Minnesota Replacement Bridge Opens Months Early

The I-35W bridge in Minneapolis, Minnesota, reopened on September 18 at 5:00 a.m., more than three months ahead of schedule, according to the Minnesota Department of Transportation (Mn/DOT). The new bridge, called St. Anthony Falls Bridge, was built to replace the I-35W Bridge that collapsed August 1, 2007, killing 13 people.

Minnesota Governor Tim Pawlenty speaks at a press conference about the opening of the St. Anthony Falls Bridge. Copyright 2006 Office of Governor Tim Pawlenty

Mn/DOT worked with a joint contractor team of Flatiron Constructors (Longmont, CO) and Manson Construction (Seattle, WA), as well as with FIGG Bridge Engineers to construct the St. Anthony Bridge. The bridge was a design-build project, which shortened the completion time by overlapping design and construction, says Mn/DOT. The bridge is made of high-performance concrete coated with two layers of plaster and one layer of a white acrylic coating. The steel rebar was coated with standard green epoxy, and the tubular steel in the railings was hot-dip galvanized and then coated with an epoxy intermediate coat and a polyurethane topcoat, according to Mn/DOT. Rainbow Inc. was the painting contractor for this job.

The new bridge is equipped with ten lanes, five in each direction. With the ability to accommodate a light rail transportation system in the future, the bridge has 323 sensors to detect any future defaults, monitor security, and activate an anti-icing system. The St. Anthony Falls Bridge is expected to have a 100-year life span, says Mn/Dot. The total cost is estimated at $234 million.

The original I-35W bridge carried approximately 140,000 vehicles per day and was not scheduled for reconstruction until 2020. The National Transportation Safety Board is still investigating the cause of the August 2007 collapse and is expected to release a final report in November.

PRA Seeks Papers on Service Life Prediction

The Paint Research Association (PRA) is seeking papers for a one-day symposium to be held January 21, 2009, at its headquarters in Hampton, UK. The title of the symposium is "Predicting the Service Life of Organic Coatings."

The purpose of the symposium is to review developments in the theory and practice of service life prediction in relation to exterior coatings. There will be a forum for developments in techniques and a review of descriptive, mechanistic, and reliability methods.

PRA is currently seeking papers from authors of new works on the following topics:

- service life methodologies, including phenomenological approaches, probabilistic and deterministic methods, scientific measurement methodologies, and reliability-based methodologies;
- theoretical aspects, including problems of reciprocity, failure modeling, dosage models, and sources of variability;
- weathering devices, including light sources, artificial weathering, and accelerated natural weathering;
- standards and standardization;
- instrumental developments, including physical methods and chemical methods;
- combinatorial techniques; and
- case histories of new product development.

More information on attending the symposium and on how to submit an abstract can be found at www.pra-world.com.

Sperian to Acquire Company

Sperian Protection (Smithfield, RI) recently announced its intentions to acquire Combisafe International AB, a developer and supplier of fall protection products.

Sperian says that the acquisition fits its growth strategy by complementing the current product line and reinforcing its presence in the Middle East. The company currently has operations in Dubai.

Combisafe is headquartered in Northampton, UK, and has approximately 100 employees. It is majority controlled by Fairford (Sweden). The transaction is still subject to approval.

FSCT Past President To Receive Heckel Award

The Federation of Societies for Coatings Technology (FSCT) has announced that the 2008 recipient of the George Baugh Heckel Award will be Dr. Frederick "Fritz" H. Walker.

From 2004-2005, Dr. Walker served as president of FSCT, which is based in Plymouth Meeting, PA. Dr. Walker also served on the Editorial Review Board of the *Journal of Coatings Technology and Research* and served as a chair of the FSCT's Structure and Governance Task Force and the Professional Development Committee. Dr. Walker is the intellectual asset manager for Air Products and Chemicals, Inc., in Allentown, PA.

The Heckel Award is the FSCT's highest honor, according to the Federation, and recognizes an individual for his or her outstanding contributions to the organization. The presentation of the award will be made at the FSCT meeting/luncheon on October 14, in conjunction with FutureCoat! 2008 at the Hyatt McCormick Place in Chicago, IL.

Courtesy of FSCT

Continued

PA Bridge Reopens Early

The Pennsylvania Department of Transportation (PennDOT) fully reopened a Pittsburgh bridge on September 8, exactly seven months after a corroded rocker bearing caused the bridge to shift.

Although repairs on the Birmingham Bridge are only partially complete, the rest of the work can be finished without lane closures, PennDot says. The southbound pier still needs to be removed and replaced but will not require removal of the bridge deck, as originally anticipated. The rocker bearing system will be replaced with a laminated neoprene system. Demolition of the pier started September 8. While work continues on the pier, temporary steel shoring towers support the weight of the southbound side.

Temporary shoring during bridge repair
Courtesy of PennDOT

Last February 8, PennDot closed the bridge after one of the concrete piers moved, causing the bridge to drop between eight and nine inches. A third-party forensic analysis commissioned by PennDOT stated that a series of small events led to the bridge's shift. The rocker bearings that normally allow the bridge beams to expand and contract with changing temperatures became restricted by corrosion and by debris from leaking expansion dams. The bearing continued to move in the same direction, putting stress on one of the piers and causing the shift.

The bridge was closed entirely until March 3, when the southbound lanes were reopened to traffic. Until September 8, the northbound lanes remained closed while the piers on that side were replaced as a precautionary measure, and the original rocker bearing system was replaced with a laminated neoprene bearing pad system, according to PennDOT. The estimated cost of the entire project is $7.5 million.

The Birmingham Bridge was originally opened in 1976. On average, 23,000 vehicles cross it per day. It consists of 19 spans and is 2,747 feet long. The main span crosses over the Monongahela River and is a steel-tied arch. The approach spans are steel, multi-girder structures.

Highway Fund Gets $8 Billion To Avoid Shortfall

The Highway Trust Fund received $8 billion from general funds in September to prevent a possible shortfall in the states, according to a statement released by Transportation Secretary Mary Peters. The money will allow state departments of transportation to pay their bills and continue construction that had been put on hold, stated the American Association of State Highway and Transportation Officials (AASHTO).

President Bush signed the bill on Sept. 15. Congress had approved the legislation on Sept. 11.

The funding comes after Secretary Peters announced in early September that the Federal Highway Trust Fund would run out of money by the end of the month, urging Congress to act quickly. She had originally asked Congress to address the problem with three separate plans. The short-term plan required a bill providing $8 billion in funding. The mid-term plan would pass another spending bill for next year that is "fiscally responsible." Her suggested long-term fix would require Congress to reform the approach to transportation funding.

Fuel tax receipts are the main source of revenue for the highway funding program and have been significantly lower than expected over the summer months, adding to the problem. In September, transportation officials estimated that the Highway Account would receive $2.7 billion but would have to pay out $4.4 billion in reimbursement requests to state departments of transportation, according to the department.

Before the legislation was passed, Secretary Peters stretched existing funds by having the Federal Highway Administration make weekly, prorated payments to state transportation departments instead of the twice-daily payments previously practiced. The department has now resumed daily payments.

Although all current state payment requests have been paid, Secretary Peters stated in a press release, "…we should not delude ourselves into thinking the fundamental problems of transportation funding are somehow resolved. It is imperative that the debate begin now as to the most effective means to finance and improve highway and transit infrastructure in the U.S. Clearly, the current model is both unsustainable and unresponsive to the country's needs."

More information can be found on the U.S. Department of Transportation's web site, www.dot.gov.

BASF Makes Offer to Acquire Ciba

BASF (Ludwigshafen, Germany) will make an offer to acquire Ciba Holding AG (Basel, Switzerland) on October 1, according to a statement released by BASF. The board of directors of Ciba supports the offer and is recommending it to the shareholders.

Ciba is a specialty chemical company that offers products and services to the coatings, plastics, and other industries. According to the company, the acquisition would make BASF the second-largest supplier of coating effect materials. Combining the two companies would provide an extensive range of pigments, resins, and additives.

The offer will have to be approved by the Swiss Takeover Board and will be valid for 20 trading days plus an extension of 10 trading days in accordance with Swiss law. BASF plans to finalize the transaction by the first quarter of 2009.

Florida's Hart Bridge Project Open to Rebid

The Florida Department of Transportation has announced advertising the painting of the Hart Bridge in Jacksonville, FL, effective September 29. Bidding will end on December 2, 2008.

Spanning the St. John's River, the Hart Bridge is a 3,844 foot-long by 65 foot-wide steel through-truss bridge. The project includes pressure-washing the structural steel to SSPC-SP 12; abrasive blast-cleaning to SSPC-SP 10 (Near-White); and applying an organic zinc-rich epoxy primer, an epoxy intermediate, a polyurethane finish, and a clear coat. Class 1A containment conforming to SSPC-Guide 6 is required because the existing coatings contain lead.

Courtesy of Florida DOT

Contractors bidding on the job must be certified to SSPC-QP 1, QP 2, or QP 3, or to AISC Sophisticated Paint Endorsement, depending on the coating application method. GPI-Southeast will provide coating inspection services.

For more information: contracts.admin@dot.state.fl.us.

On Conducting Plant Surveys

Plant surveys to establish painting needs are performed by contractors, paint manufacturers, and outside consultants. The consultant charges for this service, but contractors and manufacturers will conduct the survey and make recommendations at little or no cost. What are the pros and cons of each approach?

Wim Bonestroo, Bodycote RPC, Rotterdam, The Netherlands

Before I plead my case, I'll start by informing the reader that I am a technical manager working for an independent coating consultancy.

Although it's clear on what side of the fence I sit, there are a number of obvious reasons why plant managers are better off using the services of an independent consultant for a plant survey as opposed to using the services of a paint manufacturer or a contractor.

If the question is merely how to paint or what materials to use, a contractor or coating manufacturer can provide the answer. If, however, the question is why and when we should paint, the services of an independent coating consultant are required.

For the independent consultant, the application of a coating system is not an objective in its own right. His job is to obtain an overview of the condition of a plant, specifically with regard to the coating systems and corrosion. The need for coating maintenance must be considered in relation to the functions of the coating systems on different locations of the plant and the risks that different types and intensities of degradation pose to those functions. A coating consultant is able to help the owner assess risks and set workable intervention levels. This information provides the owner with an objective tool that can be used to make coating maintenance decisions. This tool may sometimes result in a recommendation to not paint items, or to delay painting them even though substantial coating degradation has occurred.

Maintenance decisions are two-dimensional; both the quantity and intensity of degradation need to be considered. These decisions can be complex and require knowledge of surface preparation methods, coating systems, application, structural design, corrosion mechanisms, and material properties. It has been our experience that maintenance decisions are often driven by visual criteria, i.e., "(Only) if it looks bad do we need to paint it." This approach often results in overlooking problems that may be limited in size but severe in intensity. Such problems are typically found, for example, on bolted or riveted connections, supports, or flanges, which in turn are often highly critical to structural integrity and safety. With maintenance budgets becoming ever tighter, it is advisable to spend the available funds on the real problem areas.

> ***"Maintenance decisions are two-dimensional; both the quantity and intensity of degradation need to be considered."***

In addition, using a coating system is not always the most effective and most economical way of preventing corrosion. Other options—such as improving or changing the detailing of a structure, using alternative methods of corrosion protection, such as galvanizing and metal spraying, and selecting alternative construction materials not requiring a coating system—will be considered by a knowledgeable consultant. These are recommendations unlikely to be given by a coating contractor or manufacturer.

Also, when it comes to evaluating the on-site coating performance, the consultant is really the only independent person who can provide an independent and impartial view on what does or does not work.

This response may look like an attempt to downplay the role of the contractor and manufacturer, but let me assure you, it is not. Each person plays an important and complementary role in the process of coating maintenance, but having said that, it is still unlikely that a Volkswagen dealer would seriously advise you to buy a Ford.

Wim Bonestroo began his career in 1983 as a technical service representative with Hempel Paints in Saudi Arabia. In 1985, he joined Fortis Coatings in the Netherlands as a technical service technician, responsible for the evaluation, modification, and introduction of new products. From 1993 to the present, he has been employed as technical manager by RPC (Rotterdam Painting Consultants), which provides services including coating inspection and surveys, training, and coating maintenance strategies for infrastructural, petrochemical, industrial, and offshore clients. Mr. Bonestroo is a NACE-certified coating inspector as well as a NACE CIP instructor.

Linings in Wastewater Plants: Real World Performance Evaluation

by Randy Nixon, Corrosion Probe, Inc.

Editor's Note:
This article is based on a paper the author presented at PACE 2008, the joint conference of SSPC and PDCA.

Over the last 19 years, the author has been carefully evaluating the performance of various protective lining materials in highly corrosive wastewater environments. This article presents real world performance evaluation data on seven commonly used protective lining systems in wastewater environments and focuses on film quality, chemical resistance, film thickness loss, adhesion, and permeation resistance.

Background

In 1995, widespread and premature coating system failures were identified and studied in influent wet wells, grit classification and removal structures, primary clarifiers, and other channels and tanks at the Deer Island Wastewater Treatment Plant in Boston Harbor. The amine-cured and amidoamine-cured epoxy coatings and amine-cured coal tar epoxy coatings applied in the headspaces of these various structures had blistered badly, especially at the interface of the vapor phase and the water line (or scum line) after less than six months of service exposure. The failure was first reported in the late fall of 1995 and was evaluated by the author in early 1996. While some of the failures were related to surface preparation inadequacies and initial film quality problems, the majority of

The author reports on the performance of seven types of linings in severe exposures at wastewater collection systems and treatment plants.

Effluent channel. All photos courtesy of the author.

the failures involved permeation of the coating films and blister formation, which later caused cracking and disbondment of the coating films.

Over the course of several other investigations of premature coating failures in wastewater treatment plants between 1993 and 1997, similar failure modes were identified in California, Florida, Louisiana, and New Jersey. As these investigations proceeded, one common thread was unexpectedly high concentrations of hydrogen sulfide gas. Similarly, coating systems that had long provided good corrosion protection in wastewater headspaces were routinely failing after only a year or two of service exposure.

The well-documented corrosion mechanism in the headspaces of wastewater collection systems and treatment plants is biogenic sulfide corrosion. It occurs when condensation dissolves H_2S gas on headspace surfaces, where naturally occurring sulfur oxidizing bacteria metabolize the H_2S to form sulfuric acid. Sulfuric acid aggressively reacts with the highly alkaline concrete, causing degradation of the hydrated cement paste. Sulfuric acid also actively depassivates carbon steel and ductile iron surfaces found in wastewater systems, causing active corrosion.

Much has been written about worsening biogenic sulfide corrosion rates over the past 10 years. Increased rates are related to longer detention times in storage tunnels, higher sewerage strength, greater sulfide production due to legally mandated pretreatment for the removal of heavy metals, longer transport times due to urban sprawl, the use of more force mains where aqueous sulfide production is higher because of the formation of slime layers on full pipe circumferences, and the covering of wastewater tanks and structures for foul odor containment and control.[1]

Alternative corrosion protection materials have been developed over the past 10 to 15 years to combat these higher rates of biogenic sulfide corrosion. The following are the most widely used of the alternative lining systems in North America.

- Anchored polyvinyl chloride (PVC) sheet linings (anchored into concrete when the concrete is placed, followed by heat gun-welding seams)
- Fully bonded PVC sheet linings (chemically bonded to a liquid-applied polyurethane coating material that is, in turn, adhered to the concrete substrate)
- 100% volume solids, blended amine-cured epoxy mortars filled with silica or quartz that are applied by trowel (generally self-priming, ⅛-inch- to ¼-inch-thick [3- to 6-millimeter] mortars applied directly to concrete)
- Spray-applied, 100% volume solids, blended amine-cured epoxy linings filled with fibers and some silica or quartz fine aggregate (generally applied up to 100 to 125 mils [2.5 to 3 mm] dry film thickness [DFT] using high pressure airless spray equipment)
- Spray-applied, unfilled, 100% volume solids, blended amine or novolac epoxy linings (generally applied between 30 and 50 mils [0.75 and 1.25 mm] DFT)
- Plural-component, heated, spray-applied, 100% volume solids epoxy linings (generally applied between 80 and 200 mils [2 and 5 mm] DFT)
- Spray-applied, flexible, oil-modified

Table 1: Evaluation of Lining Properties

Parameter	Evaluation Method
Film or Barrier Quality (Has film quality changed?)	Visual and microscopic examination to look for blisters, cracks, discoloration, etc. This includes checking integrity of welded joints for sheet linings.
Chemical Resistance (Has lining material been degraded?)	Physical examination to check for embrittlement, color change, film degradation, etc.
Film Thickness Loss (Has film lost thickness?)	DFT measurement using microscopic (scaled) examination
Adhesion (Has film or sheet remained adhered to substrate?)	Adhesion testing in accordance with ASTM D6677 and/or physical probing and examination
Permeation Resistance (For purposes of this paper, we assumed color change from exposed side indicates permeation depth.)	Microscopic examination of cross sections of lining materials to look for discoloration or other signs of change through section thickness

polyol polyurethane linings (generally spray-applied between 50 and 200 mils [1.25 and 5 mm] DFT using metered plural-component airless spray equipment)

The objective of this article is to assess actual field performance of the most prevalently used lining materials in severe wastewater headspace environments. Each of the commonly used types of lining systems was evaluated after a number of years of service in wastewater collection systems or treatment plants. The exposure conditions have been characterized, and real world performance has been assessed using the evaluation criteria found in Table 1.

Anchored PVC Sheet Linings

Anchored PVC sheet linings have T-shaped or knob-shaped anchors made from PVC on the back of the PVC sheets. The linings are installed as form liners when the concrete is placed. The anchors can be integrated with the sheet via extrusion, or they can be heat welded to the PVC sheets when manufactured. Anchored PVC sheet linings have been used successfully in wastewater service for over 50 years.

In service for 16 years, anchored PVC sheet linings protected the wet well headspace in an influent pump station. This area is exposed to H_2S gas concentrations that average 125 ppm annually, with excursions over 200 ppm. The surface pH measured less than 1.0.

Fig. 1: Discoloration only on exposed surface of anchored PVC sheet

Evaluation

- *Film Quality:* Visual and 30x microscopic examination showed no obvious changes in the PVC sheet, except for discoloration from white to yellowish-brown on the exposed surface only (Fig. 1).
- *Chemical Resistance:* Physical examination showed no evidence of embrittlement, softening, or degradation of the PVC.
- *Film Thickness:* Measurements showed no loss of the original PVC wall thickness. The lining remained at its original 65-mil (1.6-millimeter) thickness.
- *Adhesion:* The adhesion of the sheet lining to the concrete remained good. However, one welded joint had opened up, allowing concrete attack to occur behind the liner in a small area. It should be noted that adhesion testing procedures used for coatings are not appropriate for anchored PVC sheet linings.
- *Permeation Resistance:* Microscopic examination of the cross-section of a small piece of lining near the failed seam showed discoloration of the PVC to a depth of only 3 to 4 mils (75 to 100 microns). No other signs of degradation could be discerned (Fig. 2).

Anchored PVC sheet linings provide excellent performance in environments with aggressive biogenic sulfide corrosion, which has been well documented for over 40 years. A concern, however, is the welding of the PVC, which incorporates a weld strip that is placed over butt joints and is fused using hot air welding (500 to 600 F; 260 to 316 C). Pinholes can develop in this process if the fusing does not proceed in a continuous motion. Also, the presence of moisture or equipment problems during fusing can cause

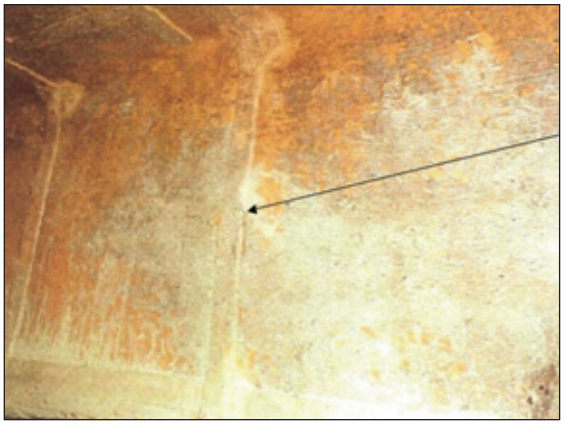

Fig. 2: Failed seam weld was the only sign of degradation from permeation on anchored PVC sheet.

poor temperature control, which can result in inadequate fusing. Poor fusing can cause subsequent corrosion, which can continue unnoticed beneath the sheet lining for a long period of time.

Fully Bonded PVC Sheet Linings

The fully bonded PVC sheet lining system includes an epoxy primer applied directly over the concrete, followed by a notch trowel-applied polyurethane coating (with a sealant-like consistency) applied at approximately 90 to 120 mils (2.2 to 3 mm). A flexible extruded polyvinyl chloride sheet that is 30 mils (0.75 mm) thick is treated with a proprietary chemical activator and is applied over the wet polyurethane coating by pushing and rolling the sheet into the wet urethane. The seams are overlapped 4 in. (10 cm), and a polyurethane seam sealer material is applied over the PVC sheet seams.

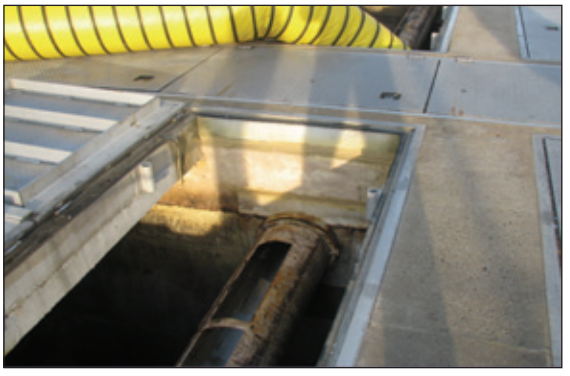

Fig. 4: Overall good adhesion of fully bonded PVC sheet lining

Fully bonded PVC sheet linings protect the headspace surfaces of the primary clarifier. Average H_2S gas concentrations in this area range from 30 to 60 ppm, with known excursions to 350 ppm. Surface pH is normally 2 to 3, with known excursions to less than 1.0. The sheet linings have been in service for 9 years.

Evaluation

• *Film Quality Maintenance:* Visual and 30x microscopic examination showed no blisters but did reveal some localized cracking of the PVC sheet, as well as discoloration.

Fig. 3: Embrittled fully bonded PVC sheet from in-service lining

• *Chemical Resistance:* Physical examination indicated embrittlement and discoloration of the PVC and a loss of flexibility when compared to a new piece of the same type of PVC material (Fig. 3). The color went from white to brownish-yellow, and the PVC appeared to be degraded. The polyurethane seam sealer used over the lap joints of the PVC sheets was badly cracked and delaminating. This material appears to be very brittle when compared to the more flexible PVC.

• *Film Thickness:* The film thickness of the PVC remained at 30 mils (0.75 mm).

• *Adhesion:* Physical examination showed the PVC sheet to be fairly well adhered to the polyurethane mastic below it. The system seemed to be fairly well adhered to the concrete where it had not cracked (Fig. 4).

• *Permeation Resistance:* Cross-sectional microscopic examination of samples of the PVC sheet removed from service showed the PVC to be discolored throughout its 30-mil (0.75-millimeter) thickness. Physical examination showed the PVC material to be embrittled when compared to a new sample of the same type of PVC sheet.

The fully bonded PVC sheet linings seem to provide good performance in preventing biogenic sulfide corrosion of concrete in aggressive headspace environments for up to 9 or 10 years. However, there is cause for concern regarding the embrittlement and/or degradation of the PVC sheet. The performance of the polyurethane seam sealer over the PVC sheets was not good and resulted in acid attack of the substrate at some seam locations. Further research should be conducted to understand the embrittlement mechanism for the type of PVC sheets used in this lining system.

Highly Filled, Blended Amine-Cured Epoxy Mortars

Generally cured via a blend of amine curing agents, these 100% volume solids lining systems were formulated to have good moisture tolerance during cure, including excellent resistance to amine blush. These mortars are highly filled to provide a minimum of ⅛ in. (3 mm) of thickness and good resistance to dilute sulfuric acid and abrasion. Most of these products are based on Bisphenol A or F resins, while some also contain novolac resins. These products provide good workability and prevent pinholing due to their ability to fill air voids. They are generally self-priming and typically can be transferred to the lining surfaces using specialized pumps. Application is by trowel, commonly followed by back rolling.

The blended amine-cured epoxy mortar protects the launder trough surfaces of the primary clarifier. Exposure conditions in this area include high H_2S gas concentrations upwards of 150 ppm in the hot summer months and surface pH measurements in the range of 1.0 or less. Additionally, the lining is exposed to turbulent flow conditions where wastewater flow changes direction. The epoxy mortar has been in service for 9 years.

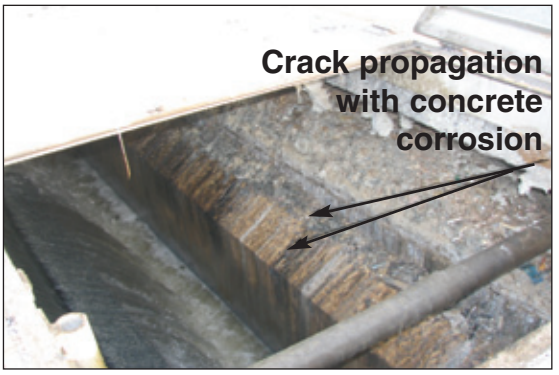

Fig. 5: Minor acidic attack where cracking occured on highly filled, blended epoxy amine-cured mortar

Evaluation

• *Film Quality Maintenance:* Visual examination as well as 30x microscopic examination of the in-service lining shows no evidence of blisters, cracking, or disbonding. The lining has discolored from tannish-yellow to dark blotchy brown, with some whitish indications on it. Cracks in the concrete substrate had propagated through the lining at a few locations. At those locations, some minor acidic attack of the concrete was occurring (Fig. 5).

• *Chemical Resistance:* When probed with a dull putty knife, the lining shows no sign of embrittlement or softening. The original roller and trowel marks are present in the film. The lining shows no evidence of film degradation in terms of strength loss or surface hardness.

• *Film Thickness Loss:* A hole saw was used to remove a small disk of the lining. Microscopic examination showed the remaining DFT to be 131 mils (3.3 mm) for a lining that was originally applied at a nominal 125 mils (3.1 mm) DFT.

• *Adhesion:* Adhesion testing in accordance with ASTM D4541 at three locations gave average results of 320 psi (22 bar) with failure occurring over 90% of the dolly surface area within the concrete. A value of 300 psi (21 bar) is considered very acceptable, especially when the failure plane is within the concrete.

• *Permeation Resistance:* Microscopic examination showed cross-sectional discoloration emanating from the exposure side of the film to a depth of 25 mils (625 microns). After probing the lining sample at the cross-sectional edge with a sharp knife, no obvious evidence of film degradation was apparent when compared to a new laboratory-cured sample of the same lining (Fig. 6).

The mortar linings provide excellent protection for concrete in aggressive biogenic sulfide corrosion environments but are labor intensive to install and do not bridge active thermal crack movement. End users should carefully examine the surfaces to be lined. If active thermal crack movement is expected or prevalent, the specification should require special crack treatment measures or the use of more flexible lining materials.

Fig. 6: No obvious sign of film degradation in highly filled, blended epoxy amine-cured mortar

Filled, 100% Solids Blended Amine-Cured Epoxy Linings

As previously noted, the filled, 100% solids systems have some fillers (fibers or fine aggregate) added to them, but they have a much higher resin-to-filler ratio than the trowelable systems discussed earlier. The resin and curing agent chemistry for these products is very similar to the trowelable epoxy systems. The filled, 100% solids epoxy amines are applied by spray and provide high film build. They are therefore less labor intensive to install when compared to the trowelable systems. However, if the filler/surfacer is improperly applied before the spraying of these products, pinholing related to outgassing from air voids in the concrete can be problematic.

The blended amine-cured epoxy linings protect the headspace walls and overhead surfaces of the influent channel to the pump station wet well. In these areas, H_2S gas concentrations average 50 to 60 ppm throughout the year, with excursions up to 85 to 90 ppm in hot summer months. Surface pH measurements gave values of 1.0 to 2.0. The linings have been in service for 5 years.

Evaluation

• *Film Quality Maintenance:* Visual and 30x microscopic examination showed no blisters or micro-cracking of the lining. Some localized failure in the form of concrete attack was documented, where pinholes had been left in the original lining film when installed. The film had discolored from its original tan to brownish-yellow. One actively moving crack in the concrete had reflected through the lining (Fig. 7).

• *Chemical Resistance:* Physical examination showed no embrittlement or degradation of the film. Original sags and roller marks were present, and the film had not softened.

• *Film Thickness Loss:* A hole saw was

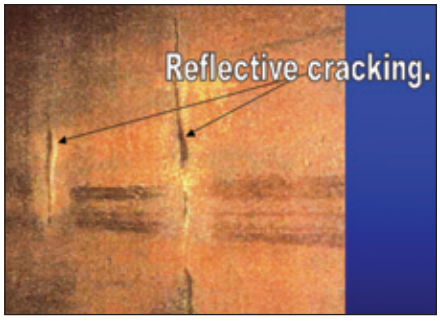

Fig. 7: Reflective cracking for one actively moving crack in filled, 100% solids, blended amine-cured epoxy lining

used to remove the lining material at two locations. Microscopic examination showed an average DFT of 94 mils (2.4 mm). The original specified lining thickness was 100 to 120 mils (2.5 to 3 mm). Visual evidence gave no reason to suspect film thickness loss had occurred.

- *Adhesion:* Adhesion evaluation using a dull putty knife showed no evidence of disbonding or delamination. The film could not be removed from the substrate without cutting it and appeared very well adhered.
- *Permeation Resistance:* Cross-sectional microscopic examination of two removed lining samples (Fig. 8) showed a clear color change in the lining film to a depth of more than 20 mils (500 microns).

The filled, 100% solids, blended epoxy amines demonstrate good corrosion protection after 5 years of service in a relatively aggressive biogenic sulfide corrosion environment. Further evaluation of performance is recommended after 10 years of service exposure. The filled

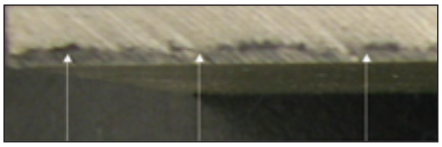

Fig. 8: 20-mil discoloration in filled, 100% solids blended amine-cured epoxy lining in total of 90+ mils

epoxy amines, like the trowelable systems discussed above, are highly susceptible to reflective cracking when applied over thermally active cracks in concrete substrates. Additionally, the filled epoxy amines can pinhole if proper filler/surfacer applications do not precede their spray application.

100% Solids, Unfilled, Blended Amine-Cured Epoxy Linings

Unfilled, 100% solids, blended epoxy amine linings are based on very similar chemistry to the filled and sprayed epoxy linings and trowelable epoxy linings discussed earlier. The designation "unfilled" does not mean that no pigments, drivers, or other solids are used in the formulations; rather, no silica or quartz fillers are added as extenders. Spray-applied, the unfilled epoxy amine linings have typically been used for new construction. They are applied over polymer-modified cementitious or straight cementitious filler/surfacer products. Generally applied between 30 and 50 mils (0.75 and 1.25 mm) in one to two coats, they can be applied up to a total of 70 to 80 mils (1.75 to 2 mm) DFT. The linings have little to no aggregate or fiber fillers and therefore have very high resin content. Based on their high resin content, it is expected that the linings develop much higher curing-related film stresses than the other two types of epoxy linings discussed above. Because of the higher film stresses, most manufacturers of similar products limit the total DFT to 40 to 50 mils (1 to 1.25 mm).

Unfilled, blended amine-cured epoxy linings protect the headspace surfaces of the influent channel to the primary clarifier. H_2S gas concentrations in the headspace surfaces average about 40 ppm annually, with excursions over 100 ppm during the warmer months of the year. The surface pH has been measured to be between 0 and 1.0. The lining has been in service for 4 years.

Evaluation

- *Film Quality Maintenance:* Film quality appeared good after 7 years, with no evidence of blisters, cracking, or film degradation. Some localized corrosion craters were present where pinholes had formed in the original coating film (Fig. 9). The film was discolored, taking on a brownish blotchy color with whitish streaks.
- *Chemical Resistance:* Physical examination showed no embrittlement or degradation of the film. Original sags, runs, and back roller marks were still present. No softening of the film was detected.
- *Film Thickness Loss:* Chips of the lining were removed at pinhole areas and mea-

Fig. 9: Localized corrosion craters at pinholes in 100% solids, unfilled, blended amine-cured epoxy lining

sured with a micrometer. The remaining film thickness was between 35 and 50 mils (0.9 and 1.25 mm) DFT. The original specified lining thickness was 30 to 40 mils (0.75 to 1 mm) DFT.

- *Adhesion:* Adhesion evaluation using a dull putty knife showed no evidence of disbonding or delamination, except at the previously mentioned pinhole or holiday locations. Otherwise, the film could not be removed from the substrate without cutting it. Adhesion was considered to be good.
- *Permeation Resistance:* Cross-sectional microscopic examination of two samples of the removed lining material (Fig. 10) showed a darkening in the lining film to a depth of 10 to 15 mils (250 to 375 microns).

The lining products demonstrated good corrosion protection after 7 years in service in a relatively aggressive biogenic sulfide corrosion environment. Further performance evaluation should be conducted after 10 to 15 years in service. The lining types are susceptible to pinholing during application if proper filler/surfacer work does not precede their installation. And, like the other two epoxy linings discussed above, the unfilled linings do not resist reflective crack propagation because their films are quite brittle once cured.

Heated, Spray-Applied 100% Solids Epoxy Linings

Generally based on cycloaliphatic amine or blended amine-cured Bisphenol A or F

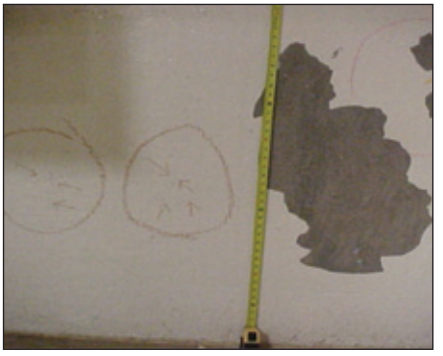

Fig. 10: Pinhole and cracking locations in heated, spray-applied 100% solids epoxy lining

epoxy resins, heated, spray-applied 100% solids epoxy linings are formulated to have excellent moisture resistance during cure. The products are applied using plural-component spray equipment, where the A and B components are heated between approximately 140 and 150 F (60 and 66 C). Heating results in very rapid initial set times and high film-build capabilities in one coat. The linings are either very lightly filled or unfilled and are, therefore, quite high in resin-to-filler ratio. Subsequently, it is expected that the heated and spray-applied epoxy linings develop very high curing-related film stresses when compared to the troweled linings or fiber-filled linings discussed above. Like the other unfilled epoxy linings, greater film stresses are expected, due to the high resin content. These products are applied between 80 and 200 mils (2 and 5 mm) DFT. Therefore, due to such thicknesses and rapid set times (owing to heating), development of even greater film stress than that of the unfilled linings can be expected. It is also likely that such rapid set times and heat cure acceleration factors reduce the recoat times for such products.

The 100% solids epoxy lining protects wet well headspace surfaces in the pump station. Here, H_2S gas concentrations average about 55 ppm annually, with periodic excursions over 100 ppm during warmer months of the year. The surface pH has been measured to be between 1.0 and 2.0. The lining has been in service for 6 months.

Evaluation

- *Film Quality Maintenance:* Film quality appeared very poor after 6 months in service. Numerous pinholes and cracks were present, and the lining was disbonded (Fig. 10).
- *Chemical Resistance:* Physical examination showed no chemical attack of the lining material. Original sags and runs were still present, and no softening of the film was discernible.
- *Film Thickness Loss:* Chips of the disbonded lining were measured for DFT. The thicknesses ranged widely between 100 and 200 mils (2.5 and 5 mm). The original specified thickness was 125 mils (3.1 mm) DFT.
- *Adhesion:* Adhesion evaluation using a dull putty knife showed evidence of poor adhesion between the epoxy lining and the cementitious surfacer applied before the lining (Fig. 11). The lining had pulled away from the surfacer and disbonded. The failure zone was within the surfacer or between the lining and the surfacer.
- *Permeation Resistance:* Cross-sectional microscopic examination of the failed lining samples showed no discoloration or change in the lining film beneath the exposed surface.

These linings provide good chemical resistance to biogenic sulfide corrosion and offer high film-build properties, excellent moisture tolerance, and rapid initial cure times. However, they are susceptible to developing strong curing-related film stresses, which can result in intercoat delamination as well as delamination associated with cohesive splitting

Fig. 11: Splitting of cementious filler/surfacer applied before heated, spray-applied, 100% solids epoxy lining

Fig. 12: Flexible, oil-modified polyol polyurethane disbonded from surfacer material

of weak cementitious filler/surfacer materials. In a second installation, this lining type had failed due to intercoat delamination between two coats (more than 50 mils [1.25 mm] each) of the lining applied within 24 hours of one another. The failure appeared to be associated with exceeding the recoat limitation for the product.

When applied over adequate surface profile and sound filler/surfacers, the linings will likely perform well in biogenic sulfide corrosion atmospheres. Their formation of strong curing-related film stresses requires that film thicknesses not be excessive and that associated filler/surfacers not be weak. Recoat limitations must be watched carefully for products with especially rapid set times, particularly epoxies that are heated for application.

Flexible, Oil-Modified Polyol Polyurethane Linings

The flexible, oil-modified polyol polyurethanes are based on the coreactants of isocyanate and various polyols. The linings offer reasonable flexibility but are not technically considered to be elastomeric. Because of the isocyanate content, these linings are extremely moisture sensitive during application and curing. As such, they must be applied over dry substrates and during dry ambient conditions. The linings are typically applied at 50 to 100 mils (1.25 to 2.5 mm) DFT using plural-component airless spray equipment. The linings offer very rapid set and cure times. They are often select-

ed because they offer some recoverable flexibility over cracks that exhibit minimal thermal-related movement.

The oil-modified polyol polyurethane lining protects the upper walls and cover of the pump station's wet well influent channel. In these areas, H_2S gas concentrations averaged between 40 and 50 ppm annually, with higher excursions. Surface pH measurements were in the 1.0 range. The lining has been in service for 3 years.

Evaluation

• *Film Quality:* Visual and microscopic examination showed no blisters or cracking in the lining. Some corrosion craters were present where original pinholes had existed in the lining material. The lining remained slighty flexible and did not exhibit any evidence of embrittlement. The lining had disbonded from the filler/surfacer and the concrete in several areas and was loose where detached from those surfaces (Fig. 12).

• *Chemical Resistance:* Physical examination revealed no softening or other signs of film degradation due to chemical exposure. Some color change had occurred where the lining went from tan to a darker blotchy brown color.

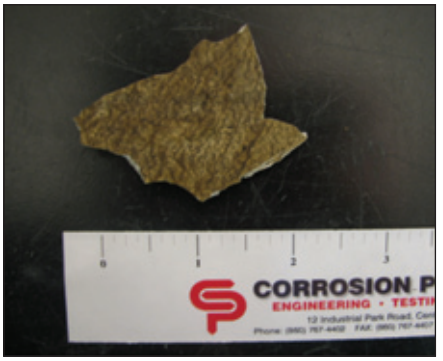

Fig. 13: Chip from disbonded, flexible, oil-modified polyol polyurethane lining

• *Film Thickness Loss:* Samples of the lining were removed and were measured using a micrometer. The thickness varied from 65 to 85 mils (1.6 to 2 mm) DFT. The original lining thickness was specified at 40 to 50 mils (1 to 1.2 mm) DFT.

• *Adhesion:* Adhesion was considered poor, given the fact that the lining material had disbonded from the substrate and the filler/surfacer material at several locations. When removed, it became clear that the lining disbonded from the primed surface in the case of both filler/surfacer and the concrete substrate (Fig. 13).

• *Permeation Resistance:* Cross-sectional microscopic examination of removed samples of the lining showed no discoloration below the upper 1 to 3 mils (25 to 75 microns) of the exposed side.

Given proper application under the right, dry conditions, the oil-modified polyol polyurethane lining type provides good chemical resistance, permeation resistance, and film quality in aggressive

biogenic sulfide corrosion environments. Based on experience, the linings will bridge minor movement across hairline cracks in concrete substrates. However, the linings are highly moisture sensitive during application and cure, which can result in blister formation, foaming (due to CO_2 generation from reaction of moisture and isocyanate), and compromised lining adhesion. Also, due to their rapid cure time and associated poor wetting properties and moisture sensitivity, the linings can develop serious adhesion problems. They must be applied with great care.

Conclusions

Real world experience has shown that there are currently several viable lining technologies available for new construction and existing retrofit applications in wastewater collection systems and treatment plants where aggressive biogenic sulfide corrosion conditions exist.

Choosing the right alternative requires careful consideration of the substrate condition (such as the presence of active cracking or the depth of prior corrosive attack), the ambient conditions under which lining application can be performed, the presence of high moisture vapor transmission through subgrade concrete structures, and the pros and cons of the available lining technologies. This article provides the reader with actual in-service performance information to support informed decisions on material selection.

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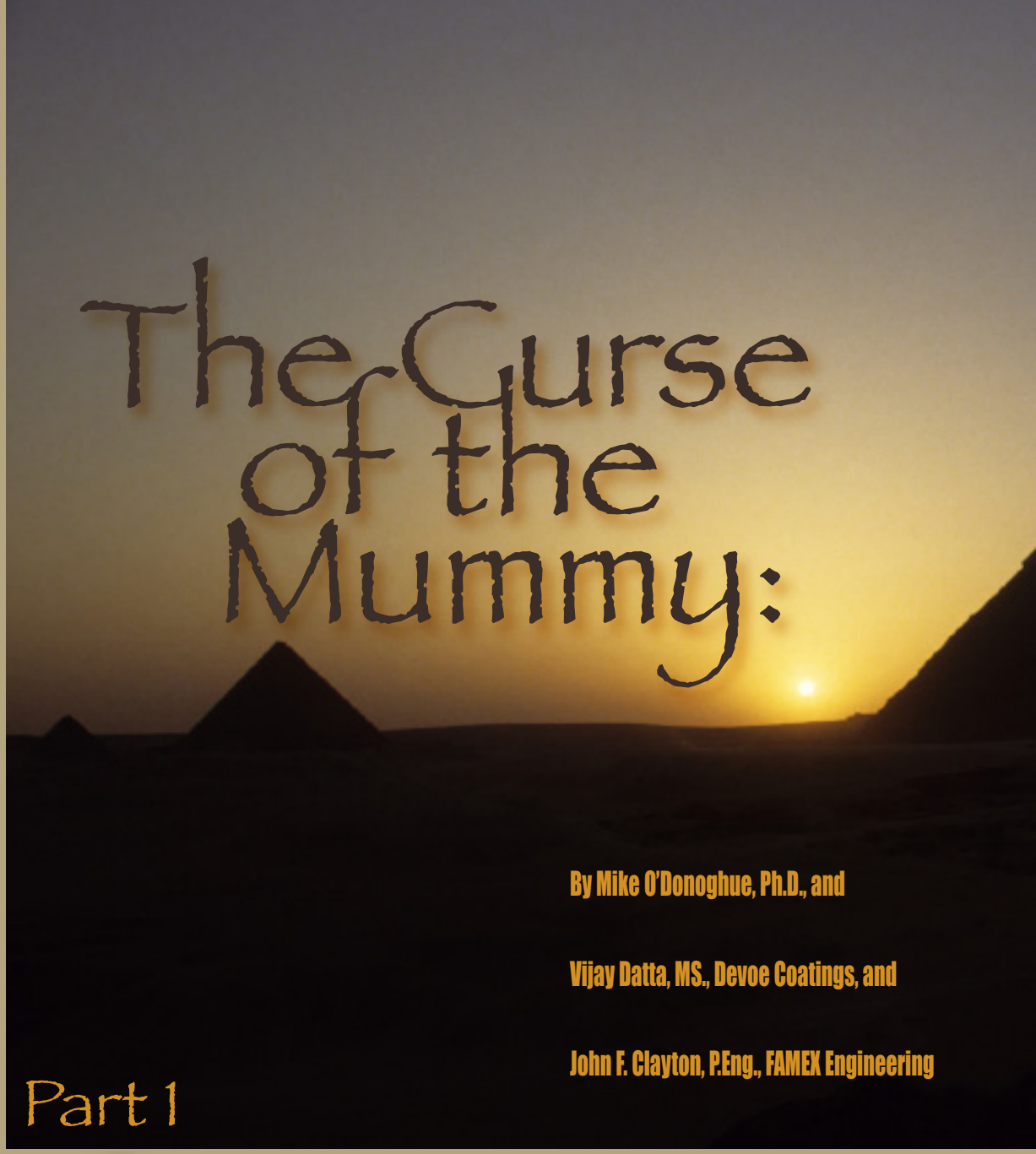
Randy Nixon is president and founder of Corrosion Probe, Inc., a consulting engineering firm providing engineering, testing, failure analysis, inspection, and project management services. He began his career with Georgia Pacific Corp. in 1976 in water/wastewater engineering, construction, and utilities management. Between 1979 and 1983, he served in management of specialty contracting services and coatings engineering for two other firms. He is widely recognized in the coatings industry for his expertise and extensive experience in piping corrosion, concrete degradation evaluation, and coatings/linings for concrete substrates. He has authored over 25 technical papers and articles.



The Curse of the Mummy:

Part 1

By Mike O'Donoghue, Ph.D., and

Vijay Datta, MS., Devoe Coatings, and

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Editor's Note: This article is based on a paper presented at PACE 2008, the joint conference of SSPC and PDCA. Part 2 is in the works.

Embarking on an exploration of intriguing coating failures, where sophisticated analytical techniques are used to dig deep within the coating, investigators sometimes make fascinating and unexpected discoveries.

Akin to an archaeological dig where great excitement and trepidation may be aroused at the discovery of a mummy, the forensic evaluation of coating failures can sometimes lead to a "chemical mummy" and a curse for those held responsible for its presence—much like the legendary and mysterious curse befalling anyone who opened the tomb of King Tut. In other instances, the mummy is easily recognized as a structure where the state of its wrappings provides an interesting clue to what lies beneath as the "bandages" are unwound.

Using a tank internal and a bridge as case histories to highlight and contrast the ingenious and sleuthful approach of investigators, this article presents the unearthing of peculiar happenings in the coating's world where the curse of the mummy is, after the fact, all too apparent.

Background

For all the great numbers of long forgotten and successful coating applications, there remain those "great undead" coating failures that are remembered forever in the collective consciousness of the coatings industry with their fare of misery, intrigue, legal bat-

Strange Discoveries in the World of Tank Lining and Bridge Coating Failures

tles, expensive remediation, and stigma.

The cause of some coating failures seems reasonably clear in the proverbial topsoil of a landscape strewn with, say, poor surface preparation, improper application, soluble salts, and solvent entrapment. In contrast, however, there are failures that test the interdisciplinary mettle (pun intended) of skillful folks who get together for a chemi-archaeolgical dig, so to speak, bent on determining the root cause of a failure buried much deeper in the core of the coatings themselves.

The question therefore is, could there be a fearsome mummy lurking below, awaiting an unsuspecting soul, and ready to be unearthed in the dig? And if so, who will be touched by the mummy's curse?

Getting Started

To begin our exploration, it must be recognized from the outset that protective coatings are sophisticated engineering materials whose principal components usually consist of a resinous binder (which may include a curative), pigments and fillers, solvent and solvent blends, and various auxiliary additives such as wetting agents, thixotropes, defoamers, biocides, and flow modifiers.[1]

Not only do coatings require careful formulation, but a number of other factors are also critical, including judicious coating selection for the intended service; proper application by a suitably qualified contractor; appropriate and well written specifications; and scrutiny from qualified third-party, independent inspectors.

Invariably, when things go wrong with a coatings application, asking what is meant by premature coating failures elicits all manner of responses. A detailed discussion of them is beyond the scope of this paper. On the one hand, coatings that have completely detached from the substrate and leave an unprotected and corroding substrate in an otherwise benign environment are obvious examples of

coating failures. So too is the demise of a coating insufficiently cured before it is placed in immersion service or a cured coating placed in chemical immersion markedly more aggressive than the coating can withstand. On the other hand, it is arguably not a coating failure when it comes to the thorny issues of those coatings that have blistered, yet remain functional and hydrodynamically stable.[2]

For the sake of clarity, perhaps one of the simplest definitions of a coating failure is as follows: "A failure of a protective coating or lining system consists of the material not performing in the manner in which it was intended."[3] So we ask "what, or who is primarily responsible for most coating failures?" One impressive study revealed fascinating results that seemed to turn popular wisdom on its head. Surprisingly, it did not point the finger primarily at the applicator. Rather, blame was apportioned as follows: owners 24.3%, engineers and specifiers 27.0%, coatings manufacturers 16.2%, contractors/applicators 27.0%, and inspectors 5.5%.[3] Was there a fearsome mummy in any of the failures? If so, was there a curse, too?

The Epoxy Lining Mummy—The Case of Delamination and the Subterranean Pools

In a fully equipped and state-of-the-art facility, the shop application of numerous lined vessels had proceeded smoothly for a couple of years. In contrasting colors, two coats of a high performance epoxy—with an excellent track record for the intended service—had been spray applied according to the manufacturer's specification to yield a total dry film thickness (dft) of approximately 8 mils. Importantly, although the color of the epoxy coating varied, the same epoxy was used as a primer and as a finish coat.

For the sake of shop efficiency, the first coat of epoxy was given a dwell time of roughly one hour under ambient conditions, followed by a bake at approximately 150 F before the application of the second coat. Throughout the application, each coat had been monitored, the final coating system had been inspected for holidays and other defects, and the results had been documented for each vessel. So when the work was completed, it was no surprise that all went well for the first year or so as the lined vessels successfully stored their intended product.

Fig. 1: X-cut for adhesion testing per ASTM D3359. Figures 1-7 courtesy of John Clayton

However, when the time came to clean the internals of some of the vessels with steam —and the external of the coated vessels could be at sub-zero temperatures—some of the topcoat in the internals delaminated. Delamination was highly problematic because the chemicals contained in the vessels could not be contaminated; thus, the reason for the delamination was of paramount concern to all parties.

A field investigation began whereby the coating system in a representative vessel was subject to adhesion testing according to ASTM D3359, "Standard Test Methods for Measuring Adhesion by Tape Test," Method A X-cut tape tests (Fig. 1). The results were noteworthy. The topcoat often adhered poorly near the welds and corners (Fig. 2). Additionally, the topcoat adhesion was random on flat surfaces, yet in other locations, the topcoat was firmly adhered and performing as first expected. Curiously, however, in areas where the X-cut tape test (shear stress) results were poor, the same coating adjacent to the compromised area gave very good results from Method A in ASTM D4541, "Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers" (tensile stress). So the first indications of coating failure were largely that it was random in nature in each of the vessels examined, and that shear stresses removed the topcoat whereas tensile stresses did not. Why? What could cause the failure and why the contrast in adhesion testing?

Fig. 2: X-cut testing showed poor topcoat adhesion at welds and corners.

The first laboratory tests consisted in part of detached coatings being examined by optical microscopy and FTIR for any particularly obvious source of contamination. None was found. Meanwhile, the owner of the shop and the coatings manu-

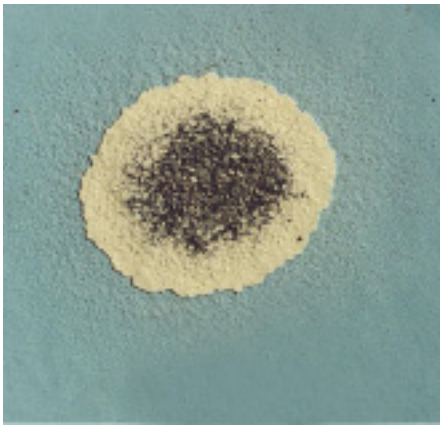

Fig. 3: Soda blasting was the most effective method of testing topcoat delamination.

facturer diligently undertook an assortment of in-house tests to see if the coating failure could be replicated when conditions such as temperatures, coating mixing protocol, and coating curing regimes were carefully varied while the coating application under each controlled condition was changed. Nothing indicative or definitive resulted.

The next phase of the investigation consisted of deliberately delaminating and removing the epoxy topcoat using a protocol that included grit, water, and soda blasting of the finish coat. In a nutshell, the most effective means of testing the delaminating topcoat was the use of soda blasting (Fig. 3). Then, once the primer was revealed, a special environmental Scanning Electron Microscope (SEM) was used on what was previously the interface between the primer and topcoat.

SEM brought to light some rather interesting findings. First, it became evident that not only could the profile of the primer be observed, but also, seen under higher magnification, a series of circular depressions protruded into the interfacial area of the topcoat (Fig. 4). The paint chips from the topcoat were notably brittle and had cracked in certain places, whereas the primer was markedly smoother and intact overall (Fig. 5). This difference in topcoat and primer behavior was due to the mechanical anchoring by the rough grit blasted surface, which had the effect of providing an interface with a very smooth and lightly undulating surface. Such a condition would facilitate the separation of the topcoat in shear. But the question remained: what caused the low degree of intercoat adhesion? And from where did the circular depressions originate? The latter were indeed a clue to the overall cause of the coating failure. But this was no crop circle; no hoax was being perpetrated.

Focusing on these depressions, SEM-EDX (Energy Dispersive X-ray) analysis was employed next to examine the upper surface layers of the primer. What was found was predominantly carbon—arguably from the epoxy or oxirane group—and materials indicative of pigments such as barium sulfate, silica, and titanium dioxide. While these materials in and of themselves did not suggest an obvious problem, it was conjectured that perhaps—more insidiously—the silica could have arisen from a silicone of some sort that in turn could have led to a weak boundary layer and subsequent adhesion loss between the epoxy topcoat and primer.

The exploration had to go to a deeper level. If SEM-EDX had already been an excavating tool as one dug deeper into the bulk matrix of the coating, then another analytical tool was sought that could be like a brush to sensitively sweep away each fresh layer as it was exposed. For piercing clarity, X-ray Photon Spectroscopy (XPS) was chosen. XPS is a highly sensitive analytical technique that characterizes the elements of molecular groups bonded on freshly derived surfaces as each surface is effectively stripped away, layer by layer, down into the epoxy itself in a process known as sputtering.

Lo and behold, mining with XPS, a provocative finding of great significance emerged beneath the coating film in the circular depressions or "subterranean pools." The mummy held out its hand! Siloxane. Yes, siloxane was identified, possibly in the form of a modified PDMS (polydimethylsiloxane—silicone oils used as surfactants to dramatically lower surface tension). Importantly, the highest concentrations of siloxane were found on the interface of the epoxy topcoat in the regions where the worst cases of delamination had occurred, i.e., the circular depressions (Fig. 6). In some bonded areas, it was virtually non-existent.

Siloxanes are indeed used in certain coating materials. However, at odds with the finding was the coating manufacturer's revelation that siloxane was not incorporated into the epoxy formulation in question, a coating with an outstanding pedigree of successful applications. So where did the siloxane come from? The investigators were intrigued.

Fig. 4: High magnification showed the primer profile and the circular depressions.

Spurred on by the findings, investigators undertook further analytical work with the very sensitive Time of Flight (T of F) secondary ion mass spectrometry (SIMS) technique. The interfaces of the delaminated epoxy topcoats were examined and the presence of siloxane was confirmed (Fig. 7).

The next phase of the investigation revolved around the deliberate formation of thick epoxy coatings on filter paper to see whether or not siloxane could be identified. Indeed it was. The circular depressions were pools of siloxane at the molecular level, and these pools had been detected in every interfacial failure of the epoxy topcoat and the epoxy primer.

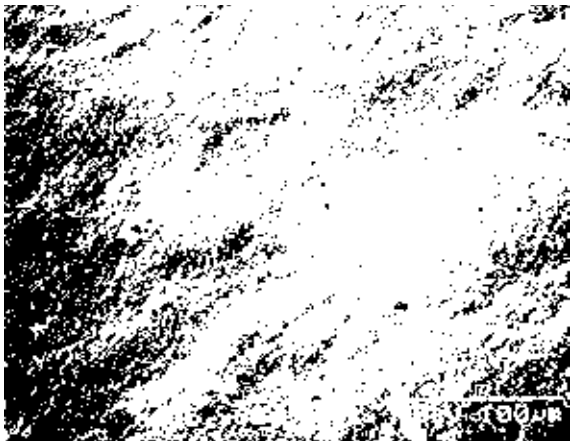

Fig. 5: The topcoat had cracked in some places but the primer was intact.

Lamentably, the siloxane had migrated to the primer surface and then had flowed over almost the entire surface as the surface tension was further reduced. This migration had the effect of forming a "chainlink fence" of siloxane on the primer where the holes in the links represented areas of siloxane, and the metal links represented adhesion sites between the epoxy primer and epoxy topcoat. Thus, the application of the topcoat via multi-component airless spray produced adhesion that was confined solely to the so-called metallic links.

The chemi-archaeological dig had unearthed the fact that the intercoat adhesion of the epoxy was compromised in such a way that shear tests readily disbonded the coating at the epoxy-epoxy interface whereas tensile tests did not. In theory, when the linings of each vessel were cleaned with hot water, the thermal expansion stress would lead to shear forces and thus cleave the bond in the chainlink fence. As an aside, it was interesting to note that airless spray, roller, and brush application of the epoxy topcoat routinely produced good adhesion to the primer. The good adhesion was presumably due to the almost monomolecular layer thickness of siloxane contaminant that was worked into the topcoat rather than being allowed to segregate as it was with the multi-component spray.

So reality had arrived with a massive thud. Where did the siloxane come from in the depressions that were a part of the chainlink fence effect and where only the perimeters of the pools provided interfacial adhesion? Although siloxane was not a part of the formulation of the epoxy coating, it was nonetheless found in prepared standard samples[4]—but only in the blue topcoat. Investigators concluded that the blue pigment in the topcoat was treated with a very small amount of PDMS (siloxane).

In the final analysis, siloxane in the epoxy topcoat was more than a culprit; it was the mummy unearthed by XPS and T of F SIMS, and it was adjudged to have caused the sporadic coating failure. Because siloxane was only found in the blue topcoat, it would appear that a minute amount of PDMS was incorporated into the blue pigment, but PDMS did not appear on any specification sheet.

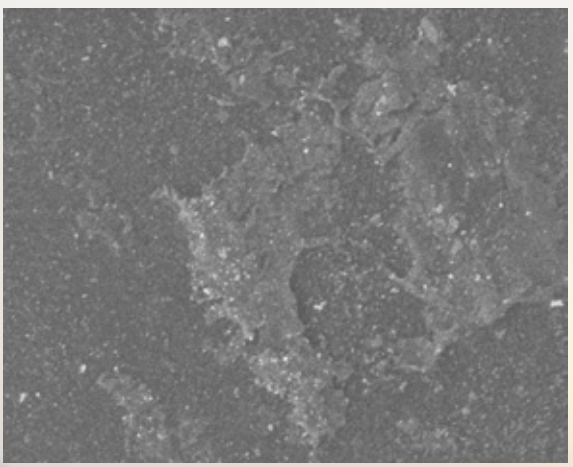

Fig. 6: The highest concentrations of siloxane were found where delamination was the worst.

The outcome? The "Curse of the Mummy" led to a very expensive settlement. The solution to remove the curse was to have all the vessels abrasive blasted and re-lined.

The Bridge Mummy:
The Not-So-Sticky Case of Coatings and Crevice Corrosion

What evidence is there to say that an old bridge resembles a mummy? An odd question to be sure. Or is it? Perhaps a mummy can well and truly be likened to a coating failure on a large steel structure such as a bridge. Perhaps there can be a curse with such a mummy?

The setting is the outskirts of a busy city center. From afar, a landmark turnpike bridge suggests from its pleasing light green hue that all is well and that the long, multi-span major truss bridge is probably in fine condition (Fig. 8). Surely, that is to be expected. After all, the bridge was refurbished only ten years ago, having been abrasive blasted to an SSPC-SP 10, Near-White Metal standard and given a three-coat system of zinc-rich primer, epoxy mid-coat, and polyurethane finish. The system was once hailed as the proverbial and best practice "Cadillac coating system."

So we approach this steel wonder. Wait a minute. Close visual inspection evokes surprise and even awe—but not because of the beauty of the bridge (Fig. 9). A multiplicity of telltale brown streaks at the structure-critical connections speaks volumes: something dastardly is going on, something that is totally absent on all those lovely green and flat steel areas. Not good. Not good at all.

A forensic engineer with coatings experience and a coatings first aid background was called in to assess the

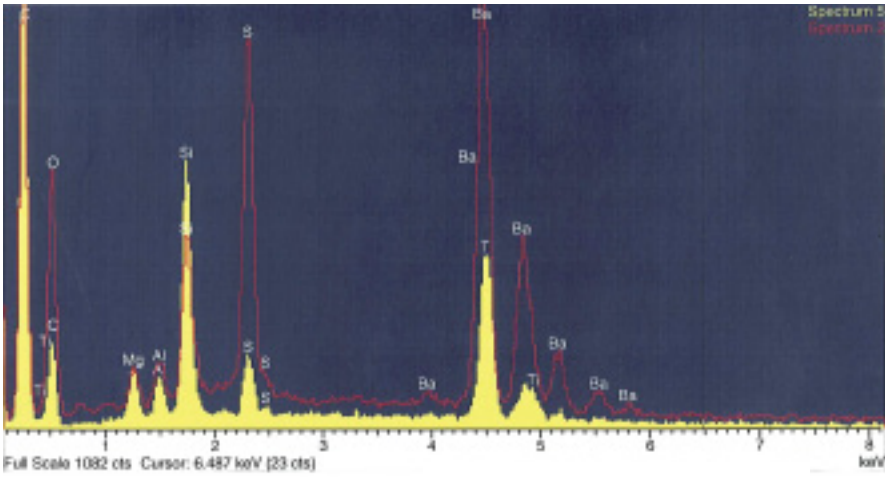

Fig. 7: Time of Flight SIMS analysis confirmed the presence of siloxane.

visual symptoms, take the wrappings off the mummy, and identify what was really going on. From his "medical" vantage, there are three levels of investigation: Level one is the observation—in this case the stain. Level two is taking samples and ascertaining the root cause of the problem. Level three is finding the solution to the problem.

Close inspection of the structure critical components showed that crevice corrosion was running amok and causing several visual symptoms such as weep rust and significant cover plate distension, the latter being due to the marked volumetric expansion of rust in the crevices.

Through optical microscopy investigation of the crevice-corroded joints, it was painfully obvious that the zinc/epoxy/polyurethane coating system applied some 10 years earlier, had not, as anticipated then, been able to mitigate crevice corrosion because the hard film-forming system did not possesses characteristics that would enable it to (a) move by capillary action into crevices and (b) function as a well-adhered anti-corrosive system once inside the crevice.

The rust matrix within the crevice corroded joints was actually ideal in some respects to be wetted out by a low viscosity material with enhanced capillary properties. But none had been used. Instead, abrasive blasting to apply the Cadillac system had failed to make any impact on the previously corroded structure-critical components. With the years of exposure to the harsh atmospheric and man-induced conditions (e.g., road salt to melt snow), crevice corrosion had proceeded unabated. The latter had progressed to the degree that the crevice corrosion had to be stopped; otherwise, the bridge agency would either have to spend considerable money for extensive structural strengthening or close the bridge to prevent its possible collapse.

The solution to the problem required an engineering and coating approach markedly different from standard methodology using hard film-forming protective coatings. A key lesson learned was to refurbish the myriad crevice-corroded connections using a high-ratio calcium sulfonate coating (Fig. 10). Such a coating offered low viscosity (less than 25 seconds in a Ford 4 cup), water-displacing properties, soft film formation, and unlimited flexibility.

First, the high-ratio calcium sulfonate penetrated deep within the connections, migrating between the substrate and pack rust to chemically (and, arguably, permanently) stop further development of pack rust via the crevice corrosion mechanism. Second, depending upon the supply of high-ratio calcium sulfonate penetrant, the low viscosity penetrant consolidated the rust matrix of the pack rust in the structure critical connections. Therein lay good adhesion and successful long-term performance. Third, a high-ratio calcium sulfonate alkyd finish coat was applied in a color that matched the existing urethane on the bridge. In this way, a zone painting approach was used to defeat the curse of the mummy.

Small wonder that the curse of the mummy was removed with the adoption of a paradigm-shift to a high ratio calcium sulfonate coating system, given its ability to penetrate crevices and stop corrosion.

Conclusions

When it comes to coating systems and failure analyses, these tales yield an invaluable insight: there are indeed chemical mummies on the micro scale and

Fig. 8: The bridge showed no corrosion when viewed from a short distance.
Figures 8-10 courtesy of Mike O'Donoghue

Fig. 9: Brown streaks at structure-critical connections indicate crevice corrosion.

Fig. 10: Crevice connections after application of high-ratio calcium sulfonate.

macro scale whose curses are all too real. The discoveries made and lessons learned from sophisticated chemical and physical excavations can be sobering, expensive, and even life saving.

In the final analysis, the curse of the mummy can be an absolute nightmare. However, the curse can be demystified and prevented by ingenuity and a better understanding of high-performance coatings and corrosion prevention.

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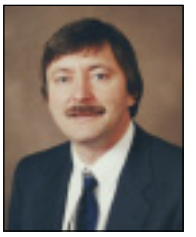

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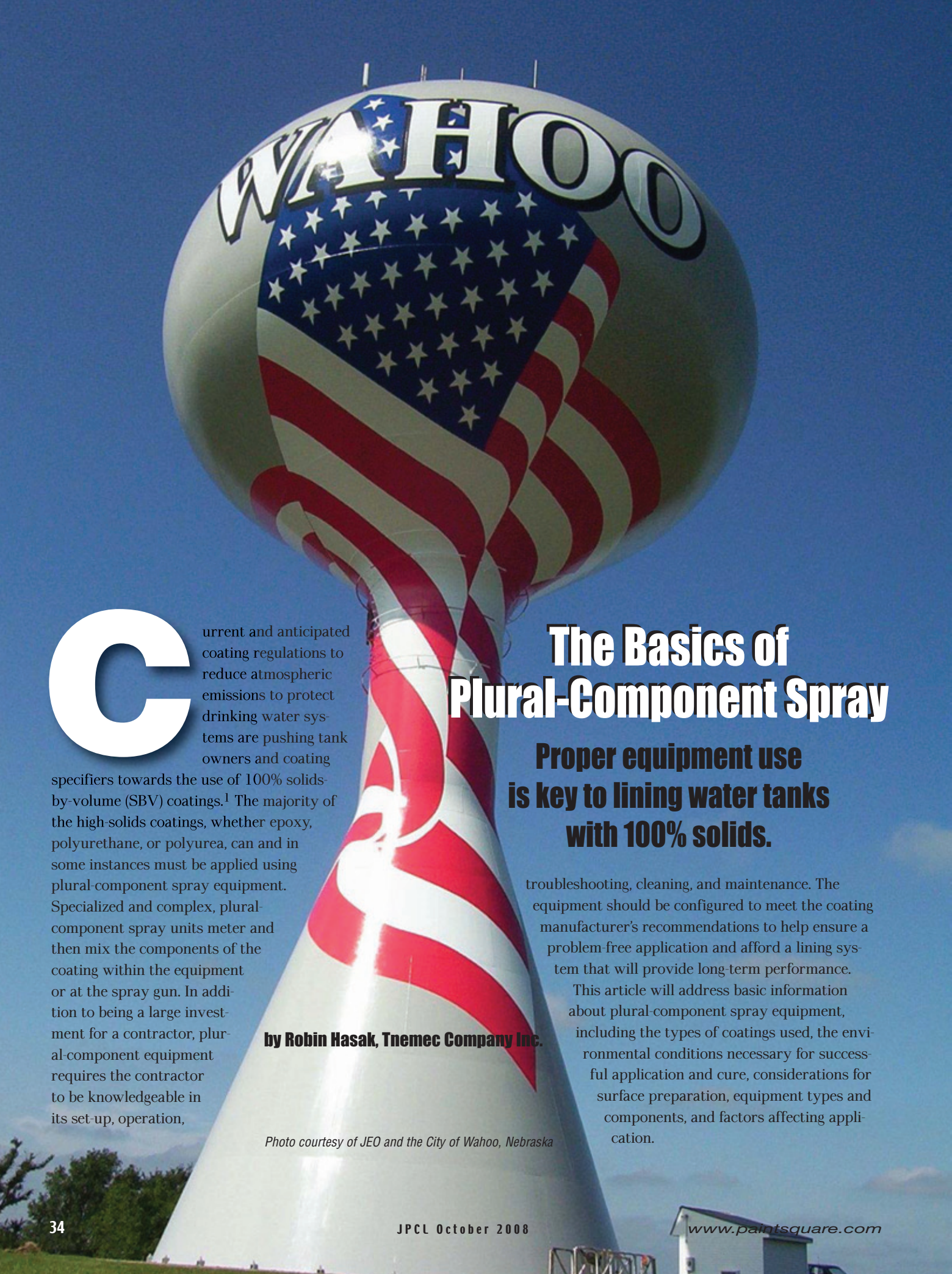

The Basics of Plural-Component Spray

Proper equipment use is key to lining water tanks with 100% solids.

by Robin Hasak, Tnemec Company Inc.

Current and anticipated coating regulations to reduce atmospheric emissions to protect drinking water systems are pushing tank owners and coating specifiers towards the use of 100% solids-by-volume (SBV) coatings.[1] The majority of the high-solids coatings, whether epoxy, polyurethane, or polyurea, can and in some instances must be applied using plural-component spray equipment. Specialized and complex, plural-component spray units meter and then mix the components of the coating within the equipment or at the spray gun. In addition to being a large investment for a contractor, plural-component equipment requires the contractor to be knowledgeable in its set-up, operation, troubleshooting, cleaning, and maintenance. The equipment should be configured to meet the coating manufacturer's recommendations to help ensure a problem-free application and afford a lining system that will provide long-term performance.

This article will address basic information about plural-component spray equipment, including the types of coatings used, the environmental conditions necessary for successful application and cure, considerations for surface preparation, equipment types and components, and factors affecting application.

Photo courtesy of JEO and the City of Wahoo, Nebraska

Coating Types Using Plural-Component Application

The following three coating types can be formulated as 100% SBV coatings with little or no volatile organic compounds (VOCs). Each of the three coatings types can be applied using plural-component equipment.

- Epoxy: A two-component material that mixes a base (resin or epoxy) with an activator (catalyst, hardener, or converter).
- Polyurethane: A two-component, fast-set coating formed by reacting (or mixing) an isocyanate with a polyol resin.
- Polyurea: A two-component fast-set coating that is formed by reacting an isocyanate with an amine resin.

Environmental Conditions and High-Solids Coatings Application

Generally speaking, the applicator who applies high-SBV coatings must know the minimum and maximum application temperature and humidity recommended by the manufacturer of the specific coating. Proper material storage temperatures, ambient and substrate temperatures, and humidity are essential for good film formation and coating cure.

Polyurethanes and polyureas can be formulated for low-temperature applications and can be tolerant of higher humidity; however, applicators must still strictly follow good painting practice. The dew point must be 5 degrees F above the substrate temperature and stable or ascending, and the substrate must be dry when the coating is applied and through initial cure.[2]

Generally speaking, epoxies require similar environmental conditions. In the case of amine-cured epoxy, the conditions of high humidity and low temperature can cause amine exudates, commonly known as amine blush, to form on the surface of the coating. If it is not removed, amine blush will interfere with the adhesion of subsequently applied coatings.

Temperatures outside the range recommended by the coating manufacturer can also hinder good film formation for all three types of coatings.

Adequate ventilation during coating application and through final cure must be in place to assure proper film formation of high-SBV coatings throughout the tank. ANSI/AWWA D102-06 ("Coating Steel Water Storage Tanks") also states that ventilation shall be used for proper cure of the coating system as well as for worker safety.[3]

Surface Preparation

The service life of a coating system depends on the degree and quality of the surface preparation specified and achieved before coating application. Because 100% SBV coatings are formulated to contain no solvent, their ability to wet out the substrate can be diminished significantly. For steel substrates, coating manufacturers typically recommend a more aggressive three- to four-mil (75- to 100-micron) angular anchor profile for single-coat applications. For concrete substrates, a concrete surface profile (CSP) range of CSP3 to CSP5 (per ICRI Technical Guideline No. 03732) is typically recommended when utilizing 100% SBV coatings for single-coat applications.[4]

Surface contamination, such as spent abrasive particulate matter or "backside contamination" (generated from contaminants in the metallic abrasive), however slight, will affect the adhesion of 100% SBV coatings.[5] Airborne particulate matter or statically charged ultra-fine particles may impede the process of effectively blowing down the substrate with clean and dry compressed air before coating application. Therefore, vacuuming the substrate may become the only option to achieve a clean and contaminant-free surface.

One possible alternative to the daily cycle of blasting and painting is the use of dehumidification equipment during interior work. Ambient temperatures can be raised or lowered, depending on the particular need at the time, and the humidity can be lowered. The applicator can then perform surface preparation for a few days longer, spend adequate time to clean the substrate, and let airborne contaminants settle out, thus reducing the risk of poor coating adhesion.

Equipment Types and Requirements

Two basic types of plural-component equipment are available today: mechanical proportioners, or fixed ratio (Fig. 1);[6] and electronic proportioners, or dosing units (Fig. 2).[7] The two equipment systems function basically the same. The coating components are fed to the proportioner (the pump), circulated and heated, proportioned at the proper mix ratio, mixed, and then spray applied.

Coating manufacturers, however, may have special needs for the application of

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their coatings that require modifications or additions to the standard equipment configurations. If the equipment manufacturer does not have the means to modify the equipment to meet the coating manufacturer's needs, the equipment maker should be able to direct the coating applicator to an approved distributor or supplier that can.

The coating manufacturer should be contacted regarding the specific equipment requirements for the application of its material. In some cases, applicator training may be necessary before the coating manufacturer will feel comfortable with an applicator purchasing and applying the coating. When an applicator needs equipment training, the equipment manufacturer should be contacted. Seldom, if ever, will a coating manufacturer assume responsibility for the actual operation of the equipment system used to apply its coatings.

Fig. 1: Mechanical proportioner (fixed ratio)
Courtesy of WIWA

Equipment Components

The individual components in a typical plural-component setup are the feed system, heating system, proportioning system (mechanical or electronic), circulation system, hose bundle, mixing system, and spray gun.

Feed System

Whether supplied in five-gallon (19-liter) containers, 55-gallon (208-liter) drums, or tote tanks, the coating components will need to be transferred and fed to the proportioning unit. A variety of feed pumps come in a wide range of configurations and gallon-per-minute (GPM) outputs that will ensure that the proportioning unit has a sufficient volume of each of the coating's components to provide the proper mix ratio (Fig. 3). An improper feed pump GPM rating, in conjunction with an improper pressure setting (either of which is too high or too low), can cause improper feeding of the proportioning unit. Off-ratio coating can result. Two ways to help prevent improper feeding are as follows: make sure that the GPM output of the feed pump is twice the amount of the GPM output of the proportioning pump or spray tip, and do not let the feed pump pressure exceed 20% of the proportioning pump pressure.

The equipment feed system should also include material agitators (Fig. 4). There is, however, one concern to be aware of: polyurea and polyurethane coatings both include an isocyanate component, which under most circumstances is not agitated, due primarily to its sensitivity to moisture and secondarily to its viscosity. Excessive agitation, regardless of the generic composition of the material, can also force air to become entrained in the material (resulting in air bubbles or foaming), which can cause the proportioning system to give improper material ratios. Desiccant filters may also be required on material containers, especially those holding an isocyanate.

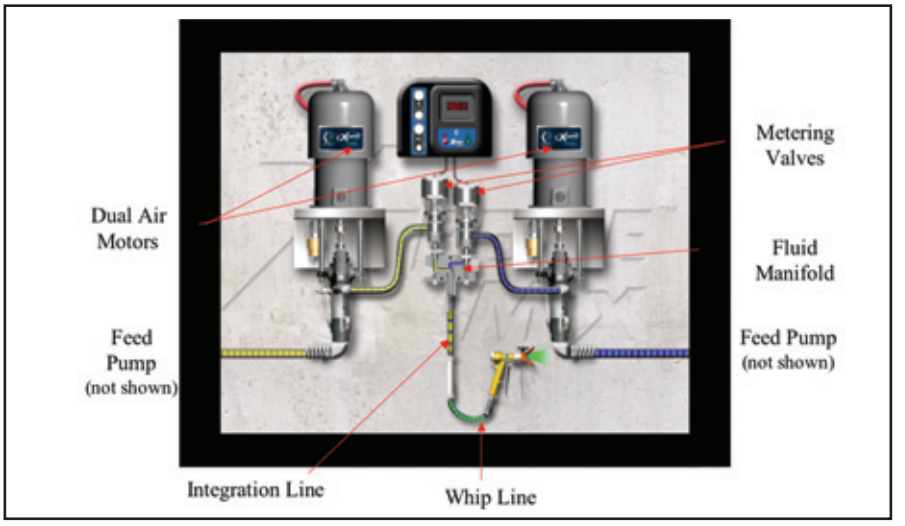

Fig. 2: Electronic proportioner (dosing unit)
Courtesy of Graco

Heating System

Material heating requirements vary with each product. The time of year and geographical location of the job also affect how well one can achieve and then maintain the proper temperature for material

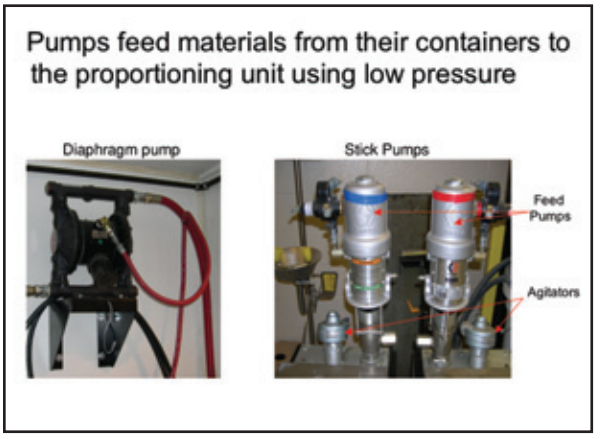

Fig. 3: Feed system
Courtesy of Tnemec

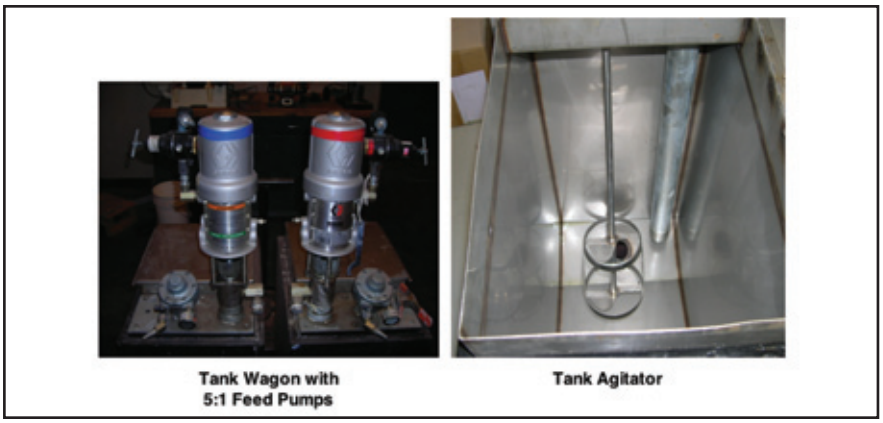

Fig. 4: Feed pumps and tank agitator
Courtesy of Tnemec

application. In colder regions, for instance, heating, circulating, and maintaining the material temperature will require more time, labor, and heating equipment than in warmer regions. Heating equipment setups can include double-wall heated material tanks, 55-gallon drum heaters (or 5-gallon bucket heaters), in-line heaters mounted on the proportioning unit, and hose-bundle heat systems (Figs. 5–9). Double-wall heated tanks normally have a water and antifreeze mixture that is kept at the desired temperature by separate thermostatically controlled heaters within the double wall of the tanks. Heat for an insulated paint hose bundle can be provided by either an electric heat trace (similar to the type used to prevent residential water pipes from freezing) or hollow tubing for circulating hot water from a small heated tank through the tubing by means of a circulation pump. Either way, the intent of providing heat to a paint hose bundle is strictly to help maintain material temperature from the pump to the spray gun. Either setup should have thermostats to control the temperature. The high-solids content and sometimes significantly high viscosity of some materials may require a combination of heating methods. When thinking about heating, another requirement for consideration is a source of electricity that will provide adequate amperage.

Proportioning System

With mechanical proportioning systems, the material ratio is set and maintained by the inside diameter of the fluid cylinders and/or the number of fluid cylinders. Through the mechanics of the proportioner, all the fluid cylinders stroke at the same time. To change the material ratio, the inside diameter and/or the number of fluid cylinders must be changed.

Mechanical proportioning systems can handle materials mixed by static mixers and applied with standard airless spray guns, as well as polyureas that require application using impingement mix spray guns. Most mechanical proportioning systems can be configured to achieve a maximum pressure rating ranging between 3,500 psi and 5,000 psi (241 and 345 bar).

Mechanical proportioning systems have a ratio tolerance range of 2%, fewer sensors and valves than electronic proportioners, and one air motor.

Fig. 5: Double wall heated tanks
Courtesy of Tnemec

Fig. 6: Drum heaters
Courtesy of Tnemec

Fig. 7: Bucket band heater
Courtesy of Tnemec

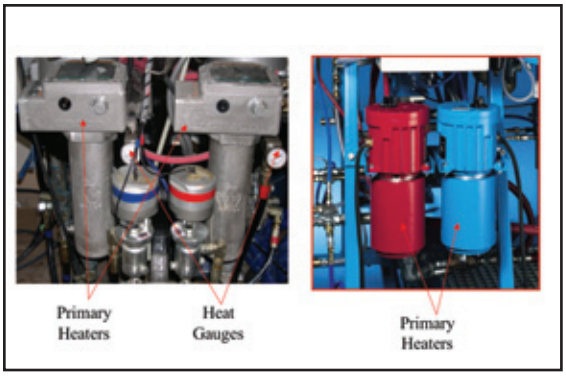

Fig. 8: In-line heating systems
Courtesy of Graco (left) and WIWA (right)

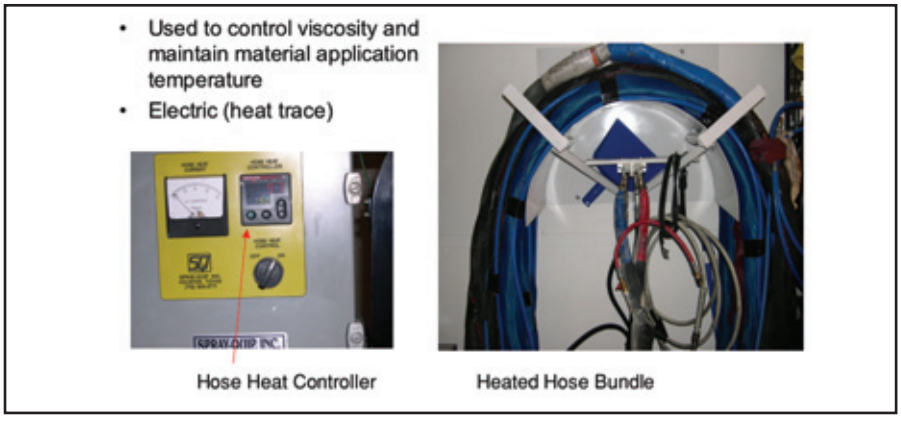

Fig. 9: Hose bundle heat systems
Courtesy of Tnemec

Due to the limited number of moving parts, troubleshooting equipment problems can be less complicated than with electronic proportioners. As with any type of equipment, however, there are also disadvantages. With mechanical proportioning systems, changing the material ratio can be difficult because the equipment must be shut down and cleaned. The fluid cylinders must then be removed from the proportioner, and the correct number or size of fluid cylinders must be installed. Fluid pressure gauges must be monitored at all times to ensure a balance of pressure between the fluid cylinders, or off-ratio material will be applied. The pump mechanic must know troubleshooting procedures that require interpretation of differences in fluid gauge pressure.

With an electronic proportioner, material ratio is set and maintained electronically through metering valves (Fig. 10). The proportioner is made up of two air motors that run separately from each other, with each motor driving its own fluid section. The material ratio is changed electronically rather than mechanically.

Electronic proportioning systems are not recommended for materials such as polyureas because they require application using an impingement mix spray gun. Most electronic proportioning systems can be configured to achieve a maximum pressure rating ranging between 3,500 and 7,250 psi (241 and 500 bar).

Electronic proportioning systems can offer advantages such as the ability to easily change the material ratio, electronic monitoring of the proportioning pumps and metering valves, automatic system shutdown when an error is sensed, error reporting, and data recording. However, electronic proportioning systems have more sensors, valves, and switches, as well as a higher ratio tolerance range of 5% (i.e., more to keep track of, more to go wrong). In addition, the pump mechanic must have more comprehensive troubleshooting skills than those required for mechanical proportioners.

Circulation System

The circulation system for plural-component equipment moves the separate components of the coating material from their heated material containers through the proportioning pump and inline heaters, through the paint lines in the heated hose bundle, and then back to their heated material containers. In the field, the process is referred to as the "recirculation mode." The material is circulated using a combination of feed pump pressure and proportioner pressure. By monitoring and adjusting the heat of the material container, the inline heaters on the proportioner, and the hose bundle heat, the material that is being readied for application can be brought to a uniform and consistent application temperature throughout the entire plural-component system, as the material manufacturer recommends.

If the material is too cold, it may not feed the proportioner effectively, thus causing the proportioner pressure to

Fig. 10: Electronic (dosing) system
Courtesy of Tnemec

be set too high to compensate for the cold material and increased viscosity. Therefore, a properly functioning heating system can be considered vital to the application. Attempting to force material that is not properly heated through the equipment could have an undesirable effect on the application, such as an off-ratio material or improper spray atomization of the material.

Occasionally, the recirculation mode may not include the material in the hose bundle paint lines. Instead, after going through the proportioner and then the inline heaters, the material goes directly back to the heated material containers. When it is time to apply the coating, the material in the paint lines that is not at the proper temperature is discarded due to an inability to obtain a good spray pattern and proper atomization.

Hose Bundle

The hose bundle typically comes in 50-foot (15-meter) lengths and includes the paint lines (one for each material component), a solvent purge line, a hose bundle heat source (i.e., an electric heat trace or hot water tubing), hose bundle insulation (for retention of hose bundle heat), and a solvent-resistant protective hose bundle cover. Recirculation lines in the hose bundle may be a standard feature or may need to be specially ordered. To maintain proper material ratios, the inside diameter of the individual material component hoses may need to be offset (e.g., ½-inch diameter for the base component and ⅜-inch diameter for the activator component). The inside diameter of the material hose will vary from one product to another, depending on the material's individual component viscosity and the material mix ratio, and on whether the atomizing pressure between the two components can be balanced.

Mixing System

Polyurea is applied using an impingement mix spray gun (Fig. 11). The spray gun is attached directly to the end of the hose bundle with a special adapter. In the event of a spray gun malfunction, check valves inside the spray gun will stop a crossover of material back into the paint lines, which would result in premature mixing of the components, and limit the problem to the spray gun. Located at the front of the spray gun, a mix module mixes the material together, while the fluid tip controls the fan pattern and supplies the proper amount of material. To prevent clogging of the mix module, material screens in the spray gun filter the material. The coating manufacturer should recommend the mix module and tip size, which must be paired together to obtain the proper mix.

Fig. 11: Impingement mix spray gun
Courtesy of Graco

Fig. 12: Mix manifold
Courtesy of Tnemec

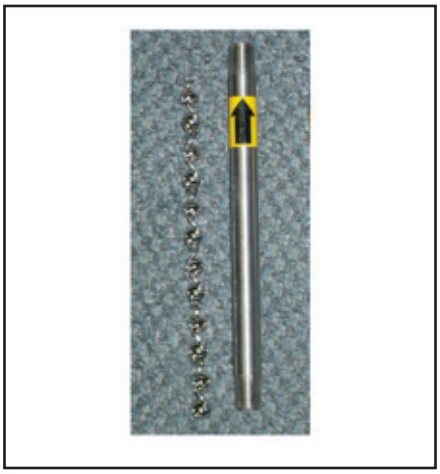

Fig. 13: Static mixers
Courtesy of Tnemec

Fig. 14: Airless spray guns
Courtesy of Tnemec

Coatings that are not applied with an impingement mix spray gun use a different type of set up that starts with a mix manifold (or block) with internal check valves, which is attached to the end of the hose bundle (Fig. 12). The mix manifold will have an assortment of fluid valves and should, but may not always, have material heat and fluid pressure gauges. The setup includes fluid valves for the solvent purge system, separate material component fluid valves that are connected by a bar and are referred to as the "dual control valve," and, if the hose bundle is so equipped, material component fluid valves for material recirculation lines.

The material line from the mix manifold to the spray gun can be configured in several different ways, depending on the coating's generic composition and the recommendations of the equipment and material manufacturers. This portion of the system can consist of one or more static mixers (Fig. 13), an integration line, a whip hose, and an airless spray gun (Fig. 14) with an appropriate spray tip.

Static mixer size is designated by inside diameter measurements—the most common, ¼ and ⅜ in.—and by the number of "folds"—the most common,

12 fold and 6 fold. The folds of a static mixer are the concave blades that mix the two pressurized material components together as the materials pass through the blades. The greater the number of folds, the more thoroughly the material is mixed. Stainless steel static mixers are usually preferred over plastic static mixers, which can be damaged more easily. Should the plastic static mixer be damaged, the applied material may not be mixed adequately. (Contractors should have spare static mixers on hand). Static mixers are directional and must be positioned with the flow arrow pointed toward the spray gun. The inside diameter, number of folds, and number of static mixers required should be recommended by the coating manufacturer.

An integration line, if required, begins combining the two coating components through the friction created by material flow through the line before the components flow through the static mixer(s), ensuring that the coating is thoroughly mixed. The airless spray gun should be rated for the proper pressure range and be the proper type for the application of high-solids material. In addition, the spray tip should be sized in accordance with the material manufacturer's recommendations.

Generally, the solvent purge system is comprised of an electric or air-driven high-pressure solvent pump and a dedicated paint line from the solvent pump to the mix manifold (Figs. 15–16). The mix manifold should include a primary solvent purge shut-off valve and a separate shut-off valve for each side of the mixing block. The solvent pump must be capable of delivering enough solvent under sufficient pressure to purge mixed material from the integration line, whip hose(s), static mixer(s), spray gun, and spray tip.

Determined by the coating manufacturer, material purge time can range from several seconds to a minute or longer. Failure to purge mixed material in time can result in the coating setting up and the loss of that portion of the equipment from the mix manifold to the spray tip.

Factors Affecting Application

Many factors can affect the application of high-SBV coatings. Some of these factors have been discussed, and others will be determined after job specifics are known. Take, for example, the earlier discussion of substrate cleanliness. Persons familiar with the lining of potable water storage tanks can recognize that, often, abrasive residue is left on lower portions of the tank to protect those surfaces from overspray and is then removed prior to coating application. If spent abrasive residue is removed from the tank before painting and the substrate is cleaned to a degree that will minimize or reduce airborne particulate matter during the application, then the substrate should be covered with visquene or clean tarps to prevent the accumulation of overspray. With 100% SBV coatings, the amount of overspray generated can be significantly more than that generated by conventional thin-film epoxy and can be difficult to remove from a prepared substrate before the coating is applied.

Another consideration, this one regarding equipment usage, pertains to cross contamination of the plural-component equipment. Most equipment manufacturers recommend that plural-component equipment remain dedicated to a particular generic coating type. Thus, plural-component equipment for epoxy coatings should be dedicated to epoxy coatings, with the base (resin or epoxy) always on the same side of the proportioner and the activator (catalyst, hardener, or converter) always on the opposing side. Switching sides on the proportioner with material components when any residual material is left in the system from the last application can cause a very large and very expensive equipment problem.

With polyurethane or polyurea mater-

Fig. 15 (top): Electric flush pump
Fig. 16 (bottom): Pneumatic flush pump
Courtesy of Tnemec

ial, this recommendation should be the same. What might happen if plural-component equipment used regularly to apply an amine-cured epoxy was brought to the next job to apply polyurethane? Before leaving for the next job, the plural-component equipment setup is flushed, but a residual amount of material is left in the fittings and miscellaneous hoses in the system. At the next job, the isocyanate portion of the polyurethane material is run through the right side of the proportioner, the same side where the amine portion of the epoxy system was run on the previous job. Enough amine residual in the system combined with isocyanate yields a chemical reaction similar to that of polyurea components. Again, the end result will cause a very large and very expensive equipment problem.

Conclusion

Much more information is available on the use of plural-component equipment with high-SBV coatings. However, the intent of this article is not to provide readers with a "how-to" manual but to provide a basic understanding of plural-component equipment and how it is used to apply coatings. Remember, the most important starting point is to open communication among the applicator, equipment manufacturer, material manufacturer, and specifier to help ensure a problem-free application and afford a lining system that will provide the expected long-term performance.

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Making 100% Solids That Are Easier to Apply

We asked two coatings experts the following question: The use of 100% solids epoxies is becoming more popular. However, these coatings must be applied by plural-component spray, and there are some problems working with this type of material (e.g. the short recoat window). From a formulation standpoint, are there things the raw material manufacturer(s) can do to make these coatings more applicator friendly?

John Ladage, Carboline Company

"Applicator friendly" can be defined many ways, but for the scope of this answer, I will discuss sprayability and short recoat windows.

The "sprayability" of any coating can be defined as how well the coating breaks up during spraying, how evenly it lays down, and how well it flows and levels to form a smooth, uniform dry film. All of these properties depend on the rheology of a coating. How a coating responds to shear and the recovery from shear will determine whether it has good sprayability.

Because a 100% solids epoxy formula contains no solvent, the resins and curing agents used need to be very low in viscosity to help keep the viscosity of the final formulation in a useable range. Low oil absorption fillers that minimize gloss reduction are also helpful in keeping the cost reasonable for this type of product. It is also important to use colorants that have low oil absorption so the formulation will have a low viscosity for spray application and hide well at the same time.

Other than low viscosity resins and curing agents along with low oil absorption fillers and pigments, the most important part of the formulation related to applicator friendliness is the thixotrope. The rheology of any formula has the biggest impact upon its sprayability. Most thixotropes are designed to work with, and in the presence of, solvent. Many thixotropes don't do very well in 100% solids coatings.

The mechanisms of flow, leveling, and film formation are quite different in solvent-borne formulations and 100% solids epoxies. Solvent-borne formulations shrink as they dry, which helps level the film. They are formulated to flow more before the solvent evaporates, which also helps level the film. Then, as solvent evaporates, an increase in thixotrope concentration causes the viscosity of the film to increase, helping to prevent sag. By the time most of the solvent has evaporated, the high concentration of thixotrope locks the film in place until the chemical reaction between the epoxy and curing agent solidifies the film.

Because 100% solids epoxies don't have the luxury of increasing viscosity

by solvent evaporation, they have to maintain film build with a constant concentration of thixotrope throughout their cure. When they first react, many epoxies actually become thinner before they ultimately thicken and gel due to molecular weight increase, so the amount of thixotrope needs to be sufficient to prevent sagging during the thinning phase. With solvent-borne formulations, the increase in viscosity due to solvent evaporation offsets the decrease in viscosity due to this initial chemical reaction. Many times, a level of thixotrope in a 100% solids epoxy that prevents sagging during this thinning out phase has a tendency, when it is first applied, to cause orange peel. So a thixotrope used in a 100% solids epoxy needs to be designed to work without solvents and needs to have a recovery time that allows the applied film to flow and level, but still has enough strength when recovered to prevent sagging as the film cures. A thixotrope is asked to do a lot more in a 100% solids epoxy. Raw material suppliers can develop more efficient thixotropes that are designed for use without solvent and that have a controlled recovery time to allow for good flow and leveling without sag during cure.

John Ladage
Laboratory Manager
Carboline Company

The use of heat with plural-component spray can mimic the film changes caused by solvent evaporation. When the coating is sprayed at a higher temperature, the viscosity is lower. Then, when the coating hits the substrate and cools, the viscosity increases—which is what happens when solvent evaporates in a non-100% solids coating. These film changes in heated, plural-component-applied 100% solids coatings are similar to film changes in non-100% solids coatings but differ in speed of viscosity increase and film shrinkage.

The increase in viscosity usually happens much more quickly in a 100% solids coating due to cooling than that due to solvent evaporation in a non-100% solids coating. In most cases, the 100% solids film cools a lot more quickly than the solvent evaporates from a non-100% solids coating. The speed of cooling obviously depends on the temperature difference between the heated coating and the substrate. The larger the difference, the faster the coating will cool. If the substrate is hot, then the coating will not cool very fast. Solvent evaporation, which depends on temperature and air movement, can vary a great deal. When solvent evaporates, the film shrinks a lot more than any shrinkage due to the cooling of a heated 100% solids film. The use of heat during application makes it a lot easier to apply a 100% solids epoxy coating and makes it easier for the thixotrope to do its job.

Short recoat windows are also an issue with 100% solids epoxies. Generally, recoat windows have a lot do with an epoxy coating's chemical resistance and its pigment volume concentration (PVC). Epoxy coatings that have more chemical resistance usually have shorter recoat windows. A shorter recoat window is due to the inability of a topcoat to soften the surface of the first coat so that it can adhere well.

If the first coat is cross-linked to the extent that it is difficult to soften, then it will most likely not be easy for a topcoat to adhere to it. In epoxies, this ability to have the surface soften can be modified by the use of reactive diluents and plasticizers that reduce cross-link density. However, this approach also has the tendency to reduce an epoxy coating's chemical resistance, which is usually an important property. Many times these reactive diluents and plasticizers are also low in viscosity, so they lend themselves well to use in 100% solids epoxies. Therefore, the development of reactive diluents and plasticizers that allow for good recoatability while maintaining overall chemical resistance is something raw material manufacturers can do to make 100% solids epoxies easier to use. Care must be taken to not add too much of these modifiers, or the physical properties of the coating can be impaired.

Unfortunately, the use of high PVC to improve the recoat window does not work well in 100% solids epoxies. As an epoxy formulation's PVC increases, its recoat window generally becomes longer. The only problem is that the useful range of PVCs in 100% solids epoxies is very narrow and does not include high PVCs. In solvent-borne formulations, the viscosity increase created by a higher level of pigment can be offset by increasing the amount of solvent. So the PVC can be increased while keeping the viscosity in a useable range. Increasing solvent, of course, is not an option with 100% solids epoxies because, by definition, they do not contain solvent. So they can only hold so much pigment and still be useable as a coating, and their maximum pigment level is not enough to significantly improve their recoat window.

Jamil Baghdachi, Eastern Michigan University

In formulating a coating, one usually makes compromises specific to each application and user. With the current state of technology, one may choose to optimize all of a coating's properties in a way that meets most of the particular properties a user desires. In practice, a formulator can use whatever resin raw materials are available and modify certain properties with a wide variety of additives to meet a user's demands. It is also feasible to design and prepare custom resins with desirable features in mind to obtain a close-to-permanent solution.

In general, the most popular requirements for 100% solids—short tack-free time, room temperature, and fast cure time—also result in a short pot life and a

short recoat window. Based on the current state of technology, a room-temperature-cure coating must either be a plural-component system or an energy-activated coating so that it can also have a sufficient shelf life. Assuming that a plural-component system is acceptable to the user, one can attempt to extend the pot life and recoat window, and to lower overall viscosities.

Jamil Baghdachi
Director, Coatings Research Institute
Eastern Michigan Univ.

Epoxy resin systems suitable for 100% solids coatings are variations of diglycidyl ether of bisphenol A and F polymers. In general, a low-molecular-weight bisphenol A-type epoxy resin has a higher viscosity than a bisphenol F-type resin. In the bisphenol F resin, a methylene bridge separates the phenolic nuclei, unlike the isopropylidene linkage in the bisphenol A resin. The methylene bridge gives the bisphenol F resin greater molecular movement compared to the bisphenol A resin. The combined effect of the bisphenol F's aforementioned properties is that the polymeric matrix of the low molecular weight bisphenol F is more highly cross-linked compared to that of the bisphenol A resin of similar molecular weight. The high cross-link density, in turn, yields a film with higher glass transition temperature and somewhat better solvent and chemical resistance, compared to a bisphenol A-based coating. (See Clive Hare, *Protective Coatings: Fundamentals of Chemistry and Composition,* SSPC 94-17, pp. 187–195.)

The cure speed of epoxy coatings is substantially influenced by the choice of amine curing agent. Ambient cure systems require active low molecular weight amine compounds. In general, primary amine-containing compounds, such as polyalkylene amines, arylyl amines, mannich bases, and cycloaliphatic amines with or without catalysis, afford very fast cure and very short pot life. The recoat window for such systems, regardless of the type of epoxy resin, is quite short. These coatings provide good adhesion and chemical and water resistance, but their toxicity is high. Moderate cure rates affording a moderate pot life and recoat window can be achieved by using cyanoethylated amines and a wide variety of polyamides. These coatings are characterized by good adhesion, chemical and water resistance, and cross-linkers with low to moderate toxicity levels.

Some cross-linking agents do, however, provide a much longer time for full cure and, therefore, an increased pot life and a longer recoat window. Curing agents such as amidoamine and polyoxyalkylene amines are examples of such cross-linkers. These coatings have excellent adhesion and water resistance but poor chemical resistance.

With current resin technology, a formulator may modify coating properties in subtle ways to obtain an applicator-friendly coating. A wide variety of additives can help broaden the application window of a particular resin and cross-linking system. In particular, additives that do not dissolve in the matrix resin tend to stratify and occupy surface regions of the cured coating, resulting in an extended recoat window.

Similarly, both epoxy resins and amine curing agents that contain pendant alkyl groups (e.g., a polyamide curing agent) tend to build cross-link density somewhat slower than the standard resin systems. This delay in reaching surface hardness, while in some cases undesirable, results in an applicator-friendly coating. Such modification of either the epoxy resin or the amine cross-linker is chemically feasible, extremely convenient, and suitable for formulating application friendly coatings.

Non-traditional approaches improving the ease of applying 100% solids coatings include preparing epoxy resins and/or cross-linking agents that are stimuli responsive. (Stimuli-responsive—electroactive—polymers have been used for 20 years in many electronic devices.) Such resins will have functionalities that, once triggered by external forces such as solvents or other resins, change their surface properties. The change in surface properties can be used to design application-friendly coatings.

A similar approach is to disperse a certain blocked or encapsulated additive or curing agent in the principal resin. Based on the design of the resin containing the stimuli-responsive material, the encapsulated material may be released under specific external stimuli such as heat or mechanical forces (high shear). Properties of the resin or composition can then be altered on demand and in proportion to the applied stimulus. Hence, the heat-responsive resin and the resultant coating could improve the ease of application of a 100% solids coating. Currently, there is a major demand for such polymers and additives.

John Ladage is laboratory manager, Marine & Zinc, for Carboline Co., where he has worked for the past 32 years. He has developed many zinc-rich primers, epoxy primers, and direct-to-metal epoxies over those years. He has been in his current position for just over one year. A member of the SSPC and FSCT, he belongs to the local St. Louis Paint and Coatings Society and served as its president last year.

Jamil Baghdachi, Ph.D., is a professor and the director of the Coatings Research Institute at the Eastern Michigan University and president of Innovative Technical Systems Corp., Livonia, MI. He has 25 years of experience in coatings formulation and development. He has published books, technical papers, and a monthly technical publication on coatings and adhesives. He holds 38 patents in related fields.

The Importance of Adhesion Control in Crack-Bridging Measurements

By Marina Delucchi, Rico Ricotti, Giacomo Cerisola, University of Genoa, Genoa, Italy

Concrete requires protective coatings over many areas. In fact, due to its tendency to develop cracks and its limited resistance to chemicals, concrete, on its own, does not offer any permanent protection against aggressive, dangerous substances. The performance requirements for coatings over concrete vary, and different tests are available in the USA and Europe to evaluate these properties.

The procedure to evaluate the crack-bridging ability (CBA) of the coatings is given in the European Standard EN 1062-7, Paint and varnishes—Coating materials and coating systems for exterior masonry and concrete—Part 7: Determination of crack-bridging properties. CBA is defined as the ability of the coating systems to take up the elongation resulting from the movements of the crack sides in the concrete. The destructive nature of crack formation and movement is one of the main problems for designers of chemical-resistant coatings for concrete.

This article reports on a study of the CBA of two commercial coatings based on polyurethane resins, evaluated as specified in the EN test method. Comments on the method and the results obtained are given.

Experimental

Unprepared commercial concrete blocks were selected as test pieces. The standard reports that the interested parties can agree to use substrates different from those indicated. The dimensions of the samples (150 mm x 80 mm x 25 mm) were in accordance with the standard, which specifies rectangular slabs of at least 75 mm x 50 mm x 20 mm. The substrate was coated with two different elastomeric coatings (designated in this article as A and B) in accordance with the manufacturer's instructions. The dry film thickness was about 300 µm. A deep saw cut was made on the back of the coated substrates to facilitate controlled cracking, and the specimens were fixed to the steel grips of a Hounsfield H5000M strain-controlled testing machine operating under Windows® test software. Finally, the samples were slightly bent to break the substrate without damaging the coating (method C.1.3.2 of the EN) and were then subjected to continuous opening of the crack (method A of the EN) with a cross-head speed of 0.5 mm/min. The measurements were carried out at two different temperatures, 298 K and 268 K (25 C, or ambient, and −5 C). The test equipment is shown in Fig. 1.

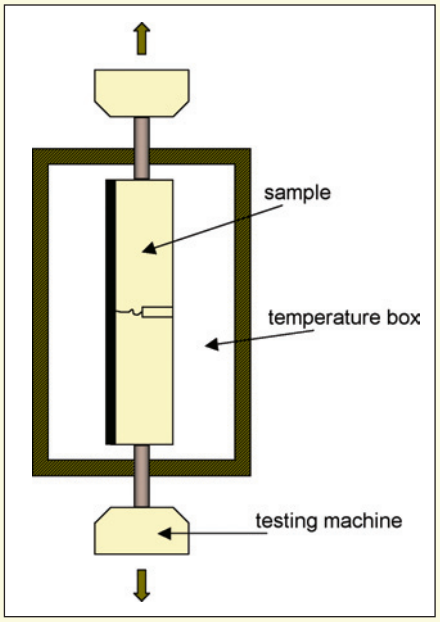

Fig. 1: Test equipment for CBA measurements
Figures courtesy of the author.

As indicated in the standard, three test pieces were used for the CBA evaluation at each temperature. The roughness index of the substrate was not measured, although it is indicated in the EN.

Results

The CBA diagrams obtained at ambient temperature for coating A are shown in Fig. 2. It is worth noticing that the initial period of the curves is almost the same, with an increase of stress over displacement up to a maximum point, while the following part is characterized by either a progressive decrease of the stress over

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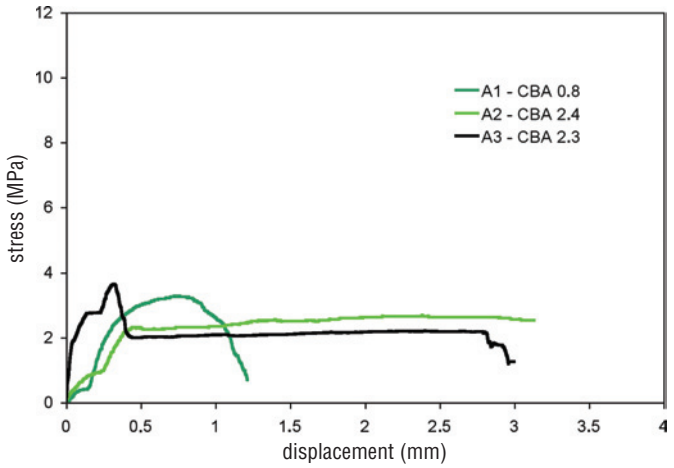

Fig. 2: CBA measurements for Coating A at ambient temperature. In the legend, the CBA values are reported in mm.

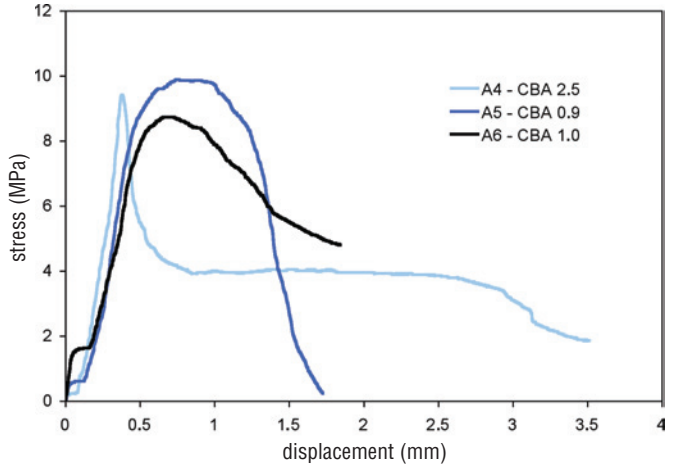

Fig. 3: CBA measurements for Coating A at low temperature, 268 K. In the legend, the CBA values are reported in mm.

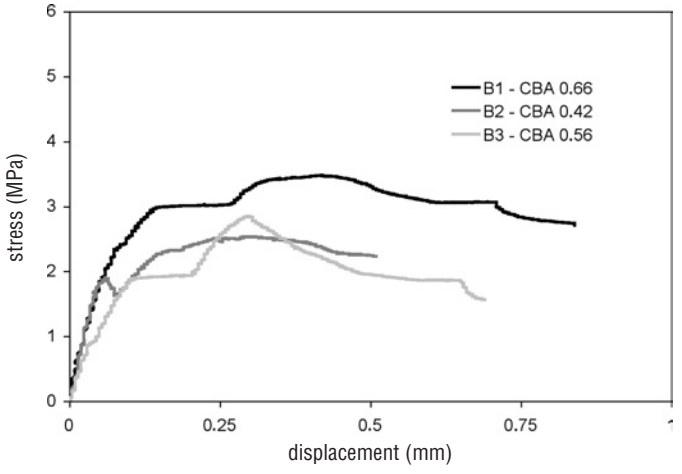

Fig. 4: CBA measurements for Coating B at ambient temperature. In the legend, the CBA values are reported in mm.

displacement or an initial stress decrease followed by a nearly constant value of the stress over displacement. Correspondingly, the visual inspection of the samples revealed that the CBA (first failure in the coating) resulted at lower values of displacement in the first case than in the second one: the CBA values ranged between 0.8 mm and 2.4 mm.

The results obtained at low temperature, 268 K, are given in Fig. 3. It is important to note that the mechanical response of the coating differs at ambient temperature (higher stresses at the same displacement) because the low temperature causes the material to harden. However, also in this case, the kinds of behavior shown in Fig. 2 occurred, and, again, a lower CBA resulted from the coating characterized by the simple bell-shaped curve (A5). The CBA values ranged between 0.9 mm and 2.5 mm.

As indicated in the EN standard, the samples were analyzed after the end of the experiment to evaluate the disbonded area in the vicinity of the crack. The area was about 2 mm for all the tests characterized by high CBAs, while it was negligible for the other specimens.

Although the standard does not require it, researchers evaluated the adhesion of the coating to the substrate. Pull-off tests were used. For the experiments at low temperature, the dollies were pulled off when the test pieces had stabilized at 268 K.

Table 1: Coating A—Results of CBA and Adhesion to the Substrate

Temperature (K)	Sample	CBA (mm)	Adhesion* (MPa)	Disbondment (mm)
298	A1	0.8	1.6	-
	A2	2.4	1.0	2
	A3	2.3	0.9	2
268	A4	2.5	0.8	2
	A5	0.9	1.8	-
	A6	1.0	1.5	-

* In all the cases coating adhesive failure occurred

Table 1 summarizes all the results for coating A. Figures 4 and 5 show the corresponding results for coating B. All the curves have the same shape, with a more or less pronounced maximum. The CBA values ranged between 0.42 mm and 0.66 mm for the test performed at ambient temperature, and between 0.52 mm and 0.55 mm for the low temperature tests (268 K). Therefore, coating B, unlike coating A, had very reproducible behavior in the two tested conditions. These samples were also analyzed after the end of the experiment to evaluate the disbonded area in the vicinity of the crack.

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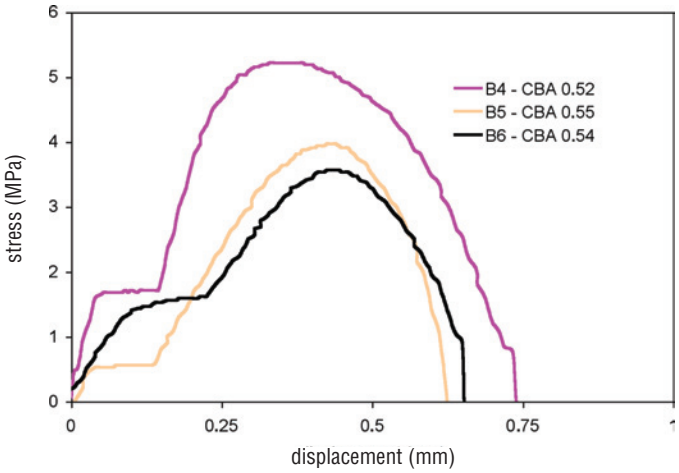

Fig. 5: CBA measurements for Coating B at low temperature, 268 K. In the legend, the CBA values are reported in mm.

Disbondment was negligible for all the specimens. The pull-off adhesion of the coating to the substrate was also evaluated.

Table 2 summarizes all the results for coating B.

Discussion

On the basis of these experiments, it can be assumed that adhesion of the coating to the substrate is a key factor in determining the ability of the coating to withstand the concrete crack opening.

From an examination of the data obtained for coating A (Table 1), it appears that high CBA values are associated with high disbondment values and low adhesion values. This behavior can be explained by considering that when the coating detaches from the concrete substrate, the coating is allowed to change shape without a concentration of the stress on the bottom; thus, it can withstand a wider opening of the concrete crack (Fig. 6).

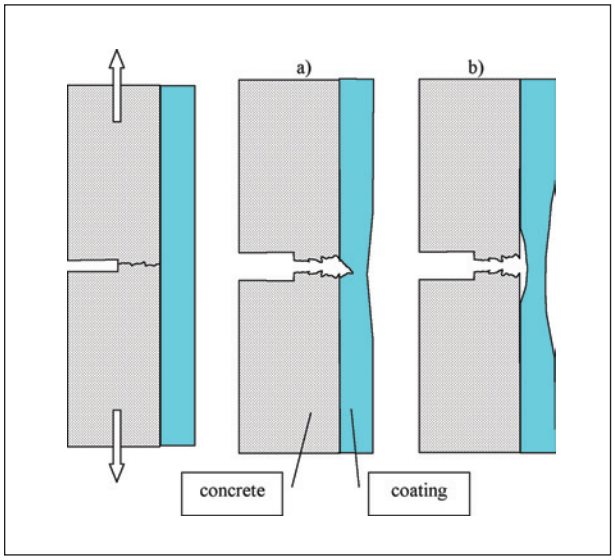

Fig. 6: Coating behavior during concrete crack opening: a) coating well adherent to the substrate, b) coating not well adherent to the substrate.

On the other hand, for coating B (Table 2), reproducible CBA and adhesion values were obtained, and the tightly bonded coating withstood only a narrow opening of the crack in the concrete at the two temperatures studied.

Conclusions

The CBA of a specific coating depends on the substrate/coating adhesion. High CBA values in this test were associated with low adhesion. We believe that adhesion is a key factor in the evaluation of the crack-bridging capability and has to be considered when selecting the substrate for the test pieces. Adhesion tests could be used to select the appropriate substrate for the test, i.e., the substrate that assures adhesion values similar to those found in the real application of the coating. Performing adhesion tests should assure better correlation between laboratory results and performance in actual installations.

Table 2: Coating B—Results of CBA and Adhesion to the Substrate

Temperature (K)	Sample	Adhesion* (MPa)	CBA (mm)	Disbondment (mm)
298	B1	1.5	0.66	-
	B2	1.9	0.42	-
	B3	1.5	0.56	-
268	B4	1.9	0.52	-
	B5	1.9	0.55	-
	B6	2.1	0.54	-

* In all the cases coating adhesive failure occurred

Although measuring surface roughness is indicated in the EN standard, it is not linked to adhesion of the coating. Therefore, even if preliminary adhesion tests are not performed, surface preparation of the specimens, at least with a metallic brush, should be a requirement of the EN. Surface preparation will improve adhesion to avoid different substrate/coating behavior and different CBA values for the same coating being tested—i.e., it will help to achieve more uniform results.

Marina Delucchi earned a PhD in chemistry for engineering in 1999 from the University of Genoa, Italy, where she is employed. She has been involved in organic coatings research, providing technical-service support in the area of coatings for corrosion protection of metallic and non-metallic substrates.

Rico Ricotti is a PhD student in the engineering faculty at the University of Genoa. His research is focused on a chemical, physical, and mechanical investigation of polymer formulations for use in protective coatings.

Giacomo Cerisola is professor of chemistry for engineering at Genoa University, where he teaches courses on chemistry and corrosion and protection of metals. He has had more than 120 articles published in national and international journals dealing with electrochemistry.

Special Events To Spice Up PACE 2009

PACE 2009 offers such a wide variety of events and entertainment that conference goers might have to give up any urge to pace themselves and, instead, enjoy them all. Sponsored by SSPC and the Painting and Decorating Contractors of America (PDCA), PACE will be held February 15–18, 2009, in New Orleans, LA. Listed below are the dates and times of the big events, as of press time. Readers should check out www.pace2009.com for updates.

Courtesy of the New Orleans Metropolitan Convention and Vistors Bureau (NOMCVB)

Habitat for Humanity

On Friday and Saturday, February 13 and 14, New Orleans Habitat for Humanity (NOAHH), Benjamin Moore, and PACE, will be taking volunteers to help with the home-construction program. NOAHH has helped over 200 families in the past 25 years; over 100 since Hurricanes Katrina and Rita. A waiver will be required. Transportation and lunch will be provided. The project and location will be assigned closer to February. Both days are from 8:00 a.m. to 4:00 p.m.

PACE Welcome Reception

The PACE and Carboline Welcome Reception, "Laissez Les Bons Temps Rouler! (Let the Good Times Roll!)," will be held on Sunday, February 15, from 5:30 p.m. to 7:30 p.m. With Fat Tuesday only a week away, the theme is an authentic Mardi Gras celebration, complete with a brass band, a Cajun Zydeco band, a parade, and local food.

Continental Breakfast and General Session

The Continental Breakfast and General Session will be held on Monday, February 16, starting at 7:30 a.m. This year's Keynote Speaker is Michael Broome, who will be discussing how to focus on one's talents, self-esteem, and several other topics in his speech, "A Humorous Look at Personal and Professional Success (How To Be A Liver Of Life And Not A Gall Bladder)."

Michael Broome

Broome has been a professional speaker for over 20 years, and enjoys raising cattle on the side. He has said that farming is the most satisfying way he knows to lose money.

Emerging Leaders Education Program

Formerly known as the PACE Young Contractors Program, this program is held on Monday, February 16, from 9:45 a.m. to 4:30 p.m. The program is designed to provide its attendees with leadership development training and the tools to work within a family business or other organization.

The program is taught in a roundtable form, and will provide strategies for dealing with generational differences. The program concludes with a Beer and Bull Session.

Some may qualify for complimentary registration.

Exhibit Hall Ribbon Cutting Ceremony and Reception

SSPC President Bruce Henley and PDCA President Mark Casale will cut the ribbon for the grand opening of the exhibit hall on Monday, February 16, at 4:30 p.m. Stay until 8:00 p.m. checking out the latest technology, products, and services from all of the available vendors.

Continued

Union Contractor Education

On Tuesday, February 17, a half-day of education is planned on the needs of the Union Contractor. The program takes place from 8:30 a.m. to noon and will include various discussions, as well as a chance to meet with peers and suppliers from around the country.

Cooking Cajun!

A trip is planned to the New Orleans School of Cooking on Tuesday, February 17, from 10:30 a.m. to 2:00 p.m. Attendees will be taught the basics of Louisiana cooking and make dishes like Gumbo, Shrimp Creole, and Bananas Foster.

Courtesy of NOMCVB

Club5

The closing ceremony of PACE 2009 will begin looking towards PACE 2010 in Phoenix, Arizona. The theme will be half Cajun and half desert southwest. It starts at 7:00 p.m. on Wednesday, February 18.

Presidents' Lectures Series

Check the education schedule for lectures taking place throughout PACE 2009 on the paint, coatings, and decorating industry.

Learning Opportunities Abound at PACE

The PACE 2009 Technical Program will provide attendees the opportunity to meet with peers, share knowledge, and learn about emerging issues and trends in the industry. The Conference, to be held in New Orleans, LA, on February 15–18, 2009, is sponsored by SSPC and PDCA. The Preliminary Program includes 25 themed sessions consisting of nearly 70 technical paper presentations and 6 workshops, scheduled for Sunday, Feb. 15, through Wednesday, Feb. 18.

Workshops

Workshops begin on Sunday, Feb. 15, when Skip Vernon of Coating & Lining Technologies and Michael Damiano of SSPC will lead "An In-Depth Look at Standards Most Frequently Used By Industrial Painters." In addition to the basics, obscure requirements and ambiguities of standards will be covered.

In "Protecting Your Workers From Inhalation Hazards of Chemical Coatings And Surfaces," presenter Thomas E. Enger of Clemco Industries will discuss how the industry's commonly used respirators protect the employee and when each type of respirator is safe to use.

Sunday's last workshop, led by Kevin D. Knight of Retro-Specs Consultants, is "Methods for Laboratory and Field Testing of Liquid-Applied Air/Vapor Barrier Membranes." The methods for laboratory and field testing of liquid-applied air/vapor barrier membranes for air and vapor permeance will be described.

On Tuesday morning, February 17, William D. Corbett of KTA-Tator will lead "Coating Adhesion Testing: Do it Right!," a workshop intended to clarify how to properly perform knife and tape adhesion tests, including common pitfalls; it will also detail the proper use of five common pull-off testers.

The last workshops scheduled will be held on Tuesday afternoon, February 17. Dwight G. Weldon of Weldon Laboratories and Gary Tinklenberg of CCC&L will present the methodology involved in solving coating failures in "Failure Analysis of Paints and Coatings." Topics will include what to look for at the jobsite, sample-taking pointers, and laboratory techniques. "Containment & Ventilation—From The Drawings To The Field" will be led by Alison B. Kaelin, CQA, KTA-Tator. This workshop provides guidance to the engineer, owner, or third party on how to verify that the contractor's accepted containment/ventilation design is consistent with what is erected in the field.

Continued

Technical Sessions

The Preliminary Program includes the following sessions, with topics ranging from the marine marketplace to the reconstruction of New Orleans.

Aesthetics and Performance

- "Exposed. The Right Way To Take It Off," B. Gunar Gruenke, Conrad Schmitt Studios
- "Restoration of a 1930's Ford Plant, Richmond CA," Burt Olhiser, Vantage Point Consulting
- "Staining and Coloring Concrete," Howard Jancy, CSI, CDT, Butterfield Color
- "Polished Concrete Project, Start To Finish," Mark B. Vogel, W.R. Meadows Inc.

Innovative Coatings and Practices for Today's Contemporary Marine Marketplace

- "The IMO PSPC: A Class Society Perspective," David Miller and Ed Jansen, ABS Americas
- "Comparative Analysis of International Maritime Organization (IMO), International Association of Classification Societies (IACS) and United States Navy (USN) Quality Assurance (QA) Inspection of Marine Coatings Systems—Surface Preparation and Coatings Application," Phillip K. Parson, QED Systems Inc.
- "A New Salt Measuring Product that Replaces the Bresle Patch (ISO 8502-9)," Paul Grossen, National Surface Treatment Center
- National Shipbuilding Research Program (NSRP) Update, Stephen B. Cogswell, Atlantic Marine, Inc.

Lead

- "Lead Contractor Approval Process," Kathryn Berry, Louisiana Department of Environmental Quality

New Orleans

- "The Reconstruction of New Orleans: Utilizing Blast and Coat Climate Control Equipment to Restore The Super Dome (and others)," Don Schnell, Munters Moisture Control Services

DOD

• "Dynamic Corrosion Prevention and Control Strategy Implementation," Daniel Dunmire, DoD Director of Corrosion Policy and Oversight

• "Detection Of Surface Contamination During A Scheduled Inspection And Repair Program," Lyn Kearns, Department of National Defense, Canada

• "Green Energy Conservation of DOD Ships and Offshore Platforms," Cinttya Morgan and Marc Thompson, PolySpec, L.P.

Bridge: Assuring Performance and Quality Projects

• "What Is Needed For A Bridge Coating To Last 100 Years or More?" Eric S. Kline, Scott B. Rice, and John Ekiert, P.E., KTA-Tator, Inc.

• "18-Month Test Results Of One-Coat Systems Applicable To Steel Bridge Structures," Seung-Kyoung Lee, Federal Highway Administration

• "Going Hollywood On The Vincent Thomas Bridge Towers," William H. (Bill) Hansel, PCS, CALTRANS

• "Cleaning and Painting of the Sunshine Skyway Cable Stay Bridge: A Challenging Repainting Project of a Signature Florida Bridge," Greg Richards, KTA-Tator, Inc.

• "Thirty Days to Paint a Bridge," David Wikoff, Munters Corporation

Durability Defined: Taking Ultra-High-Performance Coatings to the Next Level

• "New Water-Based Fluoropolymer Resins for Ultra-Weatherable Coatings," Winn Darden, AGC Chemicals

• "Protecting The Cowboys," Earl Baker and Walter Scarborough, Sherwin-Williams Company and HKS Architects

• "A New Water-Based PVDF System for Weatherable Coatings," Jerry Petersheim, Arkema Inc.

• "Now You See It, Now You Don't: Waterborne Polyurethane Graffiti Resistant Coatings," Kathy Allen and Pete Schmitt, Bayer MaterialScience, LLC

Thick-Film Coatings

• "Untraditional Application Locations," Michael Babiarz, LINE-X Industrial Coatings Division

• "Evaluation of Applied Film Thickness of Polyurea Thick-Film Elastomeric Coating/Lining Systems," Dudley J. Primeaux II, Primeaux Associates

• SSPC Polyurea Coatings Committee, Steven Reinstadtler, Bayer MaterialScience LLC

Concrete: An Amazing Substrate

• "Concrete Design For Coatings And Linings," John Durig, The Sherwin-Williams Company

• "Coating and Lining Specifications for

Continued

Concrete," Kevin Morris, The Sherwin-Williams Company
• "Concrete Surface Preparation," Fred Goodwin, BASF Construction Chemicals
• "Surface Preparation And Placement Techniques For Concrete Repair," Peter H. Emmons, Structural Preservation Systems, Inc.
• "Moisture Evaluation & Remediation," Dennis Pinelle, Simpson Gumpertz & Heger, Inc.

Case Studies
• "Degrading Sewage Pipes: An Opportunity For Coating Applicators—A Study Of Pipeline Rehabilitation Projects For Two Cities Using Single Coat, Fast Cure Epoxy Coatings," Teresa Valdes, Enviroline Group
• "Drying The Ultrahigh Pressure Water Jet Project—Neptune Terminals, Vancouver Harbour Case Study," Gregg Lowes, Munters Inc., (Canada)
• "Galvanic Drilling and Problems with Coating Dissimilar Metals in Corrosive Environments," David S. Leyland and E. Bud Senkowski, P.E., KTA-Tator, Inc.
• "Polymer Concrete for the Structural Restoration & Corrosion Protection of Columns," David Snider & Gary R. Hall, Sauereisen, Inc.
• "Rehabilitation of an Aging Concrete Reservoir Adit Tower," Raymond Tombaugh and Mongkol Mahavongtrakul, KTA-Tator, Inc. and San Francisco Public Utility Commission

Coating Types
• "High Performance Zero VOC Acrylic Topcoat," Wendy Zhao, The Sherwin Williams Co
• "A Review of Optically Active Coatings," William Cooper, Luminous Technologies Ltd
• "Characterization Of The Surface Mechanical Properties Of Paints And Polymeric Surface Coatings," Nicholas Randall, CSM Instruments
• "Flammability of Coatings," Paul P. Greigger, PPG Industries

• "Flexing Its Muscle: A High Build Elastomer Enhances A Water Treatment Process," Tony Ippoliti, The Sherwin-Williams Company
• "Flexible Polyurethane In High Impact Areas," Anders Braekke, Jotun AS (Norway)
• "Overcoating Lead Based Paint on Steel Penstocks: Practical Experience Using A High Ratio Calcium Sulfonate Alkyd (Csa) System," Mike O'Donaghue, Peter Roberts, and Vijay Datta and Terry McManus, Devoe Coatings, Akzo Nobel, and McManus Inspections Ltd.

Technology in the Coatings Industry
• "Digital Data Management For Coating Inspection Tasks On Steel Structures," JF Fletcher, Elcometer Instruments Ltd.
• "Novel Self-Healing Chemistries for Elevated Temperature Coating Applications," Gerald O. Wilson, Autonomic Materials, Inc.
• "Vinyl Coating System for the Marine Industry," Daniel Harrison PhD, Biocoatings LLC
• "Innovative Cold Sprayable Metalizing Systems for Architectural, Industrial and Marine Industries," Thomas J. Valente, LuminOre, Inc.

Failure Analysis & Testing
• "Coating Failures—Causes And Corrections," Kenneth B. Tator, P.E., KTA-Tator, Inc.
• "Adhesion Failure Mode Analysis: Cyclic Peel Testing in Synthetic Sea Water," Ray Holden, Concurrent Technologies Corporation

Chem/Petro Chem
• "Biofuels Require The Next Generation Tank Linings In Storage Tanks," G. de Vries, PPG Protective and Marine Coatings
• "Polymer Linings for Restoration & Corrosion Protection of Steel Surfaces," Gregory M. Severyn and Gary R. Hall, Sauereisen, Inc.
• "Petrochemical Plant Process' Condition Survey Analysis," Ernst Toussaint, Greenman-Pedersen, Incorporated

Power
• "Exterior Windtower Coatings—A Balance of Production, Protection, and Performance," Randy Kerans, The Sherwin-Williams Company

Concrete
• "Polyurethanes in Seamless Polymer Flooring Systems," Jing Zeng, PolySpec/Thiokol, an ITW Company
• "Coating Masonry Substrates," Steve Revnew, The Sherwin-Williams Company
• "Caveat Emptor! Preparing Cementitious Mortars to Support High-Performance Lining Systems: Broom Finish or Blasted Surface," Vaughn O'Dea, Tnemec Company, Inc.
• "Good, Bad or Indifferent, Coating of Concrete in Wastewater Environments," Bob Murphy, The Sherwin-Williams Company

Surface Preparation
• "New Method For Etching Concrete Without the Environmental Drawbacks," David A. Hunter, International Paint, LLC
• "Abrasive Blasting Using Sponge Media With Surgical Precision To Avoid Collateral Damage To Existing Coatings And Equipment," Ted Valoria, Sponge-Jet, Inc.
• "Major Keys to Cost-Effective Surface Preparation for Superior Coating Performance, Corrosion Protection and Long Service Life," Hugh J. Roper

More details on PACE coming in November

Associations

WEFTEC Breezes into the Windy City

WEFTEC.08, the Water Environment Federation's Annual Technical Exhibition and Conference, will be held for the 81st time this year, at McCormick Place, Chicago, IL. The Conference portion of the event will take place October 18–22, while the Exhibition is scheduled for October 19–22.

Described by the Federation as the largest water quality event in North America, WEFTEC offers water quality education and training and is a leading source for water quality developments, research, regulations, solutions, and cutting-edge technologies. A wide range of topics and focus areas allow attendees to design their own customized learning experience while earning up to 35 contact hours for continuing education units and 9 professional development hours. WEFTEC draws thousands of water and wastewater professionals from around the world each year, including collection systems managers; consultants; district managers; environmental engineers, chemists, and scientists; equipment manufacturers and representatives; and industrial water and wastewater treatment professionals.

Courtesy of www.choosechicago.com

In its technical program, WEFTEC.08 will feature a session that may be of interest to professionals in the field of industrial and maintenance coatings. Session 71: Build (or Rehab) It and It Will Come, part of the Collection Systems Track, is scheduled for Tuesday, October 21, from 1:30–5:00 p.m. The session moderator will be Stuart Bowns, with session assistant moderators Tamar Shuldiner and Tom Kispert. At 4:00 p.m., a paper will be presented by D.E. Jurgens and J.B. Hughes titled "Protective Coatings Lessons Learned—Failures Happen, How to Prevent Them Through Selection, Specification and Installation."

Many coatings and related companies that serve the water and wastewater industry will exhibit at the event. The following are brief descriptions and booth numbers of some of these companies known to *JPCL* at press time.

• A.W. Chesterton (Groveland, MA) provides sealing devices, wear, and corrosion coatings for the coatings industry. It offers increased equipment reliability, reduced operation costs, technical support, and training. Booth #28193, Hall B

• Carboline (St. Louis, MO) provides a range of coatings, from chemical-resistant linings to high-performance finishes. Booth # 27199, Hall B

• C.I.M. Industries (Peterborough, NH) manufactures elastomeric linings and pipes custom-engineered to protect components against wear and impact. Booth #27047, Hall B

• Enviroline Group (Pompano Beach, FL) offers single-coat, fast-cure epoxy coatings and linings for continuous immersion service in water and wastewater treatment applications. Products are custom-formulated for chemical resistance and durability. Booth #18004, Hall C

• Fast Fabricators/Vitco Company (Louisville, KY) is an independent fabricator of piping systems for the water and wastewater industry. Linings and coatings include glass, ceramic epoxy, and fusion-bonded epoxies. Booth #28174, Hall B

• Induron Coatings (Birmingham, AL) makes Protecto 401 Ceramic Epoxy Lining for protecting ductile iron pipe in sewer service. It has been used by U.S. ductile iron pipe manufacturers. Booth #28092, Hall B

• Madewell Products Corporation (Alpharetta, GA) manufactures specialty corrosion barrier coatings, linings, and mortars, including 100% solids epoxy and novolac coatings and reinforced linings. Booth #15108, Hall C

• Protective Liner Systems (Lithonia, GA) develops infrastructure rehabilitation products, from polymer cement to CIP FRP liners. It pioneered and still specializes in cured-in-place fiberglass-reinforced liners. Booth #31131, Hall B

• RLS Solutions Inc. (Broken Arrow, OK) represents Raven Lining Systems, Aquatapoxy, and the CuraFlo Spincast System. Booth #24128, Hall B

• Sauereisen (Pittsburgh, PA) specializes in protective materials for municipal wastewater infrastructure. Products include substrate repair materials, cementitious sealants, and polymer linings resisting MIC, water inflow, and infiltration. Booth #28036, Hall B

• Sherwin-Williams Co. (Cleveland, OH) manufactures a complete line of coatings and linings for municipal and industrial water and wastewater treatment facilities. Booth #16034, Hall C

• Spectrashield Liner Systems (Jacksonville, FL) makes its patented SpectraShield® liner, a spray-applied, multi-layered, silicone-modified polyurea system used to rehabilitate and protect wastewater structures such as wet wells. Booth #15013, Hall C

• Sprayroq (Birmingham, AL) developed the SprayWall® (structural) and SprayshieldGreen® (elastomeric) rehabilitative lining systems, which are marketed and installed by an international network of trained, certified licensees. Booth #31121, Hall B

• Tnemec Company (Kansas City, MO) provides protective coatings and linings for the wastewater industry, focusing on new technology and VOC compliance. Booth #25013, Hall B

• Wasser (Auburn, AL) produces single-component, moisture-cure urethane and micaceous iron oxide coatings for marine and industrial painting. Booth #23169, Hall B

• Zebron Corporation (Newport Beach, CA) provides 100% solids polyurethane to the wastewater and other industries. Booth #27221, Hall B

For more information, or to register for WEFTEC.08, visit the website www.weftec.org.

Continued

UTECH Europe 2009 Program Issued

The program for the UTECH Europe 2009 conference has been issued. The conference will be held March 31–April 2, 2009, at the Maastricht Exhibition & Congress Centre (MECC) in Maastricht, the Netherlands.

Organized by Urethanes Technology International (London, UK), the conference features international experts from the polyurethane industry. Over 100 papers will be presented throughout the event.

More information can be found at www.utecheurope2009conference.com.

Polish Coatings Program

The Institute for Engineering of Polymer Materials and Dyes (Gliwice, Poland) has announced the program for the 8th International Scientific-Technical Conference. The conference, Advances in Coatings Technology (ACT '08), will be held November 25–27, 2008 at the Warsaw International Expocentre, EXPO XXI, Poland.

ECC Announces Program

"Polymeric Nanostructures" will be the theme of the European Coatings Conference for the second time. The conference takes place November 27 and 28, 2008, in Berlin, Germany.

This year's events will include interactive group discussions and input from 13 international experts, according to the Vincentz Network, organizers of the event. The day before the main events, there will also be an extra pre-conference tutorial titled "Designing Polymers for Coatings."

The first day of the conference features two sessions—Materials and Structures in the morning, and Method and Technologies in the afternoon. The second day features a Systems and Concepts segment, with lectures titled

- "Nanostructured block copolymer films for fouling release application,"
- "Novel self-healing anticorrosion system based on pH sensitive polyelectrolyte-inhibitor complexes," and
- "Ultra thin layers as new concepts for corrosion inhibition and adhesion promotion."

Further information can be found at www.coatings.de/events/ecc44.cfm.

Companies

Emerald Appoints President

Emerald Performance Materials (Cuyahoga Falls, OH) has appointed Jim Donnelly as the president of the Specialties business unit. Donnelly was previously the senior business director of the Hilton Davis

business. The Specialties business unit produces additives for coatings and ink and a range of other products.

Elcometer Changes Name

Elcometer Instruments Limited (Manchester, UK) has changed its name to Elcometer Limited, effective June 17, 2008.

Elcometer Limited has been manufacturing inspection equipment for the coatings industry for over 50 years. The name change is intended to reflect the company's global position and reinforce the brand, according to the company.

Huntsman Opens Center in Shanghai

Hunstman Corporation has officially opened the Asia Pacific Technology Centre (ATC) in the Minhang Development Zone of Shanghai, China. Huntsman has centers all over the world, but plans to work with its centers in Europe and the U.S. to speed up the introduction of new technology in the Shanghai location, according to the company.

The ATC, which plans to expand rapidly in the next few years, will accommodate experts from the Polyurethanes and Performance Products division. The company wants to provide solutions and technology to the Asia Pacific market, the company says.

Kemira and Rockwood Complete Joint Venture

Sachtleben (Duisburg, Germany) is the new business that was recently formed in a joint venture between Kemira Oyj and Rockwood Holdings, Inc. According to both companies, this deal is supposed to create one of the world's leading producers of specialty titanium dioxide pigments.

The joint venture combines Kemira's titanium dioxide business and Rockwood's titanium dioxide pigments and functional additives business. Both companies' titanium dioxide production is based on the same process.

Wolf-Dieter Griebler will be the head of this new joint venture. He was the president of Rockwood's titanium dioxide business. Rockwood owns 61% of the new business, and Kemira owns 39%.

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Perstorp Acquires Businesses

Christophe Gas

Perstorp, the Swedish chemical group, has announced that it recently acquired Rhodia Organics and Lyondell Chimie. Perstorp currently has production facilities in 11 countries.

The new acquisitions produce TDI and HDI, which are used in coatings, among other things. TDI is used as a crosslinker in polyurethane products, and HDI is used in coatings that require stiff resistance and stability in outdoor environments.

Christophe Gas, who worked for Rhodia Group since 1988, will be responsible for the new business.

Perstorp plans to build on its acquisitions, the company says.

Buckman Appoints Board Members

Buckman Laboratories (Memphis, TN), a privately held chemical company, has announced the appointments of James A. Shepherd and Phil Shannon to the company's Board of Directors for 2008–2009. Mr. Shepherd has served as the president of several companies in the forest products industry. Mr. Shannon is currently on the board of directors of Pinnacle Airlines Corporation and chairman of its audit committee.

James A. Shepherd

Phil Shannon

Rohm and Haas Honored for Achievements

The American Chemical Society (ACS) has designated the Rohm and Haas Company (Philadelphia, PA) a National Historic Chemical Landmark. A ceremony granting this status with a commemorative plaque will take place in Philadelphia on September 15.

Rohm and Haas has developed environmentally advanced technology to use in industrial coatings with waterborne acrylic emulsion technology, according to the company. Receiving this designation will place Rohm and Haas' products along with others who hold landmark status—Scotch® transparent tape, Tide® heavy-duty laundry detergent, and flame-retardant cotton, to name a few.

Since 1953, the waterborne acrylic technology pioneered by Rohm and Haas has taken 20 million tons of VOCs out of the air, according to the company. This technology has proven beneficial to the developing economies of Russia, Eastern Europe, and China by reducing pollution. It also keeps the roofs of homes cool and marks U.S. roadways and runways, including the one that the space shuttle lands on in Florida.

The ACS established its chemical landmarks program in 1993 and has recognized over 58 landmarks since then, according to information on its web site, www.acswebcontent.acs.org/landmarks.

Tikkurila to Establish Sales in Minsk

Tikkurila, headquartered in Vantaa, Finland, plans to strengthen its position in East Europe by establishing a sales company called IP Tikkurila in Minsk, Belarus. Tikkurila is responsible for Kemira's paints and coatings business.

IP Tikkurila will be responsible for the marketing, sales, and distribution of decorative paints and industrial coatings. Mr. Mauno Nurm, country manager, who has several years of experience with Tikkurila companies in sales and managerial positions, will lead the new company.

Dow Donates to Fire Department

The Dow Chemical Company Foundation has donated $80,000 to the

Alsip Fire Department in Alsip (South Chicago), IL. Dow has a latex production facility in Alsip, and the donation was made on its behalf.

The donation will go towards funding a new training facility that focuses on confined space rescue. The new facility originally opened in August, and the fire department and Dow hosted a dedication ceremony on Sept. 10.

Polyurethane Plant Planned in Russia

Dow Izolan broke ground on a new polyurethane systems manufacturing facility on Sept. 9 in Vladimir, Russia. Established in 2006, the company is a joint venture between The Dow Chemical Company (Midland, MI) and Izolan (Vladimir, Russia).

The new plant represents the company's commitment to the polyurethanes industry in Russia, according to Dow. Start-up is expected in mid-2009.

Products

Dampney Introduces High-Temperature Coating

Dampney Company, Inc. (Everett, MA) has released a new coating system that can be applied directly to hot surfaces by brush, roller, or spray. Dampney Thurmalox 218 Primer and 219 Topcoat Pro-tective Coatings are formulated to prevent corrosion under insulation (CUI) and protect equipment exposed to high heat.

Surfaces can be coated without shutting the equipment down; once coated, surfaces will resist immersion in ambient, hot, or boiling water, the company says.

More information can be found on www.dampney.com.

Nordson Debuts Spray System

The Nordson Corporation (Westlake, OH) recently expanded its liquid product line with the debut of the Champion™ Air-Assisted Airless (AAA) Liquid Spray System.

The system can spray a variety of coatings, such as waterborne and pastel paints, primers, enamels, and varnishes, the company says. The product has been designed to deliver a smooth, even

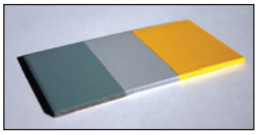
Continued

coating with minimal overspray. The system has a gun body design with a self-cleaning nozzle and an adjustable spray fan cap. The company recommends the product for both large and small production shops that paint steel framing, iron, and other substrates.

More information can be found at www.nordson.com.

Product Offers Long-Term Color Stability

Chemline Inc., based in St. Louis, MO, has introduced a coating that is designed to add color stability and chemical resistance to steel structures. Chemthane 3300 is a low-VOC, low-odor polyurethane coating.



The coating can be applied by brush, roller, or spray, and resists salts, acids, alkalis, and humidity, the company says. The product was designed for new construction or maintenance.

More information can be found at www.chemline.net.

Oxford Instruments Introduces Coatings Analyzer

Oxford Instruments (High Wycombe, UK) has introduced the new X-Strata980 X-ray fluorescence analyzer. The instrument combines an X-ray tube and high-resolution detector to measure small areas of samples and to deliver limits of detection in single-digit parts per million (ppm).

The X-Strata980 can analyze the characteristics of multi-layer coatings and other materials to detect hazardous elements. Five primary filters are options available and the analysis is said to take anywhere from seconds to minutes, according to the company.

Depending on whether or not the matrix and range are known, three types of calibration are possible with this instrument—empirical, fundamental parameter, or a combination of both. The analyzer uses an embedded camera with live video imaging, helping to create maps of the entire sample that show the concentration of different elements.

More information can be found at www.oxinst.com.

Acrylic Enamel Reformulated for Low VOCs

Krylon Products Group (Cleveland, OH) has reformulated its Iron Guard® coating to comply with volatile organic compound (VOC) restrictions of 100 g/L for industrial maintenance coatings. In addition, in most of its available colors, the coating is now free of hazardous air pollutants (HAPs).

Iron Guard is a high-gloss, waterborne, corrosion-resistant coating that enables direct-to-metal application on new or clean metal without the need for primers, thinners, and clean-up solvent, further reducing overall emissions, the company says.

For more information, go to http://go.kpgind.info/pr.

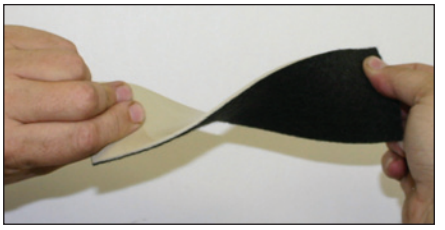
Guyson Introduces Compact Blast Cabinet

The Guyson Corporation, located in Saratoga Springs, NY, has introduced its largest blast cabinet to be fitted with the company's pressure-blast system, Model 8-EP. The pressure-blast system is faster than the suction-blast system and is preferred for coating removal and surface preparation, among other things, the company says.

The blast chamber is 36 in. high, 42 in. wide, and 42 in. deep, and is lined in rubber. The finishing chamber is accessible by top- and side-hinged doors. The cabinet also features an inner abrasion window. According to the company, the cabinet allows for a wide range of blasting materials applications.

More information can be found at www.guyson.com.

New Spray Keeps Spills from Spreading



St. Louis, MO-based Chemline has introduced Chemthane 6020, a spray-applied elastomeric containment lining. The product is a seamless hybrid polyurea lining that cures quickly, according to a spokesperson for the manufacturer. It can bridge hairline cracks in concrete containment areas and protect steel surfaces and water ponds against corrosion and leaks.

The product has no VOCs, according to the company, and is available in black, gray, or tan.

More information can be found at www.chemline.net.

ChemMasters Awarded U.S. Patent

ChemMasters Inc. (Madison, OH) was recently awarded a patent from the United States Patent Services for the development of Silencure, a product for curing and sealing fresh exterior concrete.

The product is a blend of specialized film-forming and penetrating sealers. It is applied to concrete just like any other curing compound, and the polymers form a film over the surface that cures the concrete to ASTM C309 standards. The cure contains an organohydrocar-

byloxysilane that is capable of penetrating fresh concrete to form a hydrophobic gel that restricts water and salt penetration long after the film has worn away, the company says. The product eliminates the need to wait 28 days before applying a penetrating silane or siloxane sealer.

More information can be found at www.chemmasters.net.

Asian Coating Consumption Report Released

Kusumgar, Nerlfi & Growney (West Caldwell, NJ) recently released information from a multi-client study that charts a rapid rise in Asian coating consumption. Kusumgar, Nerlfi & Growney is a consulting firm that specializes in market research and business analysis for the polymer and chemical industries. The company states that Asia's growth is forecast at 8% per year through 2012, and the coating demand in Asia totaled 21.4 billion pounds, worth $29.5 billion, in 2007.

The entire study, Asian Paint & Coatings, is available through subscription. More information can be found at www.kusumgar-nerlfi-growney.com.

Sherwin-Williams Expands Optically Active Coatings Line

Cleveland, Ohio-based Sherwin-Williams Protective & Marine Coatings has started to offer its Opti-Check™ Optically Active Pigments (OAP) in several different coatings products.

With the use of an ultraviolet flashlight, the product will show any pinholes, holidays, or improper film thickness. According to the company, pinholes as small as 0.25 mils can be identified when they contrast with the fluorescing coating.

The line of products has been approved for several types of tanks, including fuel storage, chemical holding, and potable and non-potable water tanks.

More information can be found at www.sherwin-williams.com.

Techno Coatings and Reyes Construction Team Up on Historic Bridge Retrofit

By Brian Churray, PaintSquare

Reyes Construction, Inc. (Pomona, CA) was awarded a contract of $7,059,635.90 by the City of San Diego to perform seismic retrofit and coatings application services on a historic 465-foot-long bridge over Maple Canyon. The bridge, which includes a 200-foot-long main arch span and three truss spans, was built in 1934 at the urging of the local citizenry, who deemed the structure so necessary that they personally supplied the funding.

Reyes Construction subcontracted the shop and field-applied coatings portion of the project to Techno Coatings, Inc. (Anaheim, CA) at a value of $2,225,000. Techno Coatings, an SSPC-QP 1 and QP 2 certified contractor, will provide on-site surface preparation and coatings application of the existing structural steel, as well as shop coating of the existing ornamental railings in their SSPC-QP 3 certified shop, Techno West. The existing steel is coated with lead-based paint, which will be removed within a full containment structure by abrasive blast-cleaning with copper slag or steel grit and a lead-stabilizing additive. The structural steel will be coated with a zinc-rich, moisture-cured urethane primer, a micaceous iron oxide-filled, moisture-cured urethane intermediate, and a micaceous iron oxide-filled aliphatic urethane finish.

Photo courtesy of Bruce Birney

National Park Service Awards Tank Painting Project

The National Park Service, Intermountain Regional Office, let a contract of $88,750 to Hagestad Painting & Drywall, Inc. (Kalispell, MT) to repair and recoat a 120,000-gallon water storage tank in Glacier National Park. The exterior surfaces of the 37-foot-diameter by 16-foot-high steel tank, which are coated with lead-based paint, will be pressure-washed at 3,000-4,000 psi and coated with an epoxy-urethane or alkyd-urethane system. The interior surfaces will be abrasive blast-cleaned to a Near-White finish (SSPC-SP 10) and lined with an epoxy system.

Photo courtesy of NPS

Klicos Wins Maryland Bridge Coating Contract

The Maryland State Highway Administration awarded a contract of $1,293,500 to Klicos Painting Company, Inc. (Baltimore, MD) to recoat structural steel surfaces on a 480-foot-long by 73-foot-wide bridge over the Patuxent River. The steel will be abrasive blast-cleaned to a Near-White finish (SSPC-SP 10) and coated with an organic zinc primer, an epoxy intermediate, and an aliphatic urethane finish. The contract, which required SSPC-QP 1 and QP 2 certification, includes abatement of the existing lead-bearing coatings within a Class 1A containment structure (SSPC-Guide 6).

Blastco Secures Splash Zone Painting Project

Blastco, Inc. (Houston, TX) has won a contract from the Port of Houston Authority to recoat steel piling, beams, and bulkheads at seven wharves and a lash dock within the Barbours Cut Marine Terminal. The steel will be abrasive blast-cleaned to a White Metal finish (SSPC-SP 5) and coated with a high-build epoxy coating system. The contract, which required SSPC-QP 1 and QP 2 certification, is valued at $1,698,400.

US Tank Painting Wins Standpipe Coating Contract

US Tank Painting, Inc. (Hillside, NJ) has secured a contract of $884,700 from the Borough of Sayreville, NJ, to recoat the interior and exterior surfaces of a 5 MG standpipe water storage tank. The interior surfaces will be abrasive blast cleaned to a Near-White finish (SSPC-SP 10) and lined with an epoxy system. The exterior surfaces will be abrasive blast-cleaned to a Commercial finish (SSPC-SP 6) and coated with an epoxy-urethane system.