product expert series

A LAYER OF QUALITY

BY WILLIAM D. CORBETT

Stricter environmental and performance requirements continue to push steel coating systems to new levels.

IN THE NOT TOO distant past (as recently as 30 years ago in some cases), the application of an "industrial protective coating system" in the shop meant wiping most of the grease and oil off the steel, applying a coat of red lead or iron oxide alkyd over the mill scale, loading the steel onto a truck and sending it on its way. Simply put, painting was almost an afterthought.

But with the departure of lead-based paint and owner demands for better corrosion protection in applications that require it, the industry responded with improved coatings and coating systems, and fabrication shops often were subsequently required to become certified to apply high-performance coating systems. That is, we stopped merely "painting steel" and started "installing protective coating systems to properly prepared steel surfaces." Perhaps two of the biggest drivers in how we approach corrosion protection differently today than we did 30 years ago are AISC's Sophisticated Painting Endorsement (SPE), and Qualification Procedure No. 3 (QP-3) published by the Society for Protective Coatings (SSPC). These two programs (now merged as one standard, SPE/QP 3 420-10 *Certification Standard for Shop Application of Complex Protective Coating Systems*) helped to put greater emphasis on the quality associated with the installation of protective coating systems in steel fabrication and "blast and paint" shops.

Safer, Faster, Better

Besides these quality enhancements, there have been plenty of other changes in the coatings industry as well, including those associated with environmental considerations. For example, the Environmental Protection Agency (EPA) has set requirements geared toward reducing adverse environmental effects of coating formulations during initial application and future maintenance or removal operations. For industrial coatings, this has meant formulating coatings without lead, cadmium, chromium, mercury and other toxic/hazardous metals; lowering the volatile organic compound (VOC) content to conform to federal, regional, state and local thresholds (as low as 100 g/L); producing higher solids coatings; and even adapting waterborne coating technology for industrial use. In addition, coating manufacturers are exploring the use of nanotechnology to produce "self-healing" coatings and continue to focus on producing coatings that provide better, longer-lasting protection and in a fewer number of coats.

Not only have coating systems become greener and longer-lasting, they're also being made to dry faster. Handling and transportation of finish-coated steel from the fabrication shop to the project site is impacted by the length of time that the finish coat must dry. Known as shop-field throughput, a reduction in the dry time required prior to handling (without compromising performance), as well as a minimization of handling damage, can greatly reduce project costs. Based on a study conducted by SSPC (which appears in the November 2011 issue of the *Journal of Protective Coatings and Linings*) it may be possible to save at least one or possibly two full days of shop throughput time by using a two-coat system (organic zinc or inorganic zinc silicate primer with a fast-dry finish coat—e.g., polyaspartic) compared to a two-coat or three-coat system with a slower drying finish coat (e.g., polyurethane or polysiloxane). Additionally, faster dry times reduce the risk of dust and other airborne contaminants from becoming embedded in the finished product, reducing the potential for rework and increased costs for the steel fabrication shop.

Less Layers

Coating systems are also seeing advancements in reducing the number of coating layers in a system from three coats to two coats (and research continues on the use of single-coat systems), while maintaining film build for barrier protection. For example, traditional three-coat systems (3-5 mils of zinc-rich primer 4-6 mils of epoxy or urethane mid-coat and 2-3 mils of polyurethane finish coat, for a total of 9-14 mils) are being replaced by two coat systems that display the same total system thickness (9-14 mils), but with the finish coat applied at 6-9 mils over 3-5 mils of zinc-rich primer in a single application

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(without sagging) to achieve equivalent performance. In this case, the epoxy or urethane mid-coat is completely eliminated from the system. For steel fabrication shops that only apply the primer, this information is interesting but largely academic. But for those projects where total shop painting is invoked by specification (with field touch-up of handling/erection damage), this change can have a significant impact on shop throughput.

Zinc-rich primers continue to be the mainstream product used, with shop-applied ethyl silicate inorganic zinc-rich primers dominating new construction and organic (epoxy and urethane) zinc-rich primers dominating maintenance applications. One issue with zinc-rich primers that needs to be resolved, however, involves bridge rehabilitation projects. During rehab, bridge owners are replacing connection (gusset) plates for seismic retrofitting or other maintenance requirements. The new connection plates are typically fabricated in the shop and coated with an inorganic zinc-rich primer prior to shipment to the jobsite. Existing connection plates are removed and the surfaces beneath are prepared (i.e., power tool or abrasive blast cleaned) and primed onsite using an organic (epoxy or urethane) zinc-rich primer, since these tend to be more "field friendly." These connections are slip-critical and require either Class A or Class B certified coatings on the mating surfaces. But rarely do manufacturers have slip coefficient test data for inorganic zinc-to-organic zinc mated surfaces. This issue needs to be addressed during design. For example, the specifier could require the manufacturer to provide acceptable slip coefficient test data before mating the two systems, or perhaps specify that the shop apply the same organic zinc that will be used in the field.

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Thermal spray coatings (metalizing) with a sealer coat (thermal spray coatings are porous and will oxidize, so the sealer provides both protection and aesthetic value) are becoming both more economical to install and as a result, are being used more frequently than in past years, particularly for newly fabricated steel. The U.S. Army Corps of Engineers has used thermal spray coatings to protect dam gates, and bridge owners are benefitting from the long-term performance of these systems (30 to 50 years, according to the Federal Highway Administation), with minimal maintenance. Steel fabrication shops should look to expand their capabilities to include thermal spray coatings, as this will no doubt be a continuing trend for protecting new steel.

The Electronic Age of QA

Perhaps one of the most widely apparent trends relating to changes in the coatings industry is the evolution of electronic instrumentation and software applications for monitoring the quality of surface preparation and coating applications. Many visual assessment methods like compressed air cleanliness, abrasive cleanliness (oil) and surface cleanliness (pre- and post-blast) haven't changed. However, electronic psychrometers that automatically measure and store ambient condition and surface temperature data; data loggers that automatically measure and store paint storage conditions; digital portable conductivity meters that are used to verify abrasive cleanliness (soluble salt contamination); surface profile depth micrometers that measure and store thousands of data points in batches; and digital coating thickness gauges that measure and store thousands of thickness readings in batches (and some that store digital images of the structure), as well as provide statistical analysis of the collected data in a matter of seconds, are widely available from several equipment manufacturers. Application of Blue Tooth wireless technology and even data storage in the Cloud (rather than employing proprietary software) is available to those that are "tech savvy," making paperless quality control a reality. Recent technology even enables collection of ambient conditions and surface temperature, surface profile and dry film thickness using a single gauge equipped with three interchangeable probes.

The shop painting industry will always be changing as new regulations are invoked and new coatings and coating systems are brought to market, whether in response to these regulations or to industry demands for better corrosion protection. Technological advances bleed into many industries, and there is little doubt that protective coatings will continue to be one of those industries, creating a direct impact on future shop cleaning and painting activities. MSC