BASF Unit Wins ICRI Awards; Promotes Fred Goodwin

The Building Systems business of BASF Construction Chemicals (Shakopee, MN) has promoted Fred Goodwin to the position of Scientist V and has also announced its recognition by the International Concrete Repair Institute (ICRI) as a material supplier/manufacturer for three award-winning projects in 2007.

In the position of Scientist V, Mr. Goodwin is responsible for initiating and managing programs of industry leadership value and providing expertise in support of strategic market development and corporate technology leadership.

An expert in the concrete construction and repair industry, Mr. Goodwin has over 25 years of industry experience and frequently serves as a guest lecturer at trade and professional association events. He is a recipient of the 2006 Editors Award from *JPCL*. Active in a number of professional organizations, he serves as the chairman of ASTM C09.68 Volume Change, ACI 364 Rehabilitation, and ICRI Materials and Methods Committees.

In other BASF news, ICRI, which conducts an annual awards program to recognize outstanding projects in the concrete repair industry, has given The Building Systems unit Awards of Excellence in the Strengthening and Parking Structures Categories for the following two projects.

- The Guayaquil bus terminal structural reinforcement project in Guayaquil, Ecuador, a large three-story transit structure affected by accelerated deterioration; and
- The Auditorium Plaza Garage in Kansas City, MO, the largest municipal parking structure in the city's downtown area. The structure, built in 1954, was afflicted by severe corrosion and deterioration.

Guayaquil Bus Terminal, Guayaquil, Ecuador

The company also received the Award of Merit in the Special Projects Category for materials used in significant structural repairs to the Arizona State University Sun Devil Stadium in Tempe, Arizona. The structure was undergoing corrosion-related deterioration caused by moisture infiltration to structural elements from the frequent wash-down cleaning of the stadium after events. Repair and protection was provided by coating of the structural steel with epoxy, epoxy flood-coating the concrete surfaces, and application of a urethane deck coating.

Fred Goodwin

The Building Systems business of BASF Construction Chemicals was formed on July 1, 2006, following the acquisition of Degussa AG's construction chemicals business. The company manufactures products for joint sealant, waterproofing, grout, concrete repair, performance flooring, surface adhesives, and wall coating solutions for construction and renovation projects around the globe.

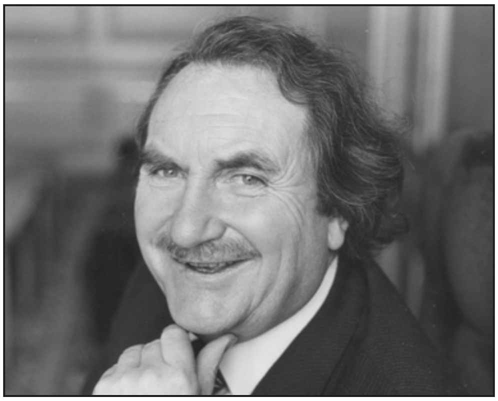
Tor Coatings Acquires Bollom Fire Protection

Tor Coatings Ltd (Birtley, UK) has acquired the Bollom Fire Protection brand and assets from the receiver. Tor, a subsidiary of Rust-Oleum Corp., has been involved in flame retardant coatings technology since its conceptual stage in the early 1970s. Bollom Fire Protection (Beckenham, UK) is known for its range of intumescent and flame retardant base coats, paints, and clear varnishes and, according to Tor, is an excellent addition to the company's portfolio.

All Bollom fire protection products will now be manufactured by Tor Coatings to the original tested and certified formulations.

Industry Mourns Former ICI Chairman Sir John Harvey-Jones

Sir John Harvey-Jones, businessman and former chairman of UK-based Imperial Chemical Industries (ICI), died at the age of 83 after a long illness on January 9, 2008. Harvey-Jones was chairman of ICI from 1982 to 1987 but was best known in the UK for advising struggling businesses in his BBC television show "Troubleshooter." He was also renowned for his outspoken leadership style and as a tireless champion of British industry.



Sir John Harvey-Jones

Harvey-Jones joined ICI in his early 30s, after resigning his commission as a Royal Navy lieutenant commander in 1954. He steadily rose in the company's ranks, and under his leadership, ICI became the first British company to post more than £1 billion in full-year pre-tax profits in 1984. He accepted Margaret Thatcher's offer of knighthood in 1985, and in 1988 was named Industrialist of the Year for the third consecutive year.

Of Harvey-Jones, Director General of the Confederation of British Industry Richard Lambert said, "He brought a sense of adventure and dynamism to the bureaucracy of ICI and made some bold decisions. He subsequently became the acceptable face of capitalism through his television programme and brought the world of business to millions in an accessible way."

Sir John Harvey-Jones is survived by his wife and daughter.

Akzo Nobel Completes ICI Acquisition

Akzo Nobel N.V. has officially completed its $16.2 billion acquisition of Imperial Chemical Industries PLC (ICI) and its two premium brands Glidden and Dulux. The deal followed months of negotiations between the two companies and approvals from EU, Canadian, and U.S. regulatory authorities. ICI accepted Akzo Nobel's final offer in August after rejecting previous offers.

The boards of Akzo Nobel and ICI announced January 2 that the acquisition had become effective in accordance with the terms proposed. The listing of ICI shares was cancelled, and ICI shares ceased to be admitted to trading as of January 3.

The new Akzo Nobel group has revenues of approximately $22 billion.

Under the terms of the purchase, ICI shareholders received about $13.15 for each ICI share held at the Scheme Record Time (11 p.m. Eastern time, Dec. 19, 2007) as well as a small interim dividend for the period from July 1 to Dec. 31, 2007.

Industrial Scientific Acquires DBO2

Industrial Scientific Corporation has announced its completion of the acquisition of Design Build Own Operate Inc. (DBO2), a leader in measuring human error in the workplace, for an undisclosed amount.

DBO2 was founded in 2001 by Barry Nelson, who will continue to serve as president and CEO. Before founding DBO2, Mr. Nelson held several senior leadership positions, including managing director, Energy and Environment for Europe, Middle East, and Africa for Honeywell International.

DBO2's leading product, SafetyNet, is a safety inspection and analysis program that helps construction, mining, energy, insurance and other companies at high risk for catastrophic injury or loss to predict and prevent worker injuries while improving quality and productivity. The system serves as a "net of prevention" by identifying hazards and unsafe trends before they become accidents.

Kent McElhattan, Chairman and CEO of Industrial Scientific said, "There's only one thing more important than processes and tools and that's the people using them. DBO2 has created a system that successfully predicts human error, thus enabling corrective action before an accident occurs."

Industrial Scientific Corporation designs, manufactures, sells, and services gas monitoring instruments, systems, and related products. Employing over 800 people, Industrial Scientific has manufacturing operations based in Pittsburgh (USA), Arras (France), Dortmund (Germany) and Shanghai (China), provides technical services to customers from local service centers around the world.

DBO2, located in San Carlos, CA, was founded in October 2001. With more than 30 million observations, DBO2 has amassed a large repository of workplace behaviors and conditions in the world. DBO2's SafetyNet, QualityNet and ProductivityNet software services are currently used on a daily basis at more than 7,000 worksites.

Getting Chewing Gum Off the Floor

What kinds of (generic) products and equipment are available for concrete and other surfaces that help with gum removal, which is a big problem for buildings in our school district. We have different types of floor coatings, bare concrete, sealed concrete, and bricks. Currently, we are using a hot box and a pressure washer. But this is limited and is destructive to some surfaces. Whatever we use for removal must not create slip and fall hazards, and VOC emissions must be avoided.

Jeff Theo, The Vulcan Group

Due to the variety of substrates and surface textures to which gum adheres, it is difficult to come up with a panacea. We have had success with the following methods.

Gum is easiest to remove when it is in a hardened state. Fresh gum, or gum exposed to hot sun, is the most sticky. The easiest way to harden gum is to apply ice. Once hard, a sharp scraper will remove the majority of the gum. The residue can be removed with a citrus-based cleaner that contains di-Limonene.

Di-Limonene, sometimes referred to as "peel oil", is derived from orange peels. The amount of di-Limonene varies with the product. As a rule of thumb, the higher the price, the more di-Limonene present. Some products are available as either a concentrate or as ready-to-use. Concentrates are diluted with water, preventing potential damage to the floor coating. Once the gum residue is removed, the area should be rinsed with fresh water.

Large areas can be treated by first scraping the heavy spots, then applying a di-Limonene-based solution using a floor scrubber. A pressure wash will remove any residue and rinse the floor.

Extremely dirty areas may require a more aggressive approach. Cryogenic or ice-blasting will embrittle the gum and remove it from the substrate in a single step.

Because different substrates may be encountered, try a small test in an inconspicuous area. High concentrations of Di-Limonene or aggressive abrasion may damage or discolor certain substrates.

Keep in mind that the best remedy is prevention. In Singapore, gum spitting is punishable by two to three lashes with a stiff cane!

Jeff Theo is vice president, Field Operations, at Vulcan Painters, Inc., Bessemer, AL. Once president of SSPC, he now sits on the Society's Board of Governors.

Brian Goldie, European Editor, *JPCL*

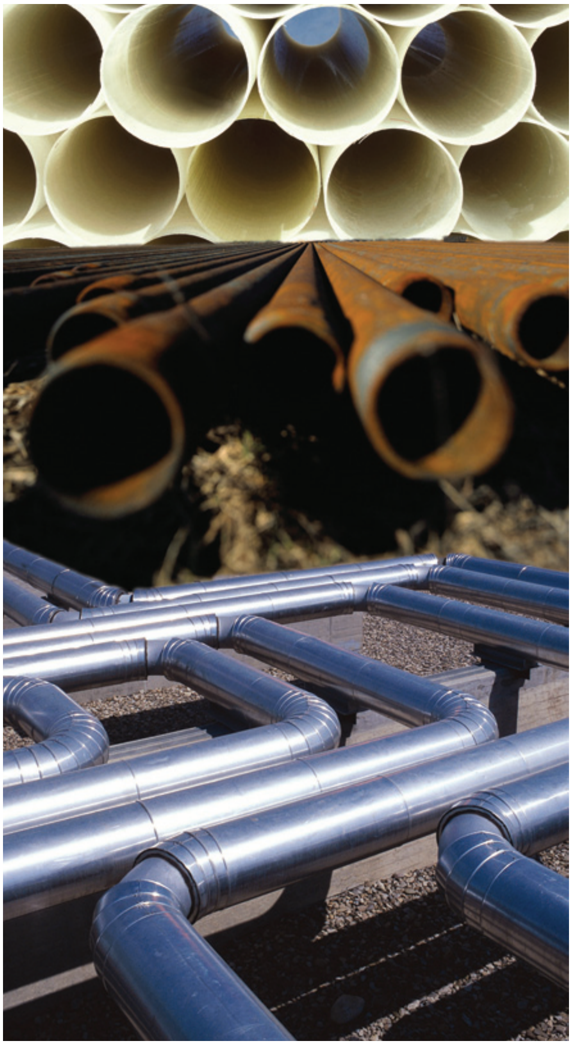
Discarded chewing gum is a nuisance that needs to be removed from concrete, stone, or brick surfaces. Traditional methods of cleaning substrates, e.g., abrasive blasting or solvent cleaning, cannot be considered as environmentally friendly for this application. Blasting with either grit or "soft" abrasive gives good results, although it can damage coatings and produce contaminated residues that must be contained, collected, and disposed of properly. Also, solvents that have been used with some success in softening dried gum release VOCs. Similarly, directing aerosol sprays of liquefied gas (e.g., butane) at the solid gum will freeze the gum, causing it to shatter and detach from the substrate. This method, however, presents the problems of flammability and the release of VOCs.

Chewing gum is normally removed from floors and other surfaces by steam. Typically, superheated steam, with or without detergent added, is directed at the dried gum, which is turned into a powder and can be brushed up. Proprietary machines that use low pressure and approximately 2 liters of water per hour are available from several suppliers. The process is considered environmentally friendly, although the temperature involved can damage some coatings. The use of high-pressure water will remove gum, but leaves the gum sticky and can redeposit it in adjacent areas.

One successful and environmentally friendly method used in Europe is the use of dry ice blasting. In this process, solid CO_2 pellets are blasted at the gum to be removed, and because solid CO_2 sublimes at ambient temperature (i.e., converts directly from a solid to a gas), no residue is left. The chewing gum is removed in a simultaneous three-stage process: energy transferred on impact, combined with a mini-thermal shock (freezing) and an increase in pressure (due to the gas formed). The process cracks and delaminates the gum and forces it off the surface. The gum can then be easily collected. There is no abrasion of the surrounding area and, as such, dry ice blasting causes little damage to any coating present. Again, there are proprietary machines available for this process.

Hopefully, however, this gum problem will be a thing of the past, as research in the UK has identified a gum base that has a hydrophilic surface around a hydrophobic polymer core, and, as such, there is always a "layer" of water on the surface. Made with these new ingredients, gum, when discarded, will not stick to surfaces and will be easily washed away.

In the Pipeline: A Review of the Pipeline Protection Conference



Papers covering hot topics in the pipeline industry were presented at the 17th International Conference on Pipeline Protection, held October 17-19 in Edinburgh, UK. Themed "Transferring Technology," approximately 180 delegates from 28 countries attended the conference. Twenty-one presentations covered topics such as fusion-bonded epoxy (FBE), water pipelines, internal coatings, three-layer coatings, pipeline integrity, and field joints. Not surprisingly in view of their worldwide use, three-layer polyolefin systems were the subject of several presentations..

FBE Systems

The conference featured two presentations on multi-layer FBE systems. D. Grimshaw et al. discussed the improved handling of a new multi-layer FBE over standard single-coat FBE and dual-layer FBE systems (often called abrasion-resistant overcoat or ARO systems) in "Handling performance and the benefits of a multilayer FBE system." This new system consists of three layers that work together to give a high level of performance. The outer layer is a tough coating that resists penetration, the middle layer is resilient and shock absorbing, and the inner layer is an FBE optimized for adhesion and corrosion protection. Improved performance was demonstrated through impact resistance, gouge resistance, and flexibility testing. The authors concluded that the novel three-coat FBE provided all the benefits and none of the weaknesses of stand-alone FBE and multi-layer extruded systems.

In the second presentation, K. Varughese described the use of a flexible FBE-ARO system on an offshore reel barge project ("Flexible FBE-ARO utilized to minimize coating damages on offshore reel barge pipeline project in the Gulf of Mexico"). Three-layer polyolefin is the preferred coating system for reel barge projects; however, the logistics and time constraints of a project in the Gulf of Mexico meant that alternative systems had to be considered. The FBE-ARO system had never been used for reel barge laying. There were initial concerns about the FBE-ARO system's flexibility and smoothness (important for interaction with seabed mud). Therefore, laboratory testing of various generic coating systems was carried out. The project was successfully completed, with no cracking or disbonding of the FBE-ARO system during the pipe bending process.

Water Pipelines

R. Sánchez Espinosa discussed the construction of a 60-inch diameter steel aqueduct to supply water to several towns near Mexico City ("Pipeline for water transmission to be installed on very corrosive soils in Mexico City Texcoco Lake area"). A study of the soils through which the pipeline would run found the soils to be very aggressive. Three-layer systems were not considered as external coatings for the pipeline because of the lack of application facilities in Mexico. Instead, the Water Commission chose a hot-applied coal tar enamel for pipes that travel through less aggressive soil and polyolefin tapes to protect pipes in more aggressive soil.

Flow testing and friction factor determination for the first phase of the raw water pipeline expansion of the Zuikerbosch purification and pumping station, along with comparative performance testing of epoxy and polyurethane linings, were covered by D.D.P. Trebicki ("Duplication of the 3.5m diameter

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Vaal Dam-Zoekfontein raw water pipeline"). The flow testing and establishment of long-term friction factors were deemed useful for the hydraulic design of the second phase of the pipeline, which was approved in 2006.

The study of polyurethane and epoxy linings was launched in response to concerns for the renovation of the linings in the first pipeline. A selection of 100% solids rigid polyurethane linings and a 100% solids epoxy were subjected to a variety of tests, including mandrel bending, water absorption, tensile strength, water vapor transmission, impact, abrasion resistance, adhesion, and cathodic disbondment. The testing considered the influence of lining thickness on performance properties. The test results led to a recommendation of a 100% solids rigid polyurethane with a minimum thickness of 0.75 mm for the pipeline.

Internal Coatings

On the topic of internal coatings, several authors discussed the smoothness of the inside surface as the most important factor in internal protection.

In "Advances in high solids flow efficiency coatings," I. Robinson described a new generation of high-solids epoxy coatings for use in natural gas flow lines. Without sacrificing performance, these high-solids epoxies are more environmentally friendly than conventionally used thin-film solvent-borne epoxy coatings. Robinson also discussed the surface roughness parameters as a function of flow coating volume solids.

In "Polyamide 11 internal coating for gas and liquid transport," A. Lapeyre et al. presented polyamide technology focusing on fluid transfer. The authors then discuss how a polyamide surface can both limit erosion and abrasion and reduce pressure losses in pipelines compared to conventionally applied coatings.

D. Melot and E. Botton examined the influence of a lining's dry film thickness and surface roughness on the flow performance of gas pipelines ("Pressure drop testing of 12" pipelines—influence of DFT and surface roughness"). The study compared three samples: an uncoated pipe set and two pipe sets coated with a liquid epoxy at different thicknesses. Results indicated that dry film thickness did not significantly affect the absolute roughness measured by flow tests. Therefore, the authors concluded, connection between high film thickness and flow improvement is questionable.

Coating Disbondment

Two papers examined the disbondment of three-layer pipe coatings.

In "Disbondments of pipeline coatings and their consequence on corrosion risks," D. Melot et al. shared cases of coating disbondment of both heat-shrinkable sleeves and three-layer polyolefin coatings. Because disbonded coatings can prevent cathodic protection current from reaching the steel, external corrosion is a threat. The authors offered possible causes for the disbonding. Temperature and inadequate surface preparation influenced the disbonding of the heat-shrinkable sleeves. Several possible explanations for the disbondment of the three-layer coatings were offered, including

- water and oxygen diffusion through the polyethylene layer,
- water saturation and diffusion in the FBE layer,
- the formation of magnetite on the steel surface from corrosion,
- the acceleration of these problems by temperature, and
- internal stresses in the polyethylene and polypropylene layers.

The failures were detected using in-line inspection tools on buried pipeline. The ability of close interval potential surveys (CIPS) and direct current voltage gradient (DCVG) to detect coating damage, including corrosion and coating disbondment, was discussed.

E. Legghe et al. investigated the influence of factors such as temperature, epoxy thickness, oxygen concentration, and cathodic potential applied on the cathodic disbondment of three-layer polymer coatings in "Loss of adhesion of three-layer pipeline coatings under cathodic protection." The authors noted that cases of cathodic disbondment have been observed not only on steel pipelines that have incurred coating damage in the transportation, construction, and burying processes, but also on pipelines with no noticeable defects. The epoxy powder primer in these three-layer systems was studied, and the authors found that the primer is prone to water absorption. The diffusion of water through a three-layer coating was evaluated. The authors noted that the rate of delamination was dependent upon the thickness and presence of the different layers in the three-layer coating.

Field Joint Coatings

Field joint coating was the subject of papers by R. Buchanan and W Hodgins and L. Leidén et al. State-of-the-art, field-applied joint coatings were reviewed by Buchanan and Hodgins ("Unique coating solutions for diverse pipeline applications"). The authors noted that the success of field joint coatings depends not only on the quality of the product, but also on the method of installation. The following types of field joint coatings were described, along with considerations for their installation: polypropylene heat-shrinkable sleeves for use with high-temperature, three-layer polypropylene coatings; impact-resistant coatings for offshore applications; high-strength joint coatings for directional drill applications; high-build, force-cured, corrosion-resistant epoxy primer for three-layer field joint coat-

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ings; liquid epoxy coatings that withstand high operating temperatures for fusion-bonded epoxy; insulated field joint casings for pre-insulated oil pipelines; and an ultra-tacky adhesive-based coating for substrates that are difficult to prepare.

In "Field-joint coating with polyolefin melt-film technique," Leidén and K. Punnonen reported on a new field joint coating technology that offers ease of use and applications comparable to factory coating. The authors described the coating equipment used in the process, including an extruder, a die, and a transveyor. The coating method, options for coating materials, and application technique were elaborated.

Three-Layer Coatings

Three-layer polyolefin coatings were covered by H.E.P. Vogt et al., who looked at the outer coating, and by V. Sauvant-Moynot et al., who concentrated on the primer coat. In "Advanced 3-layer anti-corrosion coating system with protective outer layer of cross linked PE," Vogt et al. discussed the development and testing of a new pipeline coating system that uses a crosslinked outer layer based on silane-modified, high-density polyethylene. Among the benefits of the crosslinked layer are low-temperature performance, high creep strength at elevated temperatures, abrasion and notch resistance, chemical resistance, low gas permeability, and resistance to stress cracking and crack propagation. The results of laboratory and field trials were reported. The authors noted that the crosslinked polyethylene coating is 50% more expensive than bimodal high density polyethylene material; however, this cost is mitigated by the reduction in damage to the pipe coatings during transportation, handling, and construction, and by the less stringent requirements for bedding and backfill materials and rock shield tapes.

A study to correlate the adhesion and durability of commercial fusion-bonded epoxy (FBE) primers in a wet environment to the adhesion of three-layer polyolefin was described in the presentation by Sauvant-Moynot et al. ("Three layer polyolefin coatings: how the FBE primer properties govern the long term adhesion"). The authors found that proper selection of FBE powders depends on meeting the following two criteria: the FBE's wet Tg (glass transition temperature) must be higher than the maximum operating temperature to maintain the coating's mechanical and electrical properties, and the FBE must be resistant to hydrolysis at the maximum operating temperature to avoid

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compromising mechanical anchoring and propagating osmotic blistering.

B. Turner examined the properties of commercially available polyethylene adhesives and topcoats for pipe coatings, noting that the materials show considerable variation, which may affect their overall performance ("Quality and durability of different polyethylene pipe coating solutions?"). The following properties were studied: extruder output, melt film strength, peel strength, stress crack resistance, Vicat temperature, and indentation at different temperatures. The author raised the possibility of using or adapting different test methods to provide an improved estimation of coating durability and service life. [*Editor's Note: An article based on the paper is printed on pp. 36-46 in this issue.*]

In "Disbondment mechanism of 3LPE pipeline coatings," B.T.A. Chang et al. related the coating disbondment mechanism to the residual stresses caused by thermal mismatching between the coating materials and the steel substrate. Using analytical stress analysis and finite element modelling, the authors calculated thermally induced stresses. The study found that the coating cutback is the area at which high stress is introduced to the FBE primer by FBE and polyethylene topcoat dry film thickness. Peeling stress was found to increase significantly with the increased dry film thickness of the topcoat at the corner of the coating cutback. Based on these results, the authors stated that coating disbondment could be caused by the higher stress concentration at the corner of the coating cutback.

Other Topics

Additional presentations not described in this article discussed developments in internal coatings (D. Lusk et al, "A hollow cathode high density plasma process for internally coating cylindrical substrates" and Y. Charron et al, "Ultra smoothing and structuring of pipe internal coatings"); assessing pipeline coatings (J.F. Fletcher, "New developments in porosity testing of pipeline coatings" and C.J. Argent et al., "Direct Assessment for pipeline integrity: is it viable?") and different aspects of pipeline performance (A. Jackson et al., "On the effect of increasing microballoon loadings on thermal and hydrostatic performance of Glass Syntactic Polyurethanes" and F.M. Abusaa, "Hydrogen degradation of HSLA steel in sea water under cathodic charging condition").

Copies of the full presentations can be found in the *Proceedings,* available from the organisers, BHP Group Ltd. Contact www.bhrconferences.com.

Color Is the Key in Self-Inspecting Coatings

A line of "self-inspecting" coatings allows applicators to visually assess applied coating thickness and minimize thin spots based on color, not physical measurements, according to Nippon Paint Marine Coatings, the manufacturer.

Developed and licensed in 1996 in Asia but only recently available internationally, the self-inspecting (SI) technology was created to address the disadvantages inherent in physical coating thickness measurement—cost, labor, and efficiency, says Masana Takayama of Nippon. The coatings are marketed to the marine industry for use in tanks, on hulls, and on exterior surfaces. In light of recent developments in paint specification and inspection requirements mandated by the International Maritime Organization (IMO), SI coatings offer a means of ensuring adequate coating application without generating high inspection costs, says Takayama.

Takayama points out that conventional coatings, which have the same appearance at any thickness, must be inspected by taking sample thickness measurements that cannot present a definitive measurement of the entire coated surface. Low coating thickness can lead to early coating failure and rusting, and can cause serious deterioration of critical tank components.

Rather than measuring thickness, SI coatings, which are specially formulated two-component epoxies, indicate visually that the applicator has met the minimum film thickness requirement: the color of the coating changes from transparent ("see-through" to opaque) upon achieving proper film build. Using a color sample from the manufacturer of the SI coating, the applicator can compare the sprayed surface to the sample. Areas less opaque than the sample do not meet the minimum thickness requirements for the coating.

The see-through condition of the self-inspecting paint indicates on this hull that the coating has not been applied yet to the correct dry film thickness.
Photos courtesy of Nippon Paint Marine Coatings Co.

The two-component SI epoxy coatings require the same surface preparation as conventional paints, says Takayama. For maintenance coating, substrates can be sweep blasted or power tool-cleaned to SSPC-SP 3. The coatings can be applied to intact shop-primed surfaces using conventional spray equipment.

According to Takayama, applicators do not need special training to work with SI coatings; however, the manufacturer recommends pre-painting guidance, demonstra-

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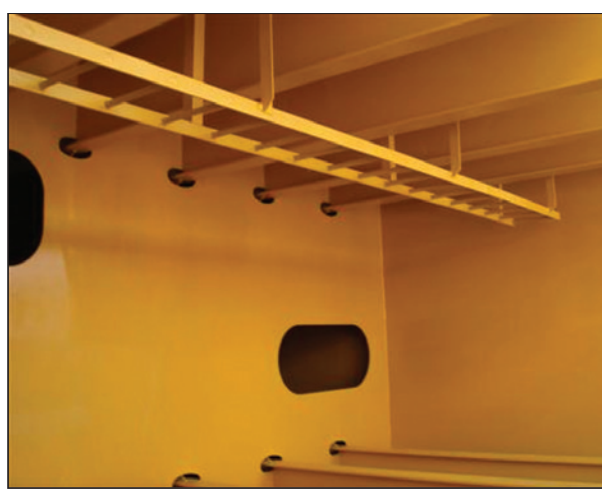
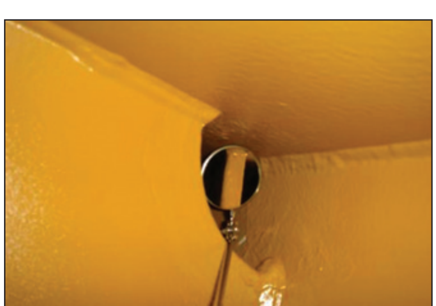
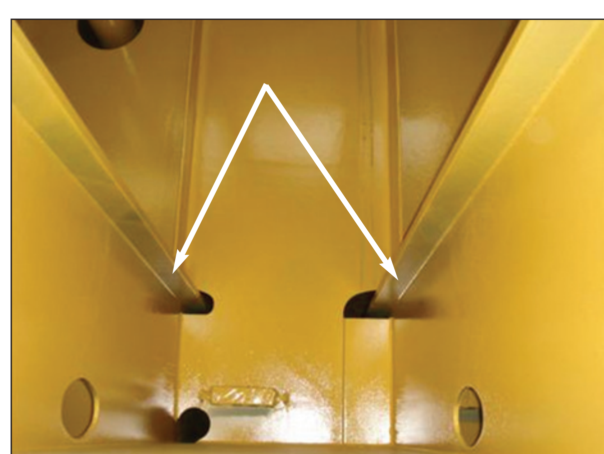






On the right, the arrows indicate the "see-through" areas in this ballast tank, where the proper dry film thickness has not been achieved. On the left and above, the coating color indicates that the dry film thickness meets the specification (300 microns; 12 mils) in this ballast tank.

tion, and spraying practice to avoid the application of excessive coating thickness and to ensure the use of adequate lighting in ballast tanks, in particular.

SI coatings have been commercially available for use in the marine maintenance industry in Asia for last 10 years, and have been used for over five years in the newbuilding industry, says Takayama. Most recently, Daewoo Shipbuilding & Marine Engineering Co. Ltd. (DSME) in Korea specified SI coatings for water ballast tanks, crude oil tanks, void spaces, outer hulls, and the exteriors of six Very Large Crude Carriers (VLCC) for Vela International Marine, a subsidiary of Saudi Aramco. The block painting of the second ship is almost complete. The coating manufacturer is tracking the reduction in total SI coatings used in relation to the applicators' experience on each VLCC for Vela, he says.

The SI coatings are now internationally available for maintenance and repair applications, says Takayama. The line of coatings for newbuilding is available in Japan, Korea, and China. To date, the company has seen the coatings used on 5,300 ships in maintenance applications and on 130 newbuilds, he says.

After 42 months in service, the SI coating, applied to 250 microns (10 mils), shows no corrosion.

Evaluating a Crude Oil Loading Berth for Maintenance Coating

by Thomas J. Marchesani, PE, Sagittae, LLC

uring fiscal year (FY) 2003, a feasibility study evaluated the condition of coatings on a crude oil loading berth, analyzed the ramifications of coating failure, and performed life cycle economic comparisons of maintenance coating alternatives. This article presents a summary of the coating inspection results, as well as an alternative method to determine the effect of coating failure and corrosion on marine loading berths.

Background

The crude oil loading berth was constructed as a series of substructures connected by walkways and concrete decking. These substructures include the causeway trestles, the berth operating console platform (BOC), the main loading platform (MLP), primary berthing dolphins, secondary berthing dolphins, and mooring dolphins. Driven carbon steel piles with interconnecting horizontal and diagonal support members form the foundation of these structures. The piles are filled with concrete. Structural steel I- beams and channels form a base for the concrete decking that connects the causeway, BOC, and MLP. Walkways of structural steel pipe and grating connect the MLP to the berthing dolphins and the berthing dolphins to the mooring dolphins. Figure 1 is a photograph of the berth.

Editor's Note : This article was presented at the PACE 2007 Conference, held February 11-14 in Dallas, TX. It is published in the PACE Conference Proceedings

Calculations based upon original construction drawings estimate the total surface area of the coated steel of the berth to be 275,000 sq ft (25,548 sq m). The berth structures were originally shop-coated with an inorganic zinc primer and two coats of polyamide epoxy. The coated sec-

Fig. 1: (Facing page) Crude oil loading berth
(Above) Main loading platform support structure. Photos courtesy of the author

BOC piling in splash zone showing mechanical damage and marine growth

tions were then shipped to the site via barge and assembled.

In 1992, the berth received a complete maintenance recoat. The superstructure received a water wash, spot abrasive blast of visible corrosion or disbonded coating, application of organic zinc to the blasted steel, and two coats of a polyamide epoxy to the entire surface. The splash zone (i.e., mean lower low water to +14 feet [4 m]) received a water wash and 100% blast to Near White Metal (SSPC-SP 10) as the tide receded. The metal was then coated with polyamide epoxy as the tide rose. Once this coat was dry to touch, the coated areas were rinsed with fresh water and topcoated with the epoxy during the next negative tide cycle. Maintenance coating of the berth cost approximately $5 million and required a four-month service outage.

In FY 2002, a detailed inspection and evaluation of the condition of the berth coatings showed that the existing maintenance coatings were partially failed and reaching the end of their service life. The study recommended maintenance coating before complete failure of the existing coatings to take advantage of the intact primer and intermediate coats. The study found that this alternative would have a lower life cycle cost than maintenance coating following complete failure of the existing coatings. The study recommended implementing field tests to evaluate intercoat compatibility and various surface preparation schemes.

In FY 2003, a cursory analysis of the berth's secondary structural members estimated the percent reduction in load capacity for these structural members if corrosion uniformly thinned the members across all surfaces.

Technical Approach

The scope of the study included the following items.

- An evaluation of the berth's cathodic protection systems
- A prediction of probable corrosion rates and an estimation of any corrosion allowance the existing berth structural members may possess
- A test program to evaluate candidate coating systems and surface preparation techniques
- Development and evaluation of maintenance coating options
- Evaluation of the net present cost (NPC) of each alternative

Visual inspection formed the basis for the coatings evaluation. The berth was examined via physical walk down. Much of the superstructure is accessible by originally installed walkways, ladders, and access platforms. In addition, temporary scaffolding structures, installed for various maintenance activities, were available to examine areas under the MLP and BOC platform. Safety boats provided access to pilings and splash zone structural steel.

Results and Discussion

Condition of Existing Coatings

The condition of coating systems on the berth was consistent with their age and operating environment. The two primary modes of degradation were chalking and mechanical damage. Two less prevalent modes included underfilm corrosion and edge failure. Where exposed to sunlight, the epoxy-based systems showed chalking severe enough in some areas to have exposed the intermediate coat of the maintenance coating system applied in the early 1990s. The superstructure beneath the causeways, MLP, and BOC platform showed very little coating failure.

Mechanical damage was evident on some pilings and in areas of high wear on the berthing and mooring dolphins. At these areas, the metal substrate was actively corroding. Areas subject to abrasion may have seen atypically high corrosion rates because repeated abrasive action removed protective oxides.

During FY 2003, an assessment of the underwater portion of the berth pilings concluded that the pilings were in excellent condition, having lost less than 10% of their original wall thickness. The coatings showed some intercoat blistering, which is probably a reaction to the cathodic protection system.

Table 1: Atmospheric Corrosion Rates for Carbon Steel

Location	Atmosphere	Average Corrosion in 1 Year, mils	Average Corrosion in 2 Year, mils
Norman Wells, NWT, Canada	Rural	0.02	0.12
Esquimalt, Vancouver Island, BC, Canada	Rural/Marine	0.68	1.05
Halifax, NS, Canada	Urban	1.25	2.10
Trail, BC, Canada	Industrial	1.91	2.74
Halifax, NNS, Canada	Industrial/Marine	5.39	8.94

Corrosion Rate Analysis

Table 1 presents corrosion rates for carbon steel from a study conducted by the ASTM G-1 committee in the early 1960s. In this study, coupons were exposed in 46 different sites, and the average corrosion penetration was measured after 1 and 2 years of exposure. The results were originally reported in an ASTM paper in 1968. The data presented here were taken from a Federal Highway Administration publication that referenced the ASTM work.[1]

Factors contributing to the corrosivity of a given atmosphere include long time of wetness, airborne chlorides, airborne sulfur compounds, and other industrial pollutants. Rural atmospheres typically maintain a lower time of wetness and contain neither the airborne pollutants of industrial sites nor the chlorides associated with marine sites. Comparing the Norman Wells corrosion data with the Esquimalt data shows the effect of the marine environment.

Industrial environments can contain corrosive airborne pollutants but may lack the high chlorides of the marine environment. Comparing the Trail, BC data with the data from Halifax, Nova Scotia, demonstrates the difference in corrosivity between an industrial atmosphere and an industrial atmosphere in a marine location. The corrosive elements of these two atmospheres act in concert to increase the corrosivity compared to either individual atmosphere.

The berth studied is situated adjacent to salt water in a northern climate. In addition, the site includes a nearby power generation plant, ballast water treatment operations, and normal movement of crude oil. These conditions result in a variety of airborne constituents corrosive to carbon steel. Intermittent flow testing of the fire monitors dowses the berth in salt water. These operational and geographical realities combine the attributes of an industrial atmosphere with those of an arctic marine atmosphere and suggest that the Halifax corrosion data are the most applicable. The data show average depth of penetration. These values were converted to corrosion rates to extrap-

Primary berthing dolphin at high tide

olate future years' metal loss.

Work by others has shown that corrosion of steel in homogenous environments typically decreases over time roughly in accordance with the equation:
(1) $P = kt^n$, where
P is the depth of the penetration in mils, k is an environment-dependent constant, t is the exposure time in years, and n is an exponent typically less than 1. Using the two data points from Table 1 (1, 5.39) and (2, 8.94) and solving equation (1) for k and n yields the following.
(1a) $P = 5.39t^{0.73}$

Figure 2 shows the effect of time on corrosion penetration and corrosion rate. The rate begins at the measured 5.39 mils (135 microns) per year (mpy) during the initial year of exposure. Over subsequent years, this rate decays to a steady state of less than 2 mpy (50 microns per year).

Based upon this analysis, 4 mpy (100 microns per year) was selected as a representative atmospheric corrosion rate for the carbon steel installed on the berth. This rate represents a conservative average of a higher initial rate that decreases over time.

Corrosion Allowance

The load capacity analysis examined circular support members with wall thicknesses ranging from 0.322 in. to 0.843 in. (0.8 to 2.1 cm) and wide flange H-beam members with flange thicknesses ranging from 0.400 in. to 0.515 in. (1 to 1.3 cm). Compression loads controlled the capacity of the pipe sections while bending of the wide flange controlled the capacity of the H-beam members. The visual inspection and analysis concluded, "Evidence of corrosion significant enough to reduce the strength of structural members was not found." In addition, ". . . the members would likely lose an average of between 5 and 15% of their individual capacity after 5 years of uniform corrosion and between 25 and 100% of their average individual capacity after 20 years."

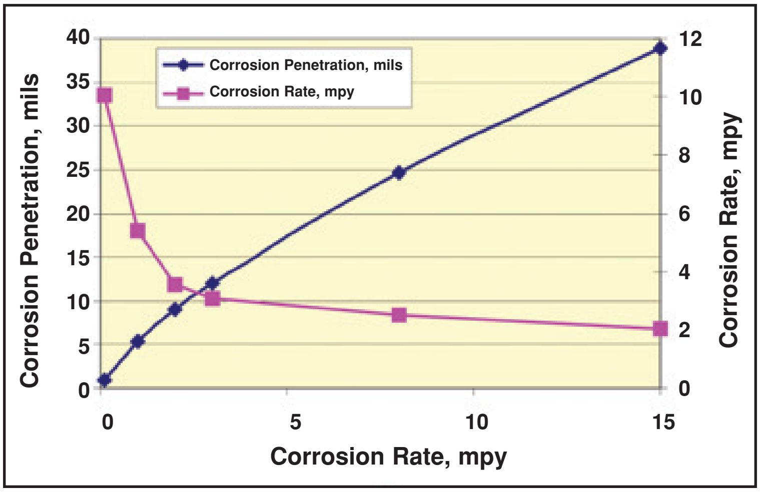


Fig. 2: Effect of time on corrosion penetration and corrosion rate

The available original construction documentation did not address corrosion allowance for the secondary structural members. As such, the analysis assumed this value was zero. More importantly, the analysis assumed that the corrosion was uniform across the entire beam. That is, all surfaces of the beam corroded at the same rate.

These simplifying assumptions result in an analysis with very conservative results. Since the secondary members are coated, they will never corrode uniformly across their entire surface. An analysis that assumes general thinning overstates the loss of structural capacity. Therefore, it is reasonable to assume that the reductions in load capacity on the low end of the reported ranges (i.e., 5% in 5 years and 25% after 20 years) represent a very conservative estimate of the maximum load reduction possible for the members under actual service conditions. In addition, a great deal of redundancy among secondary structural members typically exists. For these reasons, the structural integrity of the secondary structural members of the berth did not drive the decision to apply maintenance coatings to the berths.

Lifecycle of the Structural Members of the Berth

Accurate determination of the structural service life of the berth requires the following:

- a corrosion allowance,
- a corrosion rate,
- a realistic application of that rate to structural members,
- a structural load factor of safety, and
- individual loads on structural members.

As previously discussed, the submerged portions of the primary structural members remain within their corrosion allowance and have cathodic protection to mitigate corrosion. Provided monitoring and maintenance of the cathodic protection systems continue, it is reasonable to assume the submerged portions of the primary structural members will

Coating test patches – guard rail

retain sufficient strength to support the berth for its service life.

To maximize the applicability of any corrosion life cycle model, the corrosion rate data must be as representative as possible of the corrosion rate of carbon steel found at the site. A limited survey was conducted on industry experience with corrosion of carbon steel, including both atmospheric and tidal zone corrosion rates. Table 2 summarizes the results of this survey. The bibliography includes publication information on the reference material. Most of these publications divide the various environments into atmospheric zone, splash zone, tidal zone, continuous immersion zone, and embedded zone.

The atmospheric zone comprises the steel that is not wetted by the body of water over which it sits. The splash zone is the zone above the typical high tide that is wetted via wave, wind, or ship wake action. The area between the mean level low water and the mean level high water constitutes the tidal zone. Continuous immersion is that area below the mean level low water. The embedded zone refers to the section of pilings below the sea floor.

Excluding the extremely high corrosion rates from Table 2 as inconsistent with first hand experience at the site, the data in Table 2 suggest the splash zone portion of the primary support members will corrode at approximately 15 mpy (375 microns per year) where the coating has failed. This corrosion rate would also be expected to decrease over time. However, since the wet-dry cycling of the tide constantly disturbs the surface films of iron oxide forming on the exposed steel, the decrease in the corrosion rate will be less than in steadier state environments, such as soil or quiescent water immersion. The selection of a corrosion rate determines the outcome of any corrosion life cycle analysis. As such, a testing program should be instituted to acquire actual corrosion rates for carbon steel in the various exposure environments of the berth.

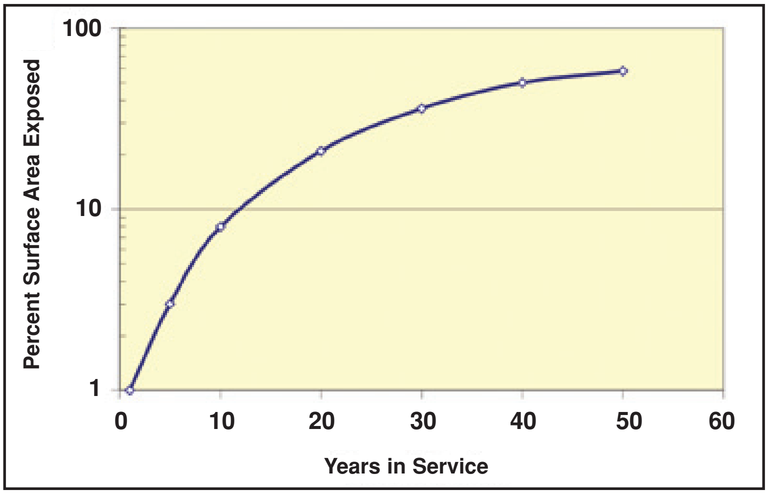


Fig. 3: Possible relationship between coating failure and service life

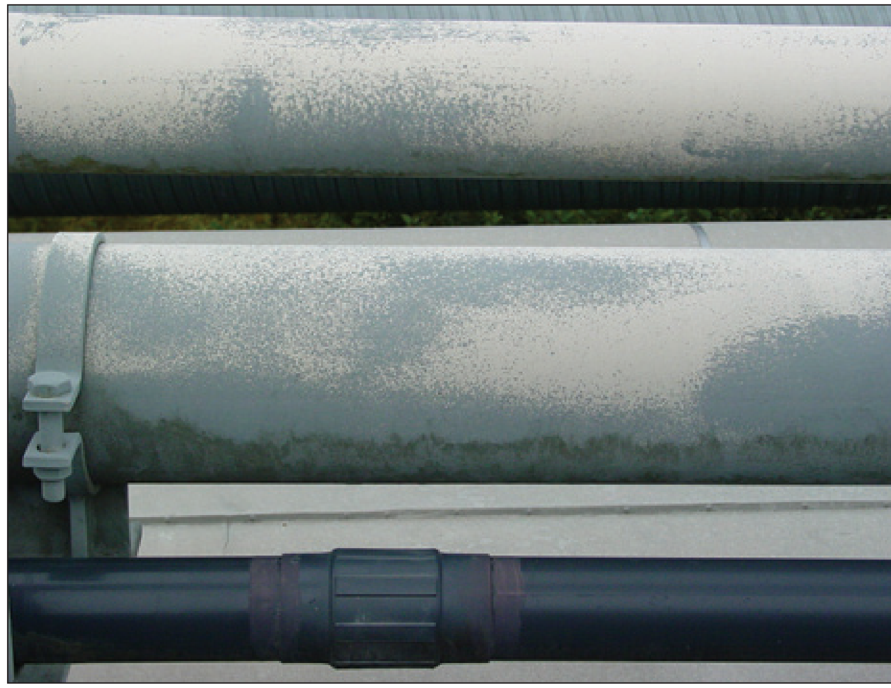

Mooring dolphin

Using a corrosion rate of 15 mpy, Figure 3 presents a possible relationship between coating failure and service life. The x-axis presents the coating service life, with year 0 corresponding to the year the maintenance coating was installed (e.g., 1992). The y-axis presents a theoretical percentage of steel piling surface area exposed to the tidal zone environment due to coating failure. This model was derived from observed coating failure of the berth studied, the adjacent berths, and other adjacent structures (e.g., aboveground storage tanks, etc.) protected with similar coatings. The

Table 2: Summary of Corrosion of Carbon Steel

Location	Location	Atmospheric Corr. Rate, mpy	Tide/Splash Zone Corr. Rate, mpy
ConocoPhillips NORSOK Stnd. M-001, Mat'l Selection, Rev. 3(2)	n/a	n/a	15.7
International Workshop on Corrosion Control for Marine Structures (3)	Kure Beach, NC	n/a	25.0
Corus Piling Hankbook (4)	n/a	2.7	6.5
Durability and Protection of Steel Piling in Temperate Climates (5)	Britain	1,4	3.0 to 31.5
Copper Development Assoc. (6)	n/a	n/a	19.7 to 59.0
ICE Briefing (7)	Britain	3.9	6.7
Seymour K. Coburn Paper (8)	Various	9.0	13.9

Coating failure on berthing dolphin bull



Redundant fire water pipe showing chalking

structures were evaluated for coating failure using ASTM D-610, "Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces." These results were coupled with the time elapsed since the given structure's last maintenance coating.

Assuming the coating fails according to the relationship presented in Figure 3, after 1 year, 1% of the coating will have failed. By year 2, this 1% of exposed steel will have corroded 15 mils (375 microns). By year 5, 3% of the coating will have failed. By year 6, this 3% will have corroded at least 15 mils, but the original 1% (exposed as a result of the coating that failed during year 1) will have corroded 15 mils for each of the subsequent 5 years, for a total 75 mils (~2 mm) of metal loss. Table 3 summarizes the relationship between corrosion rate and coating failure rate. Recognizing that these rates are estimates, they still provide insight into how coating failure and subsequent corrosion will affect the structural strength of the pilings.

The corrosion penetration figures presented in Table 3 are minimums. That is, 20 years after the maintenance coating, 21% of the piling surface area will have corroded a minimum of 15 mils (375 microns). Eight percent will have corroded a minimum of 165 mils (4 mm) and 3% will have corroded a minimum of 240 mils (6 mm). One percent of the piling surface area (corresponding to the 1% exposed 1 year after maintenance coating) will have corroded 300 mils (7.5 mm). Table 3 shows that 40 years after maintenance coating, only about 8% of the piling surface area will have exceeded the 500-mil (12.5-mm) corrosion allowance. Unless it was concentrated in one area encircling a pile, this level of discreet, pitting corrosion would not be sufficient to affect the structural integrity of the pilings. The probability of such an occurrence is remote. Even if the estimates used to generate this table are off 100%, the information suggests the structural integrity of the pilings will not be compromised even if they remain uncoated for over 40 years.

Because the coating failure rates are not known, the information in Table 3 retains a level of uncertainty. With this uncertainty comes risk. The colored partitions in Table 3 attempt to describe this risk. The closer the "Years after Maintenance Coating" is to the year the coating was installed, the higher the degree of confidence in the "Percent Coating Failure." This confidence comes

Table 3: Corrosion Penetration (mils) vs. Time for

Years after Maintenance Coating	Percent Coating Failure: 1	3	8	21	36	50	58
0	15	0	0	0	0	0	0
5	75	15	0	0	0	0	0
10	150	90	15	0	0	0	0
20	300	240	165	15	0	0	0
30	450	390	315	165	15	0	0
40	600	540	465	315	165	15	0
50	750	690	615	465	315	165	15

Highest confidence; lowest risk
Lower confidence; higher risk
Lowest confidence; highest risk

Table 4: Corrosion Penetration vs. Time for

Years after Maintenance Coating	Percent Coating Failure: 1	3	8	21	36	50	58
0	5.4	0	0	0	0	0	0
5	17.5	5.4	0	0	0	0	0
10	28.9	17.5	5.4	0	0	0	0
20	48.0	38.9	28.9	5.4	0	0	0
30	64.5	56.5	48.0	28.9	5.4	0	0
40	79.6	72.2	64.5	48.0	28.9	5.4	0
50	93.7	86.8	79.6	64.5	48.0	28.9	5.4

Highest confidence; lowest risk (blue)
Lower confidence; higher risk (orange)
Lowest confidence; highest risk (yellow)

Structural steel beneath main loading platform showing no chalking or edge failure

from the recent inspection of the coatings on the berth and surrounding structures. In addition, the risk that the berth will corrode sufficiently to affect its structural integrity is lower.

The blue section of Table 3 represents an area of high confidence and low risk. That is, there is high confidence that the "Percent Coating Failure" will not be greater than that predicted. Since the corrosion penetrations are low, there is a low risk that the corrosion that does exist will affect the berth's structural integrity. The orange section of Table 3 represents an area of lower confidence and higher risk. The "Percent Coating Failure" is less well defined. The risk is greater because the depth of penetration is greater due to the longer exposure time. The yellow section represents an area of lowest confidence because of the difficulty in predicting "Percent Coating Failure" far in the future. In addition, in the yellow section, the corrosion penetration is highest, resulting in the greatest risk. Using this failure model and the attached confidence bands, Table 3 suggests that a shift in risk and confidence occurs when the "Years after Maintenance Coating" exceeds 20 years.

Table 4 presents a similar analysis for the secondary structural members that support the superstructure above the tidal zone (i.e., those members exposed to marine atmosphere only). This analysis uses a similar model for the percentage of coating failure over time and applies the corrosion penetration versus time relationship from equation (1a). This corrosion rate versus time relationship is on the conservative side of those rates that could be generated based on the data in Tables 1 and 2. However, the visual inspection of the berth and the less rigorous inspection of adjacent structures suggest that the corrosion rate relationship from equation (1a) reasonably represents the actual berth corrosion.

The structural members investigated ranged in thickness between 0.400 in. and 0.515 in. (1 and 1.3 cm). The information from Table 4 suggests that after 40 years, approximately 20% of any given member will have lost a minimum of approximately 10% of its thickness. Smaller percentages of exposed surface area (i.e., 1%, 3%, 8%) will have greater depths of penetration. If all of this metal loss is along a weld lane, such a result could have a significant effect on the load capacity of the member.

Without knowledge of the existing loads on these members, the load capacity factor of safety applied during design, or the level of redundancy of these members within the berth structure, it is impossible to predict accurately the effect of such corrosion on the ability of the members to support

Electrical conduit

the berth. However, intuitively, the corrosion rate and coating failure rate estimates do suggest that the failure of these members is still many years in the future. The analysis further suggests that the members could benefit from a targeted maintenance coating program that addresses areas prone to coating failure, such as weld zones.

Another approach to qualify the significance of corrosion-induced thickness reductions is to compare these reductions to the thickness tolerances for shapes under the ASTM standards. ASTM A-6, "Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling," provides a thickness variation of 30 to 60 mils (750 to 1,500 microns) for shapes of thickness between $\frac{7}{16}$ and $\frac{1}{2}$ in. (1.1 and 1.3 cm). Given the corrosion rates estimated for atmospheric exposure, corrosion-induced thickness reductions would be within the mill tolerances for roughly 10 to 20 years (assuming the material was not supplied at the absolute minimum mill tolerance). This approach further reinforces the fact that general corrosion of secondary structural members does not present a high risk for reduced load capacity.

A finite element analysis of the entire berth structure could be performed to quantify the approach contained here. The resulting model could be used to determine the effects of corrosion-induced thinning of structural members. It would also allow analysis of berth modifications or alternative loading from project-related activities, such as crane placement.

Causeway trestles

Conclusions

Based upon a 2002 inspection and analysis, the existing berth coatings applied in 1992 show chalking and mechanical failure consistent with their age and service condition. Approximately 20% of the topcoat had failed in areas exposed to UV sunlight. Approximately 0.1% of the coating had failed enough to expose substrate corrosion.

Based upon work performed by NACE and FHWA, steel exposed to a northern marine atmosphere would initially corrode at approximately 4 to 5 mpy (20-25 microns per year). This rate would decline over time to less than 2 mpy (50 microns per year).

The main structural pilings were designed with a corrosion allowance of 0.500 in. (1.3 cm). If maintained properly, the CP system will keep corrosion within this allowance for the submerged portions of the piles.

Based upon a 15-mpy (375-micron per year) corrosion rate and a reasonable estimation of coating failure over time, the main structural pilings in the tidal zone should retain their load capacity in excess of 40 years (from 1992 maintenance coating), regardless of whether the maintenance coatings are repaired.

Based upon a 4-mpy (20-micron per year) corrosion rate, the load analysis concluded that the secondary structural members would likely lose an average of 5 to 15% of their individual capacity after 5 years of uniform corrosion and 25 to 100% of their average individual capacity after 20 years. This analysis is conservative in the extreme.

Recommendations

The following recommendations can be made, based on the above study.

- Institute a berth maintenance coating program that addresses corrosion protection of critical elements and reduction of the negative visual impact associated with freely corroding steel.
- Consider developing an analytical model that would determine the structural elements critical to berth integrity. Such a model would also allow integrity monitoring of the berth structural members and quantification of the effects of corrosion, alternative berth loadings, or modifications on secondary structural members.
- Monitor corrosion of secondary structural members. Consider instituting a corrosion monitoring program involving weight loss and corrosion penetration measurements on uncoated steel mounted in various locations on the berths.
- Continue to evaluate coatings and surface preparations included in field coating tests initiated under the study described in this article.

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Quality and Durability of Different Polyethylene Pipe Coating Solutions

By B. Turner, Borealis Business Unit Pipe, UK

The quality and durability of polyethylene (PE) pipe coating systems have been questioned by some sources recently, and the industry is struggling to provide a definitive answer.

Some high profile pipeline coating failures have been reported by David Norman et al.[1,10,11,12] These failures put pipelines at risk of corrosion and rupture, which would damage the environment and reduce confidence in the ability of the pipe coating industry to provide durable and "fit for purpose" coating solutions. Photographs showing examples of typical coating problems reported are shown in Figs. 1 and 2.

While many problems and subsequent failures can be attributed to

Holiday detection on coated pipeline
Photo courtesy of Borealis Business Unit Pipe, UK

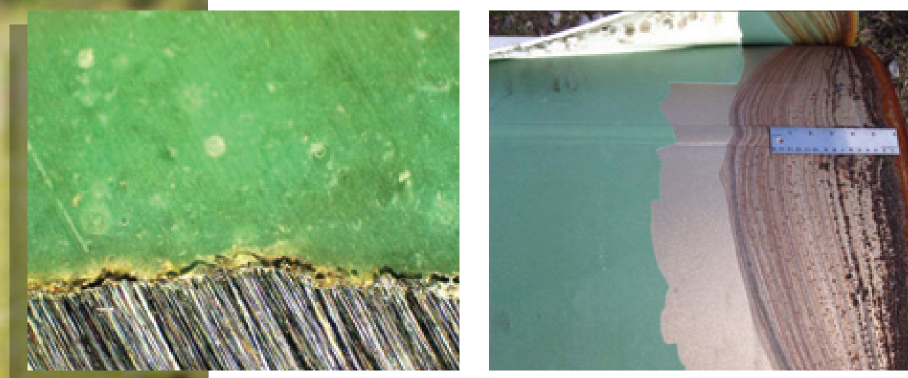

Fig. 1: Problems associated with FBE coatings
Photos courtesy of David Norman, Corrosion Control Ltd.

poor substrate preparation, incorrect coating application, and incorrect material selection, it is also evident that products generally available to applicators can vary considerably in application characteristics and final coating properties. This variation can also affect the quality of the applied coating system and the ultimate durability or service life of the pipeline coatings.

This article looks at the properties of different three-layer PE coatings (topcoat and adhesive) and discusses how the variations among these different coatings might affect ultimate performance and durability. This author intends to open a discussion and will propose some potentially new ideas on how different test methods, some from other pipe applications, might be used or adapted to provide a better estimation of durability and service life.

The test schedule chosen for this study compared various mechanical and physical properties that provide benefits to different members of the pipe coating value chain. The value chain concept (the value each interested party seeks in a product) is one that this author strongly believes in and has recently used in developing products and business opportunities. Pipeline owners and specifiers, for example, may look for coating materials to have long-term durability and low maintenance requirements, whereas applicators may tend to focus on ease of application and the ability of the system to meet specification requirements. Although described as a "chain," it may be more beneficial if we think of a matrix, with interactions and exchanges of value potential in a nonlinear way, rather than a straight line. A typical pipe coating value chain is shown in Fig. 3.

Materials and Pilot Line

High density (HD) and medium density (MD) PE topcoats and grafted PE adhesives generally available in the market were selected for testing, obtained in their original, unopened packaging, and taken from stock still in shelf life. References 1 and 2 in the tests are described as bimodal high-density compounds. The pipe coatings were applied on the Borealis pilot line in Porvoo, Finland. No special conditions or application parameters were used, and all materi-

Fig. 2 (Above and right): Problems associated with 3-layer PE coatings. Photos courtesy of David Norman, Corrosion Control Ltd.

als were treated in a similar manner.

The test schedule for this evaluation is shown in Fig. 4.

Other values reported in this article are taken from technical data provided by the manufacturer.

The pilot line (Fig. 5) will coat steel pipe up to 168 mm external diameter and is capable of applying multi-layer coatings (up to five layers by side wrap and four layers by cross head extrusion). The line was prepared to coat in a typical three-layer set-up, with epoxy powder applied by electrostatic spray, and the adhesives and topcoats applied by side extrusion through a flat die. Pipe preheating was performed by induction coil and was set at 185–195 C (~365–383 F), depending on the material; topcoat extrudate temperature was 220–230 C (~428–446 F).

Test Results

One immediate and obvious conclusion is that, for the chosen test conditions, the physical characteristics of the materials vary considerably.

Extruder Output Test

The extruder used for the output tests is a Krauss Maffei 45/30D. The same extruder was used for the "neck-in" tests (described below). It is easy to understand that higher output can realize faster application speeds, which can be an important factor for the applicator if his coating line capacity is constrained. On the other hand, higher output can also translate to lower revolutions, resulting in less power consumption at an equivalent output. In this test, the difference between the best and worst output is about 10% (Fig. 6). In theory, it should be possible to convert this to a 10% increase in application speed. In cases where the application equipment was further optimized for temperature profile and screw configuration in the extruder, and then for bimodal HDPE compounds, output improvements of up to 15% have been reported to the author.

Neck-In or Draw Down Test

The neck-in (or draw down) test involves measuring the difference

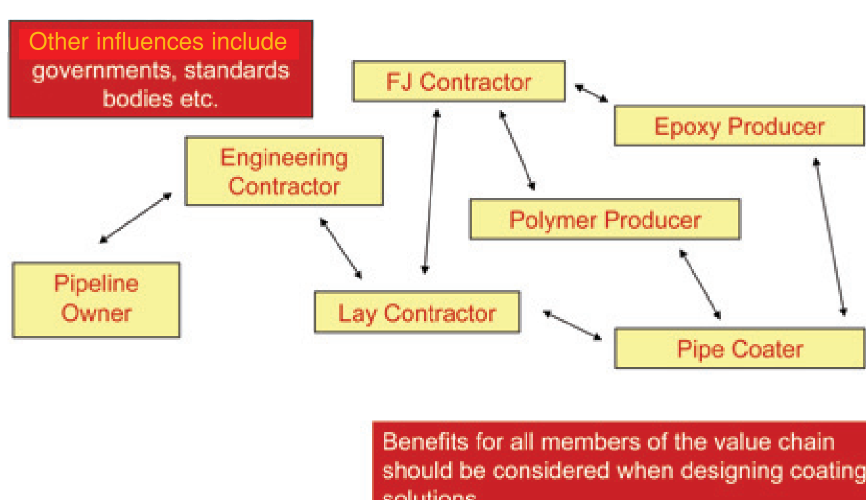

Fig. 3: Pipe Coating Value Chain Example

between the die width and the molten film width at the pressure roller for different rotational speeds of the pipe. Empirically, the faster the rotational speed, the higher the draw down should be for the same extruder settings. Draw down or "neck-in" is an indication of the melt strength of the molten polyethylene film. This test shows how reliable and stable the molten plastic will be during processing. It also shows if there are any gels or unmelted pellets in the molten mass that may lead to film breakages. More stable and reliable molten films have obvious benefits for applicators.

All compounds but Reference 1 suffered film breaks, with Reference 2 breaking at 15 m/min. rotational speed. Strangely, the neck-in for Reference 4 actually improved until it broke at 20 m/min. (Fig. 7). This indicates some difference in the rheological properties of Reference 4 that may affect application properties adversely.

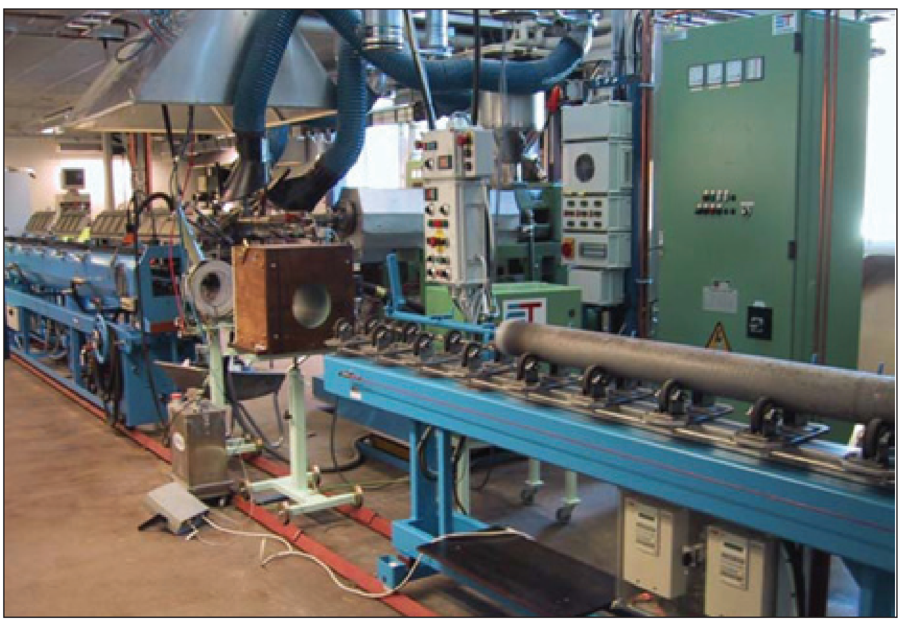

Fig. 5: General view of the pilot line

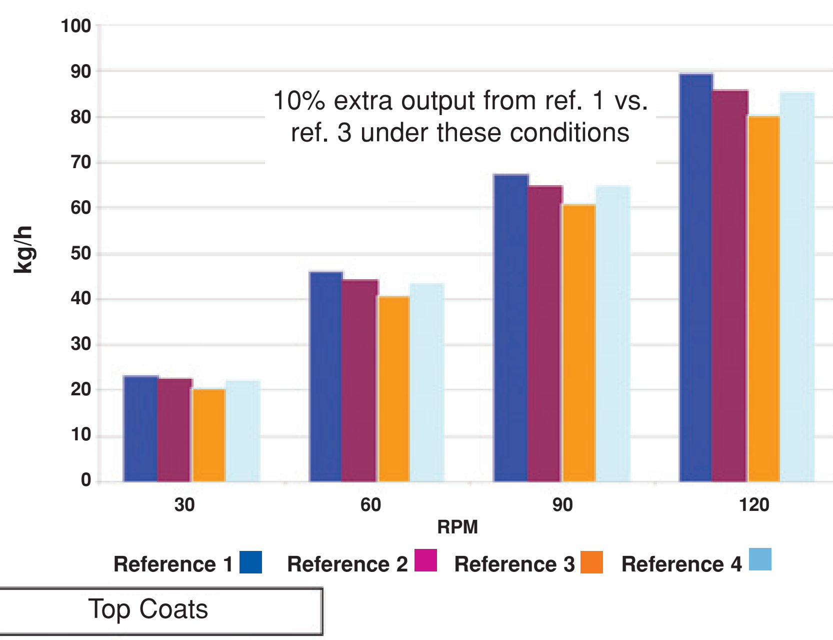

Fig. 6: Processing output at different speeds at Krauss-Maffei 45/30 D

VICAT Temperature

VICAT temperature broadly indicates the upper operating temperature limits of the applied three-layer PE coating, because the higher the VICAT temperature, the higher the softening point of the compound. The topcoat should be matched with a suitable adhesive (and epoxy) to optimize the performance of the system.

Figures 7 and 8 show the variation in measured VICAT temperatures for the tested PE adhesives and PE topcoats. Of the topcoats, References 1 and 2 should offer the best performance, with at least a 10 degrees C (~30 degrees F) difference from Reference 3. Of the adhesives, Reference 3 should offer worse high-temperature performance (Figs. 8 and 9).

Surface Hardness

Similarly, surface hardness measurement at various temperatures is an indication of the mechanical properties and upper operating temperature. Density also correlates closely to surface hardness. Here, the tests indicate References 3 and 4 of the topcoats have the lowest densities and Shore D hardness, and would provide the worst mechanical properties at higher temperatures. This correlates well to the VICAT temperature measurements (Fig. 10).

Peel Force Tests

Peel force tests are used for quality control in the coating plant and also for prequalification purposes, and it is generally recognized that the higher the peel force, the better. The retention of peel force at higher temperatures will also indicate suitability for higher operating temperatures and possibly longer service life. Adhesion is generally accepted as an indication of the quality

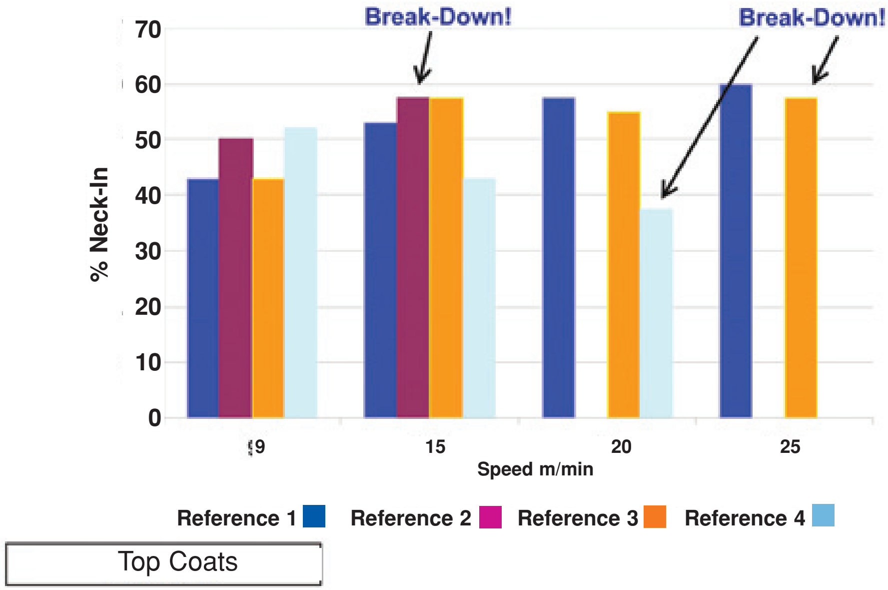

Fig. 7: Neck-in at different processing speeds

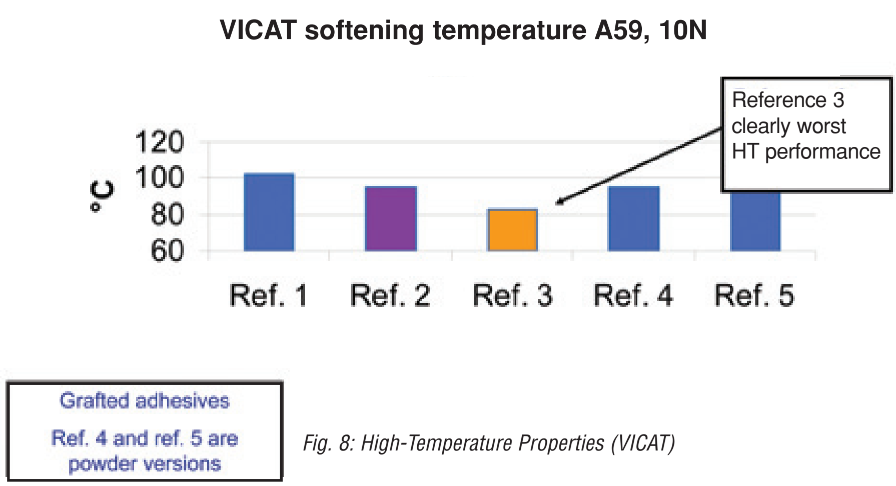

Fig. 8: High-Temperature Properties (VICAT)

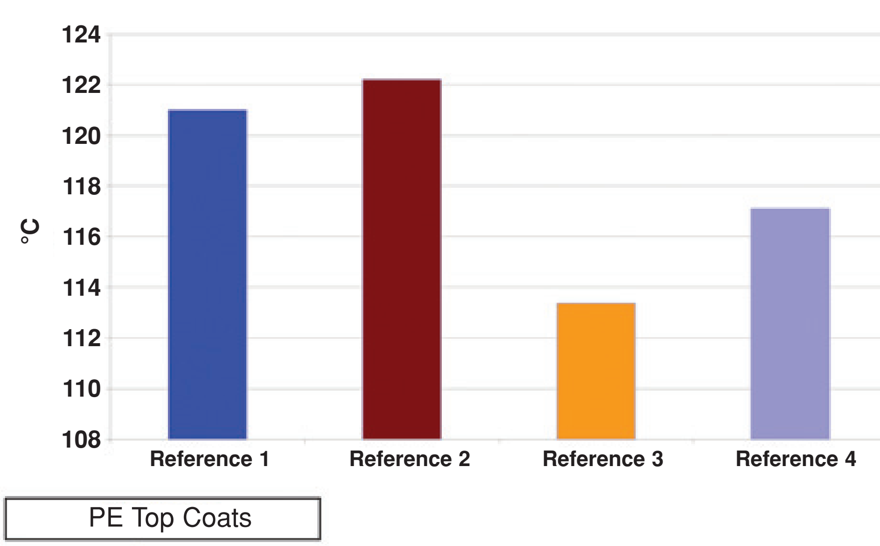

Fig. 9: High Temperature Properties (VICAT Softening Temperature)

of the whole coating system, and specifications are calling for higher values than before. In this test we look at the differences in peel time force for the 3-layer PE system as applied onto pipes coated on the Borealis pilot line.

The main governing factor in determining peel force is the chemical nature of the adhesive. An adhesive with grafted active sites will provide much better performance than, for example, a copolymer type, and the nature and concentration of the grafting should also affect the peel force.[9] (Note: the selection of an epoxy primer with a high enough glass transition temperature [T_g] is also required for higher operating temperatures, especially over 110 C.) In our tests, the adhesives—References 3 and 4—clearly give much lower performance at 80 C (~176 F). Reference 2, strangely, appeared to increase in peel strength at 80 C (~176 F). Reference 1 and Reference 5 appear to offer the best overall performance (Fig. 11).

Low Temperature Elongation Tests

This laboratory test, for the topcoat compounds, uses compression-molded plates made from virgin pellets. Tensile elongation is measured at -45 C (-49 F) on 2-mm-thick test specimens ("dog bones"), with a pulling speed of 50 mm/min.

This test, taken from the Russian GOST and Gazprom specifications,[6] is particularly useful in determining the low-temperature performance of plastics during mechanical handling, such as field bending or even moving pipes in or to the stock yard or right-of-way, and is important for cold climates such as in parts of Russia, China, and Canada (Fig. 12).

Reference 1 clearly shows much better performance than any of the other compounds tested.

It should be noted that the method of obtaining samples for this test can

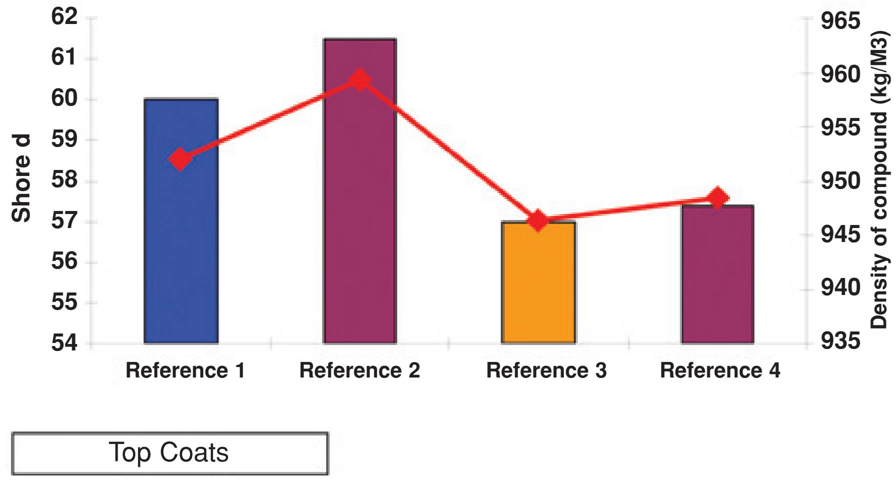

Fig. 10: Material Surface Hardness (Shore D and density)

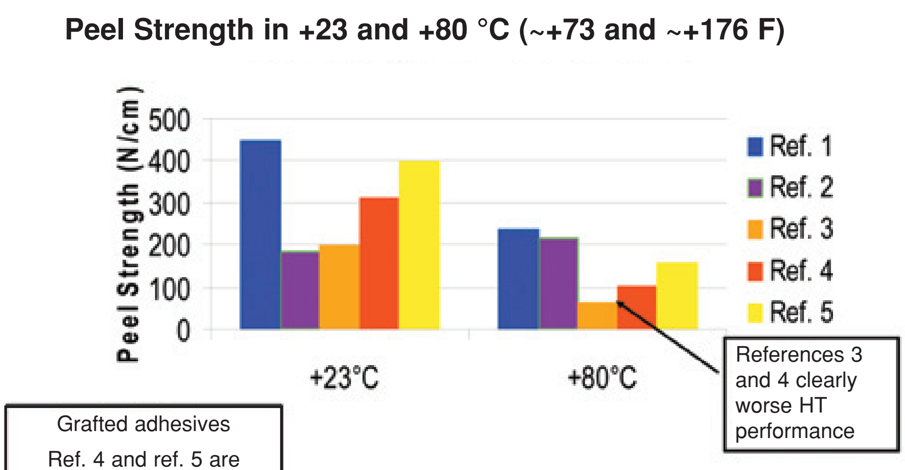

Fig. 11: Peel Strength

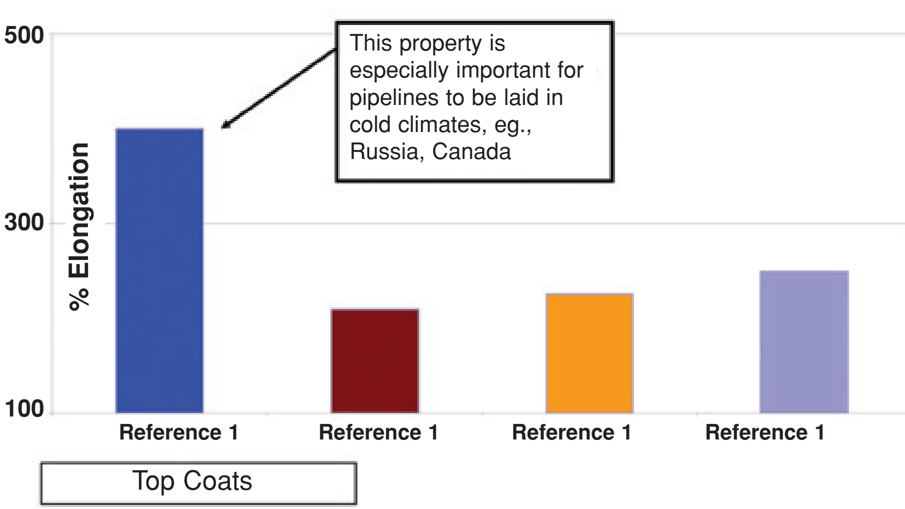

Fig. 12: Low-temperature properties (Elongation at break: -15°C [-9 F], 50 mm/min, 2 mm pressed plate)

lead to variation in the values. The GOST and Gazprom specifications call for test samples to be taken from actual coated pipes, which will lead to variations in the film thickness and continuity, thus causing variation in elongation and early breakages.

Discussion

Although all of the products tested are designed to meet the requirements of various national, international, and company standards and specifications, there is a wide variation in the tested properties of these commercially available and often used topcoat and adhesive compounds. This raises the question, "How might that variation translate to actual field performance and durability or lifetime?" Some suggestions for further tests that could be used to simulate or predict lifetime are given below in blue italics.

The draft ISO 21809-1 for polyolefin coated steel pipes will probably contain a short-term (24-hour) disbondment after a hot water soak test. This is intended for in-plant quality control. Robin John[4] proposes a 60- or 100-day hot water immersion test as an indicator of long-term durability. A thermal cycling test is included in the approval testing to Russian GOST and Grazprom specifications for 3-layer PE pipe coatings.[6]

Might a long-term hot water soak or thermal cycling test be suitable as a general screening test for durability? If so, for how long, and would it be possible to extrapolate a lifetime to failure?

When pipes are coated with polyethylene by side wrap melt extrusion, stresses are frozen into the polymer and are said to aid adhesion. However, could these stresses also play a part in disbondment? It has been noticed that lifting or detachment at pipe ends sometimes occurs.[1] This lifting might be a function of frozen-in stress and/or differential expansion and contraction between the plastic and steel.

Perhaps a test to determine the frozen-in stresses might be useful in evaluating lifetime. If so, how might the test be done?

For plastic pressure pipes, it is widely accepted that pressure testing at different temperatures can be extrapolated using regression curves to predict service lives of 50 years or more. Notch and slow crack growth is also widely used in plastic pipes to predict service life and rank for duability.[7,8]

Environmental Stress Crack Resistance (ESCR) is also used to indicate durability of plastics. Some PE resins for pipe coating have publicized ESCR at 1,000 hours, while others are 5,000 hours.

What could this difference in ESCR mean in terms of lifetime or durability?

Could the tests above or similar tests be used for pipe coating qualification, and where should the threshold be set? Marcel Roche et al.[2,4] have called for more cooperation and information sharing about pipeline coatings, and I can only echo that request. Additionally, a cross-industry research program to develop an accelerated durability test or suite of tests would be the best approach to the uncertainty that currently exists. Borealis would certainly be willing to be an active participant in such research.

Conclusion

Three-layer polyethylene coatings for steel pipelines that transport oil and gas are the coatings of choice in many areas of the world. Global energy supply is coming more and more in focus as every nation vies for security of supply. Correctly specified pipeline coatings add to the security of the pipeline, and ensuring the quality and durability of the coating is one important factor. This article has shown that the properties of different polyethylene coatings vary considerably and suggests how this variation in properties might affect performance. Tests to predict durability or service life have yet to be considered, however, and the author hopes that this article will aid in the discussion of this subject in the future.

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Example of vessel with fouling release hull coating. Photo courtesy of Subsea Industries.

Marine Coatings under the Regulatory Spotlight

By Brian Goldie, JPCL

The application and use of marine coatings are under increasing regulatory scrutiny because marine coatings are known to have a positive effect on the structural integrity of a vessel by reducing corrosion when properly selected and applied. In particular, seawater ballast tank coatings have received a lot of attention, starting with the corrosion prevention regulation in SOLAS II-1/3-2 (IMO resolution A 798[19]). This regulation, the first attempt to improve the quality of coatings used to protect ballast tanks, specified particular types of coatings and detailed how they should be applied to give long life protection. This regulation, however, applied only to bulk carriers and tankers.

Building on this start, more comprehensive regulations and standards were developed, initially as an industry-led exercise and now with the full backing of the International Maritime Organization (IMO), resulting in the latest regulation, MSC 215(82), the Performance Standard for Protective Coatings (PSPC). This standard applies to all ships over 500 GRT (gross register tonnage) after July 1, 2008, and replaces the above corrosion prevention regulation in SOLAS. However, it also applies to all vessels being constructed after December 8, 2006, under the International Association of Classification Societies (IACS) Common Structural Rules. IACS has issued Procedural Requirement (PR 34) on Application of the IMO PSPC, Resolution MSC.215 (82) under IACS Common Structural Rules for Bulk Carriers and Oil Tankers. PR 34 is to be read in conjunction with PSPC and, under IACS, the PSPC becomes mandatory. It defines the IACS verification role, not the day to day application and inspection. PR 34 aims to enable uniform understanding of IMO PSPC requirements and will expire on July 1, 2008.

A further regulatory step taken by the IMO was to control the type of antifouling hull coatings that can be used.

(Above): Example of poor construction process. Oil/grease stains (from power tools) during block assembly. Photo courtesy of Amtec Consultants Ltd

(Left): Example of ballast tank in GOOD condition (~1% breakdown on flat areas, 5-10% breakdown on edges). Photo courtesy of Amtec Consultants Ltd

While ballast tank coating regulations are directed toward safety and performance, regulations for anti-fouling coatings are environmentally driven.

This was not a safety/performance regulation, but an environmental one. The most common biocide used in antifouling coatings was TBT (tri-butyl tin), which has been found to be harmful to non-target marine organisms and the marine ecosystem. The anti-fouling convention was approved in 2001, with a date of entry into service set for January 1, 2008—assuming that it has been ratified by the required number of flag states. This required number was reached in September 2007 when Panama signed the treaty, and the convention will enter into force on September 17, 2008. After this date, ships will no longer be permitted to apply or re-apply organotin-based antifouling systems and may not have these compounds on their hulls or external parts unless they have a barrier coating that will prevent the biocide from leaching out.

It is not surprising that, at a recent Lloyd's List-organized conference on Managing and Preventing Marine Corrosion (London, November 21–22, 2007), many of the presentations covered aspects of the above coating regulations in relation to their implementation. These aspects are discussed below.

Ballast Tank Coatings and Ship Construction

In his presentation, "The Current Problems with Ballast Tank Coatings." Les Callow of Amtec Consultants Ltd, discussed how his experiences with inspecting older vessels revealed evidence of how construction factors can affect the service lifetimes of ballast tank coatings. In general, it was evident that

• cut edges tend to fail prematurely;
• welds tend to fail earlier than flat surfaces;
• areas of burn-through damage fail early;
• flat areas are generally the last to fail by corrosion; and
• ballast tank under deck areas usually fail first.

The new IMO regulations aim for a 15-year target life, with the remaining coating in *good* condition. As defined in IACS Rec 8, *good* means that rust spots on flat surfaces must cover less than 3% of the area under consideration and that there must be less than 20% breakdown on welds and edges. The new regulations aim to achieve these longer coatings lifetimes through improved new construction practices that address the areas of failure noted above by regulating the surface preparation and coating application.

Marcus Cridland (ABS) described how the Ballast Tank Coating Regulations (MSC 215 [82], Performance Standard for Protective Coatings, PSPC) were being addressed within a classification society and what the society is doing to help its customers.

The ability of coatings to resist corrosion over extended periods of time is an important contributor in safeguarding the capital investment of a vessel. Correctly functioning coatings can reduce the rate of corrosion, thereby potentially delaying the use of corrosion margins in a vessel's structural scantlings (dimensions of the ship's structural parts). In recent years, the Class Societies have permitted optimization of scantlings, which has resulted in thinner steel plates being used and subsequent reductions in overall weight of vessels. This meant that coatings were playing an increasingly important role, but their use was unregulated—hence the need for the PSPC.

The PSPC addresses key points by adopting industry best practices as *minimum* requirements, setting clear production QC standards; imposing explicit inspection testing and verification; and requiring appropriate documentation of production, inspection, and testing activities. General help is contained in the ABS Guide for CPS Notation and the 3rd edition of the ABS Guidance Notes on the Inspection, Maintenance, and Application of Marine Coating Systems, updated to include PSPC requirements. For example, there is a coating process flow diagram, cross referenced to the PSPC review steps, and examples of typical required daily log of records, although it was noted that some interpretations of the Standard still need to be debated by IACS.

Anti-fouling Regs and Paint Companies' Responses

In response to the Anti-fouling Systems Convention (AFSC), the major marine paint manufacturers voluntarily decided to withdraw tin-containing antifouling hull coatings from the market before the IMO convention enters into force. The EU also passed legislation that bans the application of tin-containing coatings and prohibits vessels with tin-based antifoulings from entering EU ports.

The paint industry responded to these regulations by further developing anti-fouling coating technology based on other fouling control mechanisms. The first coating developed uses alternative active species (biocides) in formulations similar to the banned tin-based systems. However, Edward Kleverlaan of IMO, in an update of the AFSC, noted that the effect of some of these active species on the environment and humans was being studied.

The other new technology is based on non-stick (fouling release) coatings, and examples of these were given by three suppliers. Martin Pauwels and Martin Weightman (Subsea Industries) described their totally non-toxic system based on a vinyl ester resin containing a high loading of glass platelets. This system can provide a very smooth, tough coating that is effective against corrosion and fouling. Fouling does not easily adhere to this smooth surface, which can be regained by in-water polishing to extend lifetime further.

Torben Rasmussn (Hempel) described a fouling release coating based on silicone resin and gave evidence of how the coating reduced hull skin friction and optimized fuel consumption.

John Willsher (International Paint) described fouling release coating technology based on silicone resin technology and the latest development using fluoropolymers. Silicone fouling release systems contain no biocides, have low surface energy due to a very smooth, "slippery" surface, and work well for fast and active vessels. Fluoropolymers are purported to create smoother, tougher coatings with better fouling release and static properties, and can be used on more vessel types/trading patterns.

Challenges: Present and Future

Andrew Alderson, Director Technical Excellence Centre, Registro Italiano Navale, summed up the latest regulations and, looking to the future, highlighted the challenges these regulations raise for the coatings industry. Alderson is also chairman of the IACS Expert Group on Coatings and sits on various industry technical panels.

The PSPC for dedicated seawater ballast tanks in all types of ships and double side skin spaces of bulk carriers is prescriptive for the types of coatings and control needed, said Alderson. It is not, however, a barrier to innovation. Article 5 *invites* governments to encourage the development of new technologies and alternative coating systems and to keep the Organisation advised of any positive results. These alternatives to the specified coating can include special steels or alternative coatings (e.g., quick dry).

Alderson also raised several questions. What about alternatives to the inspector or methods of inspection? As required in the PSPC, this has a large resource requirement and is slow. There are quick drying coatings available, but are there quick inspections? Possibilities include automated inspection using robots and smart coatings (self-indicating, optical coatings) but how can these be validated?

Future regulations are underway to cover the coating requirements in voids and cargo spaces of oil tankers and for the inspection, maintenance and repair of marine coatings. Can we use certified coatings for cargo tank coatings in crude oil tankers? What is the composition of the crude oil being carried and how will the ship master know if his coatings are compatible?

For inspection, maintenance, and repair, guidelines are being developed based on IACS Rec 87. The guidelines for ships' staff need to be simple and clear, or do we need qualified inspectors onboard?

Another IMO Regulation is the Ballast Water Convention. This is not a coatings regulation, but it impinges on coating performance or lifetime. This convention aims to stop the transport of invasive marine species from one part of the globe to another in the ballast water by ensuring the water is treated before discharge into the sea or is discharged into fixed onshore facilities where it can be treated. Several onboard systems have been developed, but the question remains: should these ballast water treatment processes be compatible with the prescribed coatings, or should coatings be compatible with the systems?

It is obvious that the marine coating industry is in a dynamic era, with more and more regulatory input. This can only improve the performance obtained from coatings, but can this be achieved without excessive cost to the industry—which negates any advantages gained from longer lifetimes? Only time will tell.

■

Members Finish the Year with SSPC Courses

Front row from left to right: Dale W. Smith (Industrial Painting Limited, Inc.), Roxane Svoboda (Abhe & Svoboda, Inc.), Keith B. Barger (Brock Services Ltd.), Abel Guadarrama (AJC Sandblasting Inc.), David White (Superior Ind. Maintenance), Javier Castaneda (AJC Sandblasting Inc.), Dan Harper (SIPCO Surface Protection Inc.) Back row from left to right: Richard Poplos (Color Works Painting, Inc.), Peter McManus (Color Works Painting, Inc.), Don D. Holle (Abhe & Svoboda, Inc.), Bill Mosley (Industrial Painting Limited, Inc.), Danny J. Hardin (Industrial Painting Limited, Inc.), Andy Myers (Industrial Painting Ltd. Inc.), Michael Douton (Muehlhan United Inc.)

Back row from left to right: Mark T. Rader (Planet, Inc.), Curtis Manuel (Planet, Inc.), Tim Smith (Action Electric Co., Inc.), Kevin Ryder (BIS Salamis, Inc.), David T. Blackwell (Sipco Surface Protection), Clinton M. Tate (BTI Railcar Repair Inc.), George Desipris (Olympus & Assoc. Inc.), William Todd (Certified Coatings). Front row from left to right: Frank Palmer (Frank Palmer Consultants, Ltd.), Gregory Shockley (Planet, Inc.), Kevin B. Robert (Meaux Surface Protection Inc.), Kenneth Martin (Martin Specialty Coatings, Inc.), Jeff W. Brown (United Coatings), Martin Setinsek (Gemstone, LLC.)

Some hard working protective coating professionals finished out the year by taking courses designed to improve their skills.

Train the Trainer Hits the Books

Inaugural Applicator Train-the-Trainer Classes were held December 3-4 and December 5-6, 2007. Bill Corbett was the instructor for both. The classes were held at KTA-Tator in Pittsburgh, PA. The students in each class are shown at left.

As described on www.sspc.org, the Applicator Course is intended to meet the body of knowledge of the proposed SSPC/NACE Joint Standard Recommended Practice TG 320—Industrial Coating and Lining Application Specialist Qualification and Certification. The course is also designed to provide contractor firms with a standardized curriculum for training applicators so that they can conduct the training in their shops or on job sites at their convenience. The program has two levels. Level I training is particularly suited for entry-level employees; Level II is intended for seasoned craft workers.

Bridge Coating Inspection Course Goes to Florida

SSPC offered its Bridge Coating Inspection Course (BCI), Tech Level, December 10–14, 2007, in St. Petersburg, Florida. The Florida Department of Transportation requires its lead coating inspectors to pass the course. KTA-Tator hosted the event, where instructors Greg Richards and Paul Vinik taught 24 students.

The BCI course was developed by an expert task group of bridge facility owners (transportation authorities from around the country). Designed to serve

Left and below: *Studying the art and science of bridge coating inspection*

as a certification process for bridge coatings inspectors, the program consists of three days of lecture and practical hands-on instruction, a course examination and a certification examination on inspecting surface preparation and application of protective coatings on bridge steel, including the many situations that can affect inspection, especially in the field.

Continued

SSPC Plural-Component class in San Diego

SSPC Plural–Component Course Hosted in San Diego

SSPC held its Marine Plural Component Program (MPCAC) December 12–13, 2007, in San Diego, CA, at BAE Systems Maritime Engineering Services. Rick Smith and John Kern taught the course.

The course, says www.sspc.org, is designed to certify craft workers operating plural-component spray equipment and those applying protective coatings on steel in immersion service by airless spray using plural component spray equipment.

SSPC Reports DAC Violation

SSPC has suspended Bridges "R" Us Painting Company's QP1 and QP2 certifications effective January 4, 2008, through July 3, 2008, for violation of the Disciplinary Action Criteria (DAC).

New SSPC Catalog Published

SSPC has announced the publication of its 2008 Products catalog, which now features SSPC Logo Wear.

The 2008 catalog also shows a wide range of SSPC products for sale, including

- widely recognized standards, guides, and specifications;
- fundamental texts on inspection, failure analysis, and coatings for concrete; and
- training materials for the industrial applicator.

For details about any of the products, go to www.sspc.org.

Tips on Using Plural-Component Spray Technology Safely in Confined Spaces

By Stephen Wierzchowski, RLS

Plural-component proportioning spray systems are used throughout the coatings industry for efficient, precise, and safe spray application of coating materials. These systems come in many different configurations with various capabilities, but they all help a coating contractor save time and materials while providing a quality application with minimal environmental impact.

Potable water tanks like this one can be confined spaces and require special procedures, even with plural-component spray-applied epoxy. All photos courtesy of RLS

The development of plural-component spray systems evolved with the emergence of specialty multi-component coatings that required precise proportioning combined with high application rates. Additionally, the movement toward high-solids and 100% solids coating materials contributed to the development of high-pressure systems capable of pumping and spraying highly filled, viscous materials.

Specifiers often call for these relatively new high and 100% solids high-performance coatings in structures exposed to very corrosive environments. In many instances, the structures, such as chemical tanks, ballast tanks, pipelines, tunnels, manholes, pumping stations, and sewers, can be confined spaces, which may pose unique hazards and require additional protective measures for the workers.

Confined space procedures must be followed to rehabilitate this sanitary sewer manhole.

While the use of plural-component systems for applications in confined spaces can reduce safety hazards, many variables can still have deadly consequences. Contractors using plural-component spray in permit-required confined spaces should focus on mitigating the hazards associated with confined spaces, equipment, coating materials, and chemicals well before the work begins. Definitions of confined spaces and basic tips on safe use of plural-component equipment and coatings follow. The article does not replace the need for contractors to read and understand all regulations applicable to working in confined spaces, nor does the article take the place of consulting coating and equipment manufacturers about risks their products might pose.

Definitions: Confined Spaces

The definitions below come directly from the Code of Federal Regulations (CFR). Confined space work is regulated by 29 CFR 1910.146, which was promulgated by the Occupational Safety and Health Administration (OSHA). The standard[1] defines a confined space as one that is large enough and so configured that an employee can bodily enter and perform assigned work; has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and is not designed for continuous employee occupancy.

A permit-required confined space is a confined space that has one or more of the following additional characteristics.

- Contains or has a potential to contain a hazardous atmosphere
- Contains a material that has the potential for engulfing an entrant
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section
- Contains any other recognized serious safety or health hazard

Thus, regardless of the project, working in confined spaces involves many health and safety issues, none of which should be taken lightly. In

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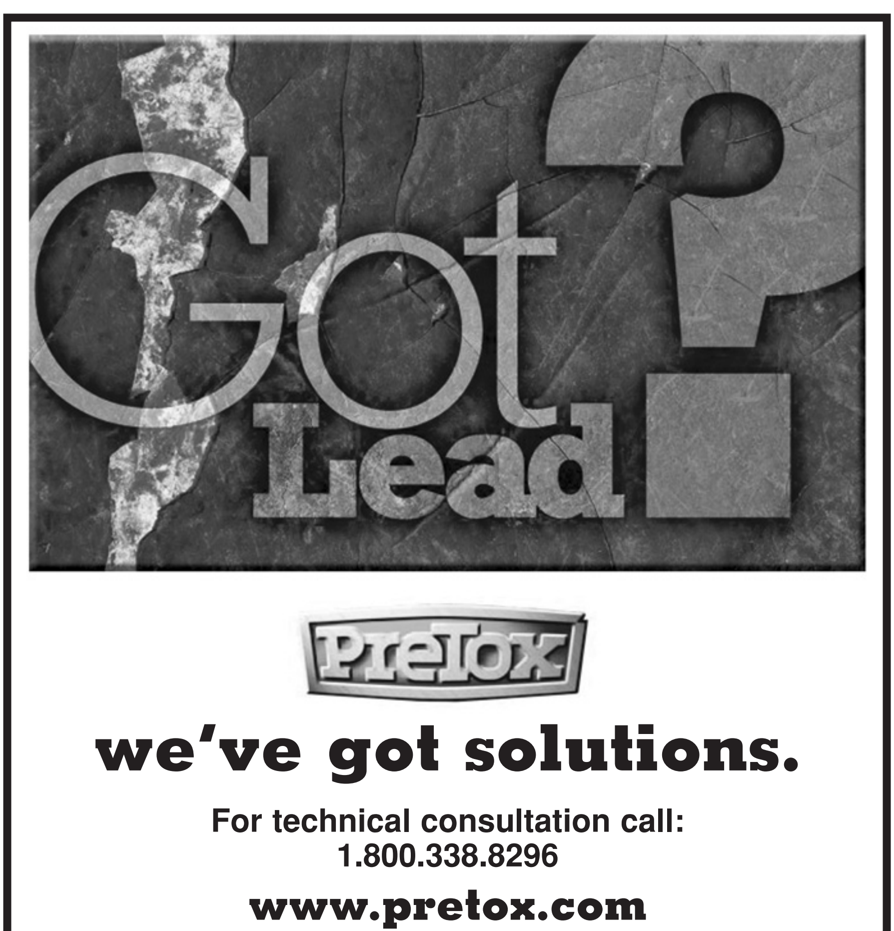

fact, according to a study from the National Institute for Occupational Safety and Health (NIOSH), confined space fatalities typically occur as a result of encountering the following hazards.[2]

- Lack of ventilation
- Oxygen deficiency
- Flammable or explosive atmosphere
- Unexpected release of hazardous energy
- Limited entry and exit
- Dangerous concentrations of air contaminants
- Physical barriers
- Instability of stored product

The NIOSH report also suggests that such incidents could have been prevented by proper recognition of confined spaces, atmospheric testing, evaluation and monitoring, and development of an appropriate emergency response plan. While the NIOSH report was written 21 years ago, it is still relevant. For example, between September 2006 and October 2007, 13 citations were issued to painting contractors for violating the confined space standard, 1910.146. (See p. 65 of this issue.)

29 CFR 1910.146 requires any contractor or employer that owns or works in confined spaces in general industry to appropriately designate and secure the confined spaces in the work place. This regulation also requires the employer of the workers who will be in a confined space to prepare a written confined space program that ensures the proper training and equipping of personnel. Such a safety program needs to address many issues and should be developed specifically for the operations that may be encountered.

Working Safely with Plural-Component: Why and How

Working with plural-component spray systems also poses several hazards related to equipment, such as

- electric distribution devices,
- compressed air/hydraulic power

systems,

- high-pressure fluids and hoses,
- pinch points (places where body parts can be pinched or severed) in moving machinery, and
- heating devices.

Plural-component spray system being lowered into shaft leading to water transmission tunnel. Safe practice is needed even before work begins.

As with recognizing the hazards associated with confined spaces, the contractor's safety personnel must recognize and appropriately mitigate the hazards associated with plural-component spray equipment so that workers can then conduct safe coating operations. Tell your equipment manufacturer how you'll be using the equipment, and ask about all potential hazards it may pose.

Equipment should be designed and constructed to operate in the environment in which it is to be used. Incorporation of equipment rated for operation in hazardous atmospheres should be a key consideration. Some permit-required confined spaces may require equipment rated for use in Class I, Division 1 or 2 environments. Utilizing extended lengths of hose to reach inside confined spaces can mitigate some of the hazards related to plural-component equipment. This hose setup reduces the likelihood of an equipment-related accident inside the work area by keeping the equipment outside the hazardous environment. However, it is not always possible to keep the equipment out of the confined space.

Coating materials applied by plural-component spray and ancillary chemicals such as reducing or cleaning solvents may also pose hazards, especially when used in confined spaces. Some coatings may have components such as isocyanates, which require the use of specialized respiratory protection equipment in addition to standard protection from particulates. Solvent-borne coatings, including high-solids coatings, contain flammable components that can be hazardous during and after application.

One additional concern not commonly encountered is the hazardous polymerization of chemicals. In some cases, the chemical reaction of coatings can create high exothermic heat, especially when the coating is mixed in mass (such as in waste pails) or is applied in thick layers. The heat itself from an exothermic reaction can be a hazard, can create toxic fumes, or can displace oxygen from the atmosphere in the confined space. The heat of the reaction can exceed 300 F, hot enough to melt plastic waste pails. The exothermic reaction is associated more with high or 100% solids coatings than with conventional coatings.

Plural-component spray equipment inside water treatment structure prior to spray application.

Continued

High-pressure plural-component spray systems make it possible to reduce or totally remove solvents from coating systems, making application in confined spaces safer and more efficient than with conventional coatings. However, solvents may still be used to purge and clean various components of the plural-component spray system, requiring applicators to take special safety precautions. Non-flammable synthetic solvents or plasticizers such as DOP (Dioctyl Phthalate) can be used to purge mixed coating materials from equipment. Unfortunately, high cost or under-performance may make non-flammable solvents less desirable than common and dangerous solvents such as MEK or acetone. Regardless of the cleaning solvent selected, strict conformance with the equipment manufacturer's instructions for safe cleaning is essential.

While plural-component coatings may contain no solvents, solvents may still be needed to clean the spray equipment.

If flammable or combustible materials are to be used in any confined space, the following precautions are among those that should be taken.
- Hot work must not be performed in the space or adjacent spaces.
- Coatings, thinners, solvents, and used solvent rags must be properly stored.
- Smoking and open flames must be prohibited.
- Equipment that may generate static electricity must be grounded/bonded.
- Ensure only properly rated equipment is utilized if hazardous atmospheres exist.
- Adequate ventilation must be maintained in storage, mixing, transfer, and application areas.
- Frequently conducted atmospheric tests may be required.
- Suitable fire fighting equipment must be immediately available.
- Power and lighting cables must be inspected to evaluate electrical hazards.
- Spills of solvents should be cleaned up immediately.

Any of the above-mentioned hazards can be dangerous at a regular job site, and they can be especially dangerous in combination with confined spaces. Be sure to check with your manufacturer and safety personnel about additional precautions needed with the materials you have purchased for a job.

Well-written and properly implemented safety programs address the hazards that personnel may encounter and should include reporting requirements and disciplinary action for non-conformance. Programs should enable personnel to be capable of
- recognizing and mitigating hazards,
- testing and evaluating atmospheres,
- monitoring the work space and surrounding environment, and
- understanding and executing the emergency response plan.

Implementing a plan that encompasses these objectives will greatly reduce the likelihood of accidents during coating operations in confined spaces.

Always Have an Emergency Response Plan

However, even the best of programs cannot foresee every circumstance. Therefore, an emergency response plan is critical and cannot be overvalued. The ability of workers to safely evacuate a hazardous environment and for rescuers to respond quickly when workers cannot escape on their own is directly proportional to the planning and communication executed in preparation for a job.

Emergency response plans should be developed for each individual work area and be specific to the existing and potential hazards therein. Personnel should have the means to evacuate quickly and safely in more than one direction. Properly trained and equipped rescue personnel should be notified of the operations before work begins and be afforded the opportunity to be involved in developing the plan. Emergency plans should also be practiced to familiarize personnel and to expose any weakness in the plan.

Closing Thoughts

Although plural-component spray equipment can improve efficiency and safety in coating operations, it does not eliminate all hazards, especially in confined spaces. The hazards of confined spaces increase the danger of any work environment and should not be underestimated. Through careful planning, evaluation of hazards, development of sound safety plans and communication with personnel and emergency services many accidents can be prevented. Finally, before you use any coating materials or equipment in a confined space, consult the manufacturers, safety personnel, and OSHA.

Disclaimer: This article is not intended to be complete or to take the place of training in safe practice for plural-component spray in confined spaces.

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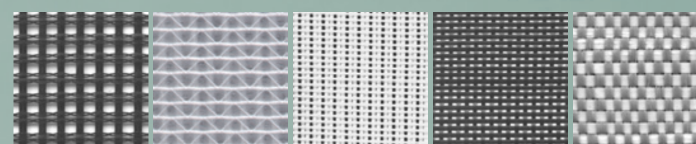
Stephen Wierzchowski is the operations manager for RLS. RLS sells Raven-branded 100% solids epoxies for the protection and renewal of municipal infrastructure, and manages the Raven Certified Applicator network. RLS also represents the AquataPoxy and CuraFlo Spincast brands in the municipal market.



Regulations

Lead Paint Standard Tops List of OSHA Violations

Violations of the construction industry's lead paint standard heads the list of the citations most frequently issued to painting contractors between October 2006 and September 2007, reports the Occupational Safety and Health Administration (OSHA). (For the same period, the agency also reported the most commonly cited OSHA standards for other trades.)

Of the total 1,483 citations issued to painting contractors, 221 were for violations of the lead standard, with penalties totaling approximately $815,000 (current amounts, not the initial fines levied).

OSHA's tally includes only federally issued citations, not those that states have issued. The agency identifies painters and paperhangers by their Standard Industrial Classification (SIC), 1721. Included in this classification are

- bridge painting contractors,
- electrostatic painting on site (including lockers and fixtures),
- contractors who paint buildings and other structures (except roof contractors),
- ship painting contractors,
- traffic lane painting contractors,
- paper hanging contractors,
- house painting contractors, and
- whitewashing contractors.

Table 1 lists the 20 most frequently cited standard violations among painting contractors. Twenty-three standards are listed because of ties between six standards violated. The table is not complete. To view the complete table, go to www.osha.gov.

Table 1: 20 Most Frequently Cited Standard Violations among Painting Contractors

Standard	#Cited	#Insp	$Penalty	Description of Standard
1926.0062	221	26	85,290	Lead
1926.0453	189	169	150,922	Aerial lifts
1926.0451	166	67	118,735	General requirements
1910.1200	109	62	13,215	Hazard Communication
1926.0501	89	84	89,207	Duty to have fall protection
1910.0134	88	36	18,576	Respiratory Protection
1926.1053	79	57	49,311	Ladders
1926.0454	72	70	38,189	Training requirements
1926.0020	53	50	32,339	General safety and health provisions
1926.0503	41	38	24,628	Training requirements
1926.0021	34	32	21,880	Safety training and education
1926.0404	28	24	10,273	Wiring design and protection
1926.1060	28	27	13,832	Training requirements
1926.0100	27	27	9,205	Head protection
1926.1101	24	3	8,775	Asbestos
1926.0102	17	17	4,977	Eye and face protection
1926.0452	17	14	7,310	Additional requirements applicable to specific types of scaffolds
1926.0405	14	11	2,842	Wiring methods, components, and equipment for general use
1910.0146	13	1	30,000	Permit-required confined spaces
1926.0095	12	12	7,765	Criteria for personal protective equipment
1910.1052	11	1	5,625	Methylene Chloride
1926.0502	9	8	4,450	Fall protection systems criteria and practices
1926.1052	9	8	5,390	Stairways

OSHA Proposes New Safety Rules for Shipyard Workers

The Occupational Safety and Health Administration (OSHA) has proposed revisions to "General Working Conditions in Shipyard Employment" aimed to help reduce hazards and provide greater protection for shipyard employees, including those employees performing maintenance painting. OSHA published the proposed rule in the December 20, 2007 Federal Register, and the agency will accept public comments on the proposals until March 19, 2008.

"Working in shipyards is one of the most hazardous occupations in the nation," said Edwin G. Foulke, Jr., assistant secretary of labor for occupational safety and health. "Shipyard employees perform industrial operations such as abrasive blasting and welding, operate

Continued

heavy equipment and often work in confined spaces onboard vessels. This proposed rule would help reduce the hazards these employees face."

The proposal updates and clarifies provisions in the shipyard employment standards (29 CFR Part 1915 subpart F) that have largely gone unchanged since OSHA adopted them in 1972. OSHA proposes to revise and update existing provisions and to add new provisions, including the control of hazardous energy and motor vehicle safety.

Proposed updates include establishing minimum lighting for certain worksites, accounting for employees at the end of work-shifts if they work in confined spaces or alone in isolated spaces, and adding uniform criteria to ensure shipyards have an adequate number of appropriately trained first aid providers. The proposal also updates sanitation requirements.

Interested parties may submit comments electronically at http://www.regulations.gov, the Federal eRulemaking Portal, by sending three copies to the OSHA Docket Office, U.S. Department of Labor, Room N-2625, 200 Constitution Avenue, NW, Room N-2625, Washington, DC 20210; or by fax at 202-693-1678 if the comments and attachments do not exceed 10 pages. Comments must include the Agency name and Docket Number for this rulemaking (Docket No. OSHA-S049-2006-0675).

OSHA to Propose Rulemaking for New Respirator Fit-Testing Protocol

The Occupational Safety and Health Administration (OSHA) has published a Notice of Proposed Rulemaking (NPRM) in the December 26, 2007 Federal Register (www.osha.gov) for a new fit-testing protocol under Appendix A of OSHA's Respiratory Protection standard. The agency is proposing to add the Abbreviated Bitrex Qualitative Fit-Testing (ABQLFT) protocol to the current protocols. OSHA will accept public comments until February 25, 2008.

The proposed protocol would apply to employers in the construction industry, general industry, and shipyard employment.

"This proposed rule will add a new fit-test method that has a shorter exercise duration than the current methods," said Assistant Secretary of Labor for OSHA Edwin G. Foulke, Jr. "This method will give employers additional flexibility in selecting procedures for conducting fit-testing."

The proposed rule would add the ABQLFT as an alternative to the four existing OSHA-approved qualitative fit-test protocols. The ABQLFT protocol currently listed in the existing OSHA-approved Bitrex fit-test protocol in the Respiratory Protection standard would shorten the duration for each of the seven fit-test exercises from one minute to 15 seconds.

Interested parties may submit comments at http://www.regulations.gov, the federal eRulemaking Portal, by sending three copies to the OSHA Docket Office, Room N-2625, U.S. Department of Labor, 200 Constitution Ave. N.W., Washington, DC, 20210; telephone: 202-693-2350; or if the written submission is ten pages or fewer, fax to 202-693-1648. All comments on the NPRM must include the docket number for this Federal Register notice, OSHA 2007-0006.

Technical questions about this NPRM can be addressed to John E. Steelnack, OSHA Directorate of Standards and Guidance, at (202) 693-2289.

For more information about OSHA, visit www.osha.gov.

OSHA Extends Comment Period for Lookback Review of Methylene Chloride Standard

The Occupational Safety and Health Administration (OSHA) has reopened the public comment period for the review of its methylene chloride (MC) Standard (29 CFR §1910.1052). OSHA is now accepting comments until March 10, 2008. The agency first announced the review in the July 10, 2007, Federal Register (72 FR 37501—37503), and comments were originally due October 9, 2007.

OSHA issued the standard in 1997 to protect employees from occupational exposure to MC. Data that OSHA and other health groups had collected showed that exposure to MC could be associated with health problems such as cancer and neurological disorders.

Among its many applications, methylene chloride is used in paint stripping for industrial, commercial, and residential applications; metal degreasing; and aircraft paint removal.

Continued

The January 8, 2008 Federal Register notice (www.osha.gov) invites suggestions from the public on how the standard's requirements could be modified to reduce the burden on employers while maintaining employee protection.

Public comments must be submitted no later than March 10, 2008, and can be sent by regular mail, express, hand delivery, or by courier service. Comments should be sent to the OSHA Docket Office, Docket No. OSHA-2007-0024, U.S. Department of Labor, 200 Constitution Ave., N.W., Room N2625, Washington, DC 20210. Comments are also accepted electronically at www.regulations.gov. Comments may be sent by FAX to 202-693-1648.

For further information, contact Joanna Dizikes Friedrich, Directorate of Evaluation and Analysis, OSHA, Room N3641, 200 Constitution Ave., N.W., Washington, DC 20210, telephone 202-693-1939.

To read the 1997 regulation, go to www.osha.gov and search the Federal Register (on the righthand navigation bar) for 29 CFR 1910.1052, Methylene Chloride. For a discussion of the original standard and its relevance to maintenance painting operations, go to the JPCL archives on www.paintsquare.com and see "Regulation News" in the March 1997 *JPCL*.

Products

Fiber-Reinforced Zinc Ends Mud-Cracking

Hempel says that its new fiber-reinforced zinc silicate solution, GALVOSIL FIBRE 15750, will eliminate mud cracking in zinc-silicate coatings and offer high flexibility and durability. According to the company, its newly developed solution allows higher dry film thickness, compared to other solutions, without cracking.

The company says that the fibers improve coating flexibility; durability; and resistance to abrasions, cracks, and impact. The solution is designed for use in antifoulings and ballast tank coatings, where high dry film thickness is required.

Other characteristics include good adhesion, easy application, and a cure time of 10 hours. Its 80% zinc content ensures corrosion protection in dry film, the company reports.

For more information, visit Hempel's website at www.hempel.com.

Antimicrobial Coatings Designed for HVAC Systems

Sureshield Coatings Company (Northbrook, IL) has introduced its Sureshield line of specially formulated antimicrobial, easy-to-clean coatings designed for HVAC products with metal surfaces.

"The key to minimizing odor, stains, and other chronic HVAC system complaints is provide an active layer of protection to surfaces where mold, mildew, fungi and other microbes can flourish," says Michael Jacobs, president of Sureshield Coatings Company, who points out that HVAC components coated with antimicrobial coatings are already being used in hospitals, clean rooms, office buildings, and many other commercial and industrial buildings.

Sureshield is available in clear, solid, and transparent colors, and a variety of textures and glosses.

For more information, contact the company—website: www.sureshield-coatings.com; tel: 866-573-4424; email: info@sureshieldcoatings.com.

Associations

NACE Hits the Big Easy

Coatings-related programming will be featured at CORROSION/2008, NACE International's 63rd annual conference and exhibition on corrosion prevention, to be held March 16–20 at the Ernest N. Morial Convention Center in New Orleans, LA. A brief review of sessions related to coatings follows, as does a list of relevant exhibitors (as of press time).

Forums

• International Marine Coatings Forum, March 16
Marine industry leaders, representing shipbuilders, regulatory agencies, owners, and users, will examine current issues faced by marine coatings personnel, including regulatory changes, new IMO specifications, and the increased commercial pressures on ships in service with regard to corrosion control—specifically ballast tanks, fouling control, and invasive species infestation.

• Nuclear Coating Inspector Forum, March 17
This forum, moderated by Jon Cavallo, vice president, Corrosion Control Consultants & Lab, Inc., will cover a number of issues surrounding nuclear coatings, such as plant life extension, the effects of an aging work force on qualified nuclear coatings personnel, new testing approaches for nuclear power plant (NPP) coatings, and changes in containment coatings for the new generation of NPP designs.

• How to Avoid Premature Coating Failures, March 17
This tutorial, presented by Mike O'Brien, president, MARK 10 Resource Group Inc., will provide participants with practical knowledge to examine and reduce coating failures.

• Bridge Painting: The Usual to the Unusual, March 17
This forum will address the entire bridge coating evaluation process, including how to decide between bridge coating repair or full re-coat. Bridge Painting Sessions will include: Louisiana Bridge Paint Evaluation Studies; Woodrow Wilson Bridge Painting, An Overview; From the Chemistry in the Can ... To the Chemistry on the Project; The Pros and Cons of Chloride Removal from Steel Structures; and FHWA's High Performance Steel Program As It Relates to Bridge Coatings.

• And They All Come Tumbling Down: Anatomy of Bridge Failure, March 18
This one-hour session will review the aspects of bridges that failed due to cor-

Exhibitors

Over 350 companies will be exhibiting at NACE/2008. The following is a list of exhibiting companies (and their booth numbers) that are involved in protective coatings and linings work.

3M Corrosion Protection 208
AGC Chemicals Americas Inc 300
Akzo Nobel Coatings Inc 857
ASTM International 409
BASF Corp 402
Belzona Inc .1117
Blair Rubber Company 1121
Bredero Shaw 601
Canusa CPS .700
Central Plastics 1026
CeRam-Kote by Freecom Inc 1506
CHLOR*RID International Inc 1112
Clariant 1239
Corrocoat USA Inc. 948
Corrosion Control Int'l 1301
Corrpro Co Inc 801
Cortec Corporation 606
Curran Assoc Inc 1313
Cygnus Instruments Inc 326
Dampney Company Inc 513
DE Stearns Co 813
DeFelsko Corporation 1018
Enviroline Monitoring Systems 852
Fischer Technology Inc 1407
FSC Coatings Inc. / Zero Rust 500
Graco Inc 1207
Greenman-Pedersen 925
Hempel Coatings USA Inc 452
Henkel Corporation 1501
Heresite Protective Coatings 911
Hi-Temp Coatings Technology 1512
HoldTight Solutions Inc 230
Integument Technologies Inc 1317
JPCL 204
KTA Tator Inc 1001
Montipower LLC 1807
Oxford Instruments Coating Measurements 1412
Pipe Wrap LLC 200
Pipeline Inspection Co. Ltd. 939
PolyCorp 515
Polyguard Products 345
PPG Industries Inc 1000
Rema Tip Top North America Inc 1339
Rohm & Haas Company 1100
Sherwin Williams 1107
Specialty Polymer Coatings Inc 752
Sponge-Jet Inc 508
Sub-One Technology 654
Tapecoat Company 901
Tek-Rap Inc .920
The Bayou Companies 312
Thermion Inc 308
Tinker & Rasor 639
Tnemec Company Inc 1625
Trenton Corp 1116

rosion, look at the status of bridges today, and tackle questions like "When can you expect them to fail?" and "What can be done to stop the failures?" Examples of catastrophic failures to be studied include: the Silver Bridge in Point Pleasant, WV (December 15, 1967); a 100-ft (30-m) span of the Mianus River Bridge in Greenwich, CT (June 28, 1983); and a 65-ft (20-m) section of a three-lane overpass near Montreal, QC (September 30, 2006).

• Front Page Issues: Fueling the Future, March 18

An increase in the domestic supply of alternative fuels faces a major challenge—the transportation of ethanol can cause stress corrosion cracking on the current pipeline infrastructure. This has spawned a number of research projects within the industry and the federal government. Peter Lidiak, general manager of Pipelines for the American Petroleum Institute, and Jeff Weiss, associate administrator for the Pipeline and Hazardous Material Safety Administration, will discuss the current challenges that face the industry and the state of the research and development efforts to address them.

Courses

The following courses are scheduled.

• Offshore Corrosion Assessment Training (O-CAT), 5-Day Course, March 11–15

This intensive five-day program addresses in-service inspection and maintenance planning for fixed offshore structures. The curriculum benefits various personnel, from those with management and planning responsibilities to the field inspectors conducting in-service inspections of the facility.

• Corrosion Control in the Refining Industry, 5-Day Course, March 12–16

An overview of refinery process units and specific process descriptions is provided in this course. The course benefits those with a minimum of 1–2 years

Continued

experience in refineries including design engineers, process engineers, procurement agents, maintenance planners, service company representatives who support refineries, corrosion and equipment engineers, metallurgists, inspectors, and inspection supervisors.

• Shipboard Corrosion Assessment Training (S-CAT), 5-Day Course, March 12-16

This course provides a foundation of coatings, corrosion, and corrosion control knowledge for assessing the condition of tanks and other structures. Practical guidelines for surveying and evaluating the condition of the protective coating systems on marine vessels are also covered. This course is beneficial to coating inspectors, shipyard planners, design engineers, port engineers, and type commander representatives.

• CIP One-Day Bridge Specialty Course, March 15, 2008

This course, designed for those who have completed CIP Level 1, focuses on coating application on bridges and the role of the bridge coating inspector in the quality control process. The course was recently revised with the assistance of representatives from various DOTs, including New Jersey, Florida, Georgia, Massachusetts, Texas, Louisiana, and Nova Scotia, as well as the Triborough Bridge and Tunnel Authority.

Technical Committee Meetings

The following technical committees and associated subgroups will discuss coatings-related issues at NACE/2008.

• STG 02 - Coatings and Linings, Protective: Atmospheric
• Coatings, Thermal-Spray (TG 146)
• Fretting Corrosion Between Piping and Pipe Supports (TEG 229X)
• Coatings, Thermal-Spray for Corrosion Protection (TEG 255X)
• Offshore Platforms: Coatings for Corrosion Control of Steel (TG 313).
• Offshore Coating Condition Assessment for Maintenance Planning (TG 340)
• Offshore Coatings: Laboratory Testing Criteria (TEG 346X)
• STG 03 - Coatings and Linings, Protective: Immersion and Buried Service
• Coatings and Linings over Concrete for Chemical Immersion and Containment Service (TG 141)
• Coatings, Polyurethane for Field Repair, Rehabilitation, and Girth Weld Joints on Pipelines (TG 281)
• External Pipeline Coatings: Practices, Test Methods, and/or Test Methodologies for High Operating Temperature Pipelines, Immersion and Buried Service Only (TG 336)
• External Pipeline Coatings: Field Installation and Inspection Criteria for Maximum Performance (TG 337)
• Coating Systems (External) for Pipeline Directional Drill Applications (TG 352)
• External Pipeline Coatings: Multi-Layer Extruded Polyolefin Coating Systems (TG 353)
• Pipeline Coatings: Underground Blistering (TEG 354X)
• STG 04 - Coatings and Linings, Protective: Surface Preparation
• Surface Preparation of Contaminated Steel Surfaces (TG 142)
• STG 43 - Transportation, Land
• Railcars: Corrosion Protection and Control Program (TG 063)
• Removal Procedures for Nonvisible Contaminants on Railcar Surfaces (TG 271)
• Land Transportation: Information Exchange on Corrosion and Coating-Related Issues (TEG 291X)
• Rail Car Interior Coating Application—Revision of NACE Standard RP0386 (TG 332)
• Coating System Application for Interior Surfaces of New and Used Rail Tank Cars (TG 333)
• Rail Cars: Coating Application on

Exterior Surfaces of Steel Railcars (TG 339)

- Rail Cars: Corrosion Under Tank Car Insulation (TG 366)
- Waterborne Coatings on Railcars (TG 378)
- Surface Preparation by Encapsulated Blast Media for Repair of Existing Coatings on Rail Cars (TG 379)
- STG 44 - Marine Corrosion: Ships and Structures
- Marine Vessel Corrosion (TEG 181X)

Further Information

For more information, or to register, visit NACE International's website, www.nace.org, and click on the Conferences/Exhibitions link.

UMR Coatings Institute Changes Name

On January 1, 2008 the University of Missouri-Rolla (UMR) changed its name to Missouri University of Science and Technology (MS&T). The new name more accurately describes the University's true focus, MS&T says. MS&T was founded in 1870 as the first technological university west of the Mississippi River. The original name was Missouri School of Mines and Metallurgy. In 1964, the University was re-named the University of Missouri-Rolla in an effort by the state of Missouri to consolidate the names of the four campuses that form the University of Missouri system, MS&T reports.

Along with the name change comes a change in the Institute's website and related email address. According to the Institute, the new website is http://coatings.mst.edu/, and the new email address is coatings@mst.edu.

FSCT Expands Online Learning Schedule

Responding to the increasing demand for its series of Virtual Learning Conferences (VLC), FSCT has expanded its schedule for 2008. The topics and speakers to be featured include the following.

- February 12—Principles and Practices of Pigment Wetting, Dispersing, and Stabilization in Aqueous Coatings, János Hajas, BYK-Chemie GmbH
- March 6—Extender Pigments, John Ballard, Burgess Pigment Company
- March 20—Black Pigments: Colloidal Properties and Effects in Coatings, Daniel Goldberg, Evonik Degussa Corp.
- April 3—Coatings Fundamentals I: Overview, Formulation, and Polymers, Ernest Galgoci, Air Products & Chemicals, Inc.
- April 10—Coatings Fundamentals II: Surface Chemistry, Rheology, and Additives, Ernest Galgoci, Air Products & Chemicals, Inc.

Continued

• April 24—Coatings Fundamentals III: Solvents, Pigments, and Coatings Testing, Ernest Galgoci, Air Products & Chemicals, Inc.

According to the Federation, registration for the VLC programs will open on the FSCT website soon. One fee is charged per location, regardless of the number of participants. For complete details, contact FSCT—tel: 610-940-0777; website: www.coatingstech.org.

Companies

Benjamin Moore & Co. To Acquire Insl-x Products Corp.

Benjamin Moore & Co. (Montvale, NJ) has announced its intent to purchase select assets and brands of Insl-x Products Corporation, a coatings manufacturer based in Stony Point, NY. Benjamin Moore said the acquisition will add "several strong brands" to its North American coatings operations, including the Insl-X, Coronado, Bruning, Trinity Lacquers, and Lenmar labels. Terms of the acquisition were not disclosed.

Denis Abrams, Benjamin Moore President and CEO, said the Insl-x company will continue to operate under the leadership of current president Jim Weil, whose father founded the company in 1960. Benjamin Moore said Insl-x's existing management and employees would also remain in their current positions, with manufacturing and distribution of Insl-x products also continuing at existing locations.

Insl-x manufactures and markets its own brand of specialty and industrial products in Illinois, Nevada, Texas, and Alaska.

Benjamin Moore & Co., a Berkshire Hathaway company, manufactures residential, commercial, and industrial maintenance coatings.

Graco to Buy GlasCraft

Graco Inc. has entered into a definitive agreement to acquire Cohesant

Technologies' GlasCraft Inc. subsidiary for $35 million, which includes certain assumed debt and transaction costs. The acquisition will be accomplished through a merger with GlasCraft's parent entity, Cohesant Technologies Inc., and a spin off of all non-GlasCraft business operations. The acquisition, which is expected to be completed in the first quarter of 2008, is subject to customary closing conditions, including the approval of Cohesant Technologies' stockholders, Cohesant says.

GlasCraft developed the first spray system for the composites manufacturing industry nearly 45 years ago. The company also designs, manufactures and sells high-performance dispensing systems for the polyurethane foam and polyurea coatings industries.

Minneapolis, MN-based Graco Inc. designs, manufactures, and markets systems and equipment to move, measure, control, dispense, and spray fluids, including coatings.

Spider Hires Sales Rep for Chicago

Spider has hired James Ferland as a district sales representative for its Chicago operation center. In this position, Mr. Ferland will be responsible for solving contractors' suspended access and safety challenges in the Chicago area.

Mr. Ferland has held a variety of sales roles in Chicago's construction market, Spider says. As a sales representative for Mittal Steel, he was credited with strengthening customer relationships and profitably delivering on sales objectives. In his most recent position as account manager with Hilti, he successfully sold, serviced, and promoted its mechanical and electrical product lines.

John Sotiroff, vice president, sales and distribution, said, "James' familiarity with Chicago's construction market combined with the support of our outstanding Chicago operations team mean our customers in that region will continue to receive the highest quality products and services we have to offer."

Blastco Secures Tank Improvements Contract

Blastco, Inc. (Torrance, CA) was awarded a contract of $2,632,250 by the Rancho California Water District (Temecula, CA) for five tank improvement projects on three existing water storage tanks. The contract includes recoating the interior and exterior surfaces of the 5 MG Carancho Reservoir No. 3, as well as installing a new mixing system. The contract also includes recoating interior surfaces of the 5 MG Norma Marshall Reservoir, as well as installing a mixing system and performing seismic upgrades. The contract also includes recoating interior surfaces and installing a mixing system in the 7.7 MG General Kearny Reservoir No. 2. The interior surfaces of all three tanks will be lined with an epoxy system; the exterior of Carancho Reservoir No. 3 will be overcoated with an epoxy-urethane system.

Classic Protective Coatings Secures Spheroid Repair Project

Classic Protective Coatings (Menomonie, WI) was awarded a contract of $386,968 by the City of Mahtomedi, MN, to recoat and repair an existing 500,000-gallon spheroid elevated water storage tank. The project includes abrasive blast-cleaning and recoating the exterior surfaces, the interior wet surfaces, and the interior dry surfaces. The interior surfaces will be lined with epoxy systems and the exterior surfaces will be coated with an epoxy-urethane system.

Indiana DOT Awards Pedestrian Bridge Renovation

The Indiana Department of Transportation awarded a contract of $1,241,745.90 to Beaty Construction, Inc. (Fairland, IN) to transport, repair, and reassemble a three-span, 212.33-foot-long by 14-foot-wide steel Parker truss bridge. The project includes cleaning and recoating existing structural steel surfaces and new steel ornamental railings. The existing coatings, of which approximately 20% remain, will be treated as hazardous.

State Painting Awarded Reservoir Maintenance

State Painting Company, Inc. (Salt Lake City, UT) was awarded a contract of $1,682,900 by the Eastern Municipal Water District (Perris, CA) to perform various maintenance repairs on a 7.6 MG water storage tank and a 6.0 MG water storage tank. The project includes cleaning and relining the interior surfaces of both tanks, as well as performing as-needed touch-up to exterior surfaces impacted by the repairs. The interior steel surfaces will be abrasive blast-cleaned to a Near White finish (SSPC-SP 10) and lined with a three-coat epoxy system. The contract requires the use of dehumidification equipment to facilitate proper interior curing.

VIP Painting Awarded Stadium Painting Project

VIP Painting (Coral Springs, FL) was awarded a contract by St. Lucie County (FL) to pressure-wash and paint existing metal surfaces at Tradition Field, the spring training home of the Major League Baseball New York Mets. The project involves applying a waterborne direct-to-metal system to overhead columns, canopies, and under-railings on the front façade, as well as a steel staircase, the terrace canopy, and the berm concession canopy. The contract is valued at $28,500.

Liberty Maintenance Wins Bridge and Wall Painting Project

Liberty Maintenance, Inc. (Campbell, OH) was awarded a contract of $1,143,000 by the Orlando-Orange County Expressway Authority to perform system-wide bridge and barrier wall surface preparation and painting services. The contract, which required SSPC-QP 1 certification, involves applying a textured primer and a waterborne acrylic finish to 291,963 square feet of uncoated concrete and 242,463

Greenhorne & O'Mara Wins Bridge Painting Consulting Contract

Greenhorne & O'Mara, Inc. (Laurel, MD) was awarded a contract of $54,547.99 by Carroll County, MD to provide engineering services for an upcoming bridge painting project. The contract includes evaluating existing bridge conditions to identify ten to fifteen bridges in need of spot-painting, zone-painting, or overcoating. The inspection includes performing hazardous material testing. The contract also includes specifying surface preparation and coatings application for the project.

square feet of previously-coated concrete. The project also includes cleaning 4,315 square feet of aluminum surfaces.

Kinard Painting and Sandblasting Wins Tank Renovation Bid

Kinard Painting and Sandblasting (Wynnewood, OK) was awarded a contract by the City of Madill, OK to recoat the interior and exterior surfaces of a 230,000-gallon-capacity standpipe water storage tank and a 240,000-gallon-capacity 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. The contract is valued at$109,670.

Maryland Bureau of Mines Awards Equipment Coating Contracts

The State of Maryland Department of the Environment, Bureau of Mines awarded two separate contracts for coatings application on three existing dosers. Marshall Ruby & Sons (Frostburg, MD) was awarded $64,225 to recoat two dosers. Beitzel Corporation (Grantsville, MD) was awarded $67,450 to repair and recoat one doser. The interior walls and silo cone surfaces, as well as the exterior surfaces, will be recoated with a rust-inhibitive enamel system.

Lake Havasu City Lets Tank Rehabilitation Project

The City of Lake Havasu City, AZ, awarded a contract of $571,000 to Arizona Coating Applications, Inc. (Phoenix, AZ) to repair and recoat the interior and exterior surfaces of two 1 MG water storage reservoirs and one 0.5 MG water storage reservoir. The interior surfaces will be abrasive blast-cleaned to a Near White finish (SSPC-SP 10) and lined with an epoxy system.

Continued

Larco Wins Airport Fuel Farm Coating Contract

Larco, Inc. (Crossett, AR) was awarded a contract of $10,965 by the City of Hot Springs, AR, to recoat existing airport fuel farm surfaces, including two 20,000-gallon-capacity tanks, a 12,000-gallon-capacity tank, two filter systems, and associated piping. The metal surfaces will be abrasive blast-cleaned to a Commercial finish (SSPC-SP 6) and recoated with an epoxy primer, an epoxy intermediate, and a polyurethane finish.

The exterior surfaces will be abrasive blast cleaned to a Commercial finish (SSPC-SP 6) and coated with an epoxy-urethane system.

Tennessee DOT Lets Bridge Painting Projects

The Tennessee Department of Transportation awarded three contracts for surface preparation and coatings application on a total of seventeen existing bridges over roadways. Industrial Painting Services (Buford, GA) secured a contract of $555,394 to recoat a total of 54,798 square feet of structural steel surfaces on six bridges. Seminole Equipment, Inc. (Tarpon Springs, FL) secured a contract of $693,264 to recoat a total of 57,489 square feet of structural steel surfaces on eight bridges and a contract of $632,280 to recoat a total of 44,811 square feet of structural steel surfaces on three bridges. The steel on all seventeen bridges will be abrasive blast-cleaned to a Near White finish (SSPC-SP 10) and coated with the TN DOT Standard inorganic zinc-epoxy-polyurethane system.

Jetco Awarded Standpipe Rehabilitation

Jetco, Ltd. (Prospect Heights, IL) was awarded a contract of $707,800 by the City of Aurora, IL, to rehabilitate an existing 5 MG standpipe water storage tank. The project includes recoating the interior and exterior surfaces of the tank, as well as performing miscellaneous repairs. 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.

Ohio Valley Painting Wins Water Plant Painting Project

Ohio Valley Painting Company, Inc. (Dayton, OH) was awarded a contract by the City of Hamilton, OH, to perform interior painting work at the South Water Plant. The project includes cleaning and painting a total of approximately 24,000 square feet of interior concrete walls, ceilings, and floor surfaces. The ceilings will be finished with an acrylic emulsion coating. The walls and floors will be coated with an epoxy-acrylic system. The contract is valued at $38,962.

For information about Project Preview, contact Brian Churray: bchurray@paintsquare.com.