) applications in light- to medium-duty industrial applications, while epoxy resins and two-component (2K) polyurethanes are used in more demanding environments.

For anticorrosive primers, the dominant generic types are epoxy-based or zinc-rich (inorganic or organic) systems, according to Mike Winter, regional solution manager—Americas for Marine & Protective Coatings at AkzoNobel. For finish coats, he adds that polyurethane and polyolefin systems are widely used. Olson observes that existing resin technologies have made headway in terms of acceptance over the last decade, including both polyurethanes and polysiloxanes. Both AkzoNobel and Covestro have observed a decline in the use of alkyld coatings for industrial maintenance applications. “There is some use of alkyd coatings in industrial maintenance applications, but alkylds tend to have lower performance properties,” notes Winter. VOC regulations and the need for longer lifetimes are impacting the use of alkylds, according to Olson. DSM, on the other hand, is seeing an increase in demand for its waterborne acrylic and alkyd dispersions compared to the demand for urethane hybrids and 2K systems. “While the performance of waterborne acrylics/alkyds is not yet equal to that of 2K systems, it often meets the expectations of our customers for many of their industrial maintenance applications, and these coatings have an added benefit of being user-friendly,” Cronin says. Indeed, with VOC reduction an important trend, Heuer points out that high solids ultra-high-solids and waterborne products are more often used today than in the past.

**IMPROVING PERFORMANCE AND SUSTAINABILITY**

“Price always matters, as does the need to decrease VOC content, but the main driver of new resin technology development is performance,” asserts Cronin. Reduction of the VOC content of coating formulations has been, and continues to be, one of the main drivers in resin development, according to Winter. There are also, he adds, key performance drivers such as improving the application of products, extending the application window, and increasing productivity through shortening of drying and over-coating times or reducing the overall number of coats required. In particular, he notes that future regulations could significantly limit the options for inorganic systems. For instance, the design of high-performance formulations and coatings that meet the demands of today’s high-performance customers is an important area of research for Evonik, agrees Cronin. It is no longer about alkyld, acrylic, or but acrylic, but about combining the characteristics of each and strengthening them,” he adds.

**RECENT DEVELOPMENTS**

Advances in resin technology have been generally incremental, but more dramatic improvements have occurred in response to the changing regulatory environment and expectations of users of industrial maintenance coatings. Epoxy chemistry, an older chemistry, but one that still accounts for a significant amount of the industrial maintenance market, continues to be incrementally developed, according to Winter. He points to the development of ultra-high solids single-coat tank lining systems that can be sprayed with standard airless spray equipment rather than plural component spraying systems, yet still provide a high level of chemical resistance.

BASF has focused on advancing acrylic resin technologies. One recent example is a new hydronyl functional acrylic resin dispersion for waterborne, 2K polyurethane, DTM coating applications that, according to Stewart, provide performance comparable to solventborne technologies. “Formulations formulated with this new resin exhibit excellent durability, flow, and leveling and the added benefit of low viscosity and low iso-cyanate demand,” she says. The resin has an end-of-potlife viscosity increase indicator that signals the applicator to stop using the coating. BASF has also launched two new self-crosslinking resins for waterborne topcoats; one allows formulation of low VOC coatings with early hardening development and glass retention, and the other provides improved adhesion and resistance to chemicals and weathering degradation, according to Stewart. He also notes that BASF continues to invest in the development of technologies that enable faster cure, lower savings through the reduction of coating applications, and greater temperature curing flexibility to provide faster return-to-service of structures that are being coated/protected. Hybrid resin chemistries are attracting attention in the industrial maintenance market due to the need to reduce VOCs yet provide greater durability, according to Heuer.

“Resin technology will be a key enabler of the shift toward more sustainable products,” agrees Cronin. It is no longer about alkyld, acrylic, but about combining the characteristics of each and strengthening them,” he adds.

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"Price always matters, as does the need to decrease VOC content, but the main driver of new resin technology development is performance," asserts Cronin. Reduction of the VOC content of coating formulations has been, and continues to be, one of the main drivers in resin development, according to Winter. There are also, he adds, key performance drivers, such as improving the application of products, extending the application window, and increasing productivity through shortening of drying and over-coating times or reducing the overall number of coats required. As regards the design of binder technologies and the formulation of maintenance coatings. In particular, 2018 is going to be a key milestone with regards to Registration, Evaluation and Authorization of Chemicals (REACH) regulations in Europe and failing out what raw materials will be available for product use, according to Winter. As the market moves toward lower VOC systems and waterborne chemistries, meeting conventional solventborne performance becomes a challenge, according to Stewart. "It's a challenge with certain technologies to be able to reduce the VOC of the coating and produce a higher solids product that can still be applied at the same film thicknesses and without increasing the cost per square foot of the applied system," Winter comments. These challenges are particularly true for thin-film finishes, such as polyurethanes. The need to create lower VOC systems that offer the same performance has led to developments in older chemistry (such as polyurethane) and the emergence of new technologies (polyaspartic, polyurethanes), according to Olson.

It is no longer about urethane, alkyd, or acrylic, but about combining the characteristics of each and strengthening them," he adds. "The continuous improvement in hybrid-resin systems is the most important area of research and development," agrees Cronin. "It is no longer about just using one resin, alkyd, acrylic, or but about combining the characteristics of each and strengthening them," he explains. "This is still an opportunity to improve the performance of one-component systems. We are definitely not near the end of this journey," he adds.

Evonik, for instance, has focused on the development of specialty resins based on silicate hybrid technology. "With this technology platform, it is possible to create more effective and lower-emitting resins with high-solid contents that have a range of functionality and offer non-isocyanate curing mechanisms. In addition, traditional processing and application equipment can be used to seal coatings in new manufacturing or application technologies," Huser says. For Covestro, emphasis has been placed on the development of polyurethane and polyisocyanate technology.