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metal marketplace—in the types of monumental applications that meet the performance standard AAMA 2605 of the American

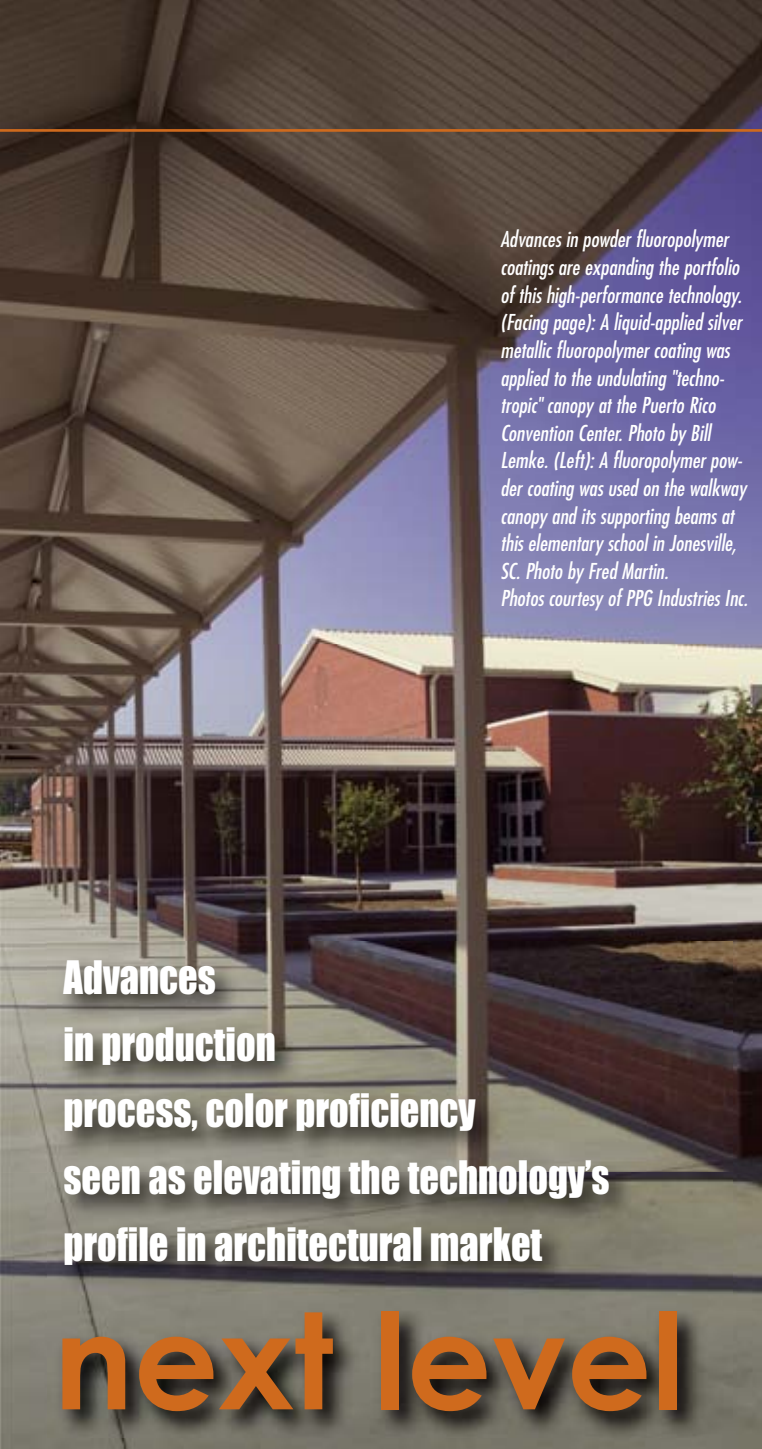
powder coatings—factory-applied finishes that start out in powder form, then are melted and cured on metal surfaces in high-temperature “bake” processes—have long been considered a “green” technology due to the absence of VOCs (volatile organic compounds).

But the technology has made only modest inroads in the high-profile, exterior architectural-

Architectural Manufacturers Association. This standard sets rigorous performance requirements for chalk and fade resistance and color and gloss retention. (See “Powder Coatings: On the sidelines for the green-building revolution?” *JAC*, Aug.-Sept. 2007, p. 22.)

PPG Industries Inc., however, is attempting to change all that, or at least alter the landscape perceptibly. And the effort has gotten some notice. The company recently won a 2009 “R&D 100” award from *R&D Magazine* as a result of the recent introduction of Duranar powder coatings. The award recognizes 100 technologically significant products introduced in the previous year, based on judging by an independent panel and the magazine’s editors.

The Duranar brand boasts a long and impressive history as a liquid fluoropolymer coating—high-performance, factory-applied finishes characterized by superior resistance to weathering, corrosion,



Advances in powder fluoropolymer coatings are expanding the portfolio of this high-performance technology. (Facing page): A liquid-applied silver metallic fluoropolymer coating was applied to the undulating "technotropic" canopy at the Puerto Rico Convention Center. Photo by Bill Lemke. (Left): A fluoropolymer powder coating was used on the walkway canopy and its supporting beams at this elementary school in Jonesville, SC. Photo by Fred Martin. Photos courtesy of PPG Industries Inc.

**Advances
in production
process, color proficiency
seen as elevating the technology's
profile in architectural market**

next level

abrasion, extreme temperatures, and chemicals. These properties are the result of the high bond strength of the fluorine-carbon chemical bond.

The Duranar coatings are based on PVDF (polyvinylidene fluoride) resins, widely known by the brand name Kynar, a product of the chemical company Arkema. Also well-known is the Hylar brand of PVDF coating resins, manufactured by Solvay Solexis. Other fluoropolymer coatings—including those capable of ambient cure in field-applied settings—are based on fluoroethylene vinyl ether (FEVE) resins.

PPG says the Duranar powder coatings are produced with a unique color-blending and manufacturing process that allows powder coatings to be economically manufactured in small batches of custom colors. The process also has the potential to make powder

coatings for architectural aluminum even "greener" by reducing the material waste and amount of energy used in production, the company says.

PPG and the Duranar powder coatings team—Ron Ambrose, Kristin Bartlett, the late Dennis Carson, Tony Chasser, Carol Jackson, Henry Lowman, Steven Sternberger and Howard Wright—were recognized for the R&D 100 achievement at a recent awards ceremony.

Lowman, PPG global director of extrusion coatings, said the award recognizes the product's potential "to revolutionize architectural coatings in a way that benefits both the building industry and the environment."

Exhibit A: Color competitiveness

In a recent conversation with JAC, Lowman and Sternberger—PPG marketing manager, powder coatings—said the small-batch and custom-color capabilities of the Duranar powder coatings are designed to meet the requirements of architects and specifiers who insist on the color flexibility and range offered by conventional liquid coatings, but would give powder consideration due to its "green" profile—zero solvent content, meaning no VOC emissions during manufacturing or application.

Liquid coatings applied by the coil-coating or spray-coating process, on the other hand, do contain VOCs, although emissions are generally contained and eliminated with the use of high-tech environmental-control systems—at least in major application facilities.

Liquid fluoropolymer coatings, however, offer some powerful advantages to the building designer and specifier. These include a proven track record of long-term performance in high-profile and monumental building exteriors—20, 30, or more years with unmatched color and gloss retention—and wide latitude in the selection of color and finish. Manufacturers of liquid fluoropolymer coatings—including PPG—can mix and match colors, quickly and in small sample quantities.

With powder coatings, the color-matching process has proven to be more problematic, essentially involving the entire production process—blending of formulation components, including color pigments; extrusion; chilling; processing into a flake material; and grinding into a powder. Then the powder must be electrostatically applied to a metal surface, where the color can be evaluated.

PPG says the new small-batch process addresses this issue.

"We can make small-batch, custom-color batches economically now," Lowman says. He adds that the powder chemistry also carries certain performance attributes, in particular enhanced cured-film hardness. Powder coatings have earned a reputation for hardness and durability in varied applications, including automotive, appliance, and other product finishes.

At the same time, Lowman concedes that the powder-coatings version of Duranar cannot identically match all the color and effect capabilities of the liquid counterpart. For example, the powder product cannot produce the same metallic effects. But he observes that the current construction-market climate—where high-profile,



“monumental” projects are relatively scarce—lends itself to expanded use of powder in commercial applications where special finish effects are less in demand.

Lowman also says the corrosion resistance of the Duranar coating carries significance in the many coastal and urban environments where so many building projects are located. These environments put building exteriors to a stern test, due to the presence of harsh salt and chemical exposures.

“For the design architect, small-batch, custom-color capability is the key. To the building owner, corrosion resistance is the key,” Lowman says. The technology’s superior durability properties—corrosion resistance combined with weathering capabilities—are based on coating systems composed of a proprietary, high-performance liquid-applied primer and the highly durable PVDF topcoat, PPG says. The powder version is reported to offer the “proven pigmentation and resin technologies as PVDF polymer-based liquid coatings,” the company says.

“These are 20-year-plus systems” says Sternberger.

Lowman and Sternberger also say the new technology is seen as a bold step forward in making powder a bigger player in the global market for high-performance



Liquid-applied fluoropolymer coatings have compiled a long and impressive track record of performance in demanding architectural applications, the result of the technology’s superior durability in exterior exposures. (Top): Metal panels at the Century Tel Center sports arena in Bossier City, LA, are finished with a beige-colored fluoropolymer coating. (Above): The rich color of the roof at the Prescott Gateway Mall, Prescott, AZ, was produced with a fluoropolymer coating. Photos by Wes Thompson.

exterior architectural finishes. Liquid fluoropolymer coatings enjoy a strong position in the domestic market, but are less dominant overseas, particularly in Europe. In addition, the pollution-control systems that prevent VOC emissions from factory-applied liquid coatings are not universally present in other geographic regions, Lowman points out. In these areas, powder can provide a greener option.

Also entering the debate is the “carbon

footprint” question—which coating system results in a reduced environmental impact in terms of the complete product lifecycle. The jury remains out on this verdict, however.

“Powder reduces VOCs at the point of application, but you do consume energy in manufacturing,” Sternberger says. “There has not been an objective LCA of liquid versus powder in this regard.”

But he adds, “What’s greener is what lasts the longest on the building.”

Other factors also come into play in making the choice between powder and liquid coatings, Sternberger says. The harder cured film of powder carries weight in certain high-impact settings, for example. In addition, some coating facilities may benefit from the use of powder as an opportunity for expansion.

"Whenever you have choices, chances are better for success. The key for PPG is that we can say this offers the same performance as liquid."

Weighing the evidence

As a manufacturer of both liquid and powder factory-applied coatings for architectural metal building elements such as panels, roofs, and extrusions, PPG recently issued a "white paper" that offers comparisons and recommendations on the use of the two types of coating technologies.

The company says the paper, *Architectural Applications for Liquid and Powder Fluoropolymer Coatings: A Comparative Review*, provides architects and curtain-wall consultants with updated specifying guidelines, and details the aesthetic and environmental attributes of liquid, conventional powder, and "next-generation" powder coatings such as the new Duranar powder products.

A copy of the white paper can be downloaded from the PPG website located at www.ppgideascales.com.

Comparisons and recommendations addressed in the paper involve considerations such as VOC content, color and appearance options, prevailing performance standards for metal coatings, film hardness, and cost, among other issues.

The document, for example, makes the point that the hardness of powder coatings lends these products to application to surfaces that are subject to contact from the public or other sources of wear and abrasion—window and door frames, storefronts, railings, and fencing.

Liquid-applied coatings, on the other hand, can produce bright metallic effects with the use of metal-flake pigments, while powder coatings are limited to the use of mineral-based effect pigments such as mica.

The white paper gives equally high marks to liquid fluoropolymer coatings and the "next-generation" powder coatings in a number of comparison categories, including appearance properties; corrosion resistance; applications involving monumental and commercial-building curtain walls;

applications in industrial and seacoast environments; and several other measures.

The next-generation powder coatings are given superior rankings in a number of categories, including emissions and waste generation, energy use, and material transfer.

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