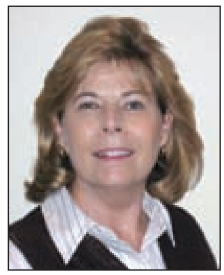
Costello to Lead Int'l, Devoe Brand Integration

International Paint LLC (Houston, TX) has promoted Laura Costello to the position of manager of Strategic Marketing Protective Coatings North America. She will be responsible for leading a two-year effort to integrate Devoe High Performance Coatings into the International Paint Protective Coatings business and for marketing all brands.



Laura Costello

Costello has been in the protective coatings industry, including working at International Paint Protective Coatings, from 1984 to 1994 and 2003 until present. She has two B.S. degrees in chemistry and biology from the University of Louisville and a master's degree in marketing from Webster University in St. Louis. Costello is a Six Sigma Certified Black Belt in Quality Analysis and a member of SSPC, the American Marketing Association, and the American Productivity & Quality Center.

International Paint LLC is an AkzoNobel company that provides high-performance coatings, linings, and fire protection products.

Scaffold Group Honors Industry Professionals

Ten prominent members of the scaffolding and access community were recognized with awards for their dedication and service to the Scaffold Industry Association (SIA) at the industry awards dinner of the SIA's 37th Annual Conference & Exposition in San Francisco on July 23, 2009.

"The SIA is fortunate to have passionate, hard-working members who are the blood-line of our association. Every year, it is with pride that we have the opportunity to recognize such individuals and their accomplishments by means of long-standing awards!" said SIA President, Bill Breault. The awards and winners are listed below.

- Coupling Pin Award Winner: Randy Moody, Brock Group, Baytown, TX
- Hall of Fame Award: Marty Coughlin, WACO Scaffolding & Equipment, Cleveland, OH
- Outstanding Chapter President Award: Chris Moody, Brock Group, Baytown, TX
- Outstanding Company Contribution Award: ThyssenKrupp Safway, Waukesha, WI
- Outstanding Council Chairperson Award: Greg Janda, Alimek Hek, Dallas, GA
- Outstanding Service Award: Gene Morgan, Mdm Scaffolding Services, Grapevine, TX
- D. Victor Saleeby Award: Dave Glabe, DH Glabe & Associates, Westminister, CO
- Spirit Award: John Miller, Millstone Corporation, Upper Marlboro, MD
- "Unsung Hero" Award: Wendy Larison, Urban Scaffolding Ltd., Edmonton, Alberta
- Accredited Training Institute of the Year: WACO Scaffolding & Equipment, Cleveland, OH

The Scaffold Industry Association (SIA) is a non-profit trade 501(c)(6) association committed to raising the standards of professionalism within the scaffold and access industry. The SIA represents all facets of the scaffold & access industry through various councils that include aerial work platform, construction hoist, fall protection equipment, international, industrial, mast climbing, plank and platform, supported scaffold, and suspended scaffold. Through its various programs, the SIA promotes safety, training, and a highly professional, responsible image of the scaffold and access professional. The SIA is also the secretariat for the American National Standard, SIA ASC A92 standards. For more information, call 816-595-4860 or visit them at www.scaffold.org.

OSHA to Publish Names of Fraudulent Trainers

The Occupational Safety and Health Administration (OSHA) is publishing an "Outreach Trainer Watch List" of those who have had their trainer authorizations for OSHA's Outreach Training Program revoked or suspended. As of mid-August, the names of four trainers were posted on the List.

The agency will identify fraudulent trainers by monitoring training programs. OSHA has also provided a hotline, 847-297-4810, for individuals to file complaints about fraud and abuse.

"A tighter record control procedure has been instituted requiring trainers to sign their reports and certify the class was conducted in accordance with OSHA's guidelines. Trainers face civil and criminal penalties under federal law if reports or certifications are found to have been falsified," said Jordan Barab, acting assistant secretary of labor for OSHA.

The "Watch List" can be viewed at: https://www.osha.gov/dte/outreach/construction_generalindustry/watchlist.html.

Trainers are authorized by completing a one-week OSHA trainer course.

For more information about OSHA, go to www.osha.gov.

Retired Clemco VP Dave Hansel: 1938–2009

Dave Hansel, former Clemco vice president, died on July 24, 2009, at the age of 70. Patti Roman, Clemco's vice president of marketing, made the announcement.

Mr. Hansel began his career in the industry in 1960, working in the shipping room at Clementina Ltd, Clemco's sister company. His talents were recognized early on, noted Ms. Roman. By 1969, he was traveling a territory, working with distributors, and demonstrating equipment out of a van. From there, Mr. Hansel went on to serve as sales manager, general manager, and vice president, spending the balance of his career in his native San Francisco Bay area. He retired in 2003.

Mr. Hansel's contributions to the company and the industry were numerous. He was a member of SSPC, PDCA, NACE, and other organizations, serving on many of the organizations' committees.

"Dave was an effective and talented manager, great communicator, and always willing to share his knowledge," Ms. Roman said. And, she added, through his still popular Clemco *Blast Off 2* book, he leaves a legacy of educating and serving Clemco customers.

"Dave was good-humored, personable, and well-respected," Ms. Roman recalled. "He was an impassioned and loyal San Francisco 49ers fan, and always had a joke to tell, a smile on his face, and a kind word to say."

Mr. Hansel was preceded in death by his wife. He is survived by two sons and a daughter, their families, and many friends. Contributions in his memory may be made to the American Diabetes Association.

PACE 2010 Set for Phoenix

The Power of Paint and Coatings: PACE 2010, the sixth joint conference of SSPC and PDCA, has been set for February 7–10 in Phoenix, AZ. The conference will feature more than 300 exhibits of innovative products, tools, and technology; a technical and business program covering emerging issues and trends in the coatings industry; training courses; committee meetings; and special events.

Photo courtesy of the Greater Phoenix Convention & Visitors Bureau

The intended audience for the event includes anyone who works in the paint, high-performance coatings, and decorating industry; residential, industrial, and commercial contractors and business owners; wallcovering professionals; manufacturers; suppliers/vendors; engineering firms; consultants; architects; designers; inspection firms; steel fabricators; state, local, and federal DOT; and power companies, as well as other private and public facility owners.

Exhibit space may be reserved by contacting Lorena Walker at SSPC—tel: 412-281-2331, ext 2215 (toll-free: 877-281-7772); email: walker@pace2010.com. Prospective exhibitors may also contact Marsha Bass at PDCA—tel: 314-514-7322, ext 227 (toll-free: 800-332-7322); email: bass@pace2010.com.

The PACE website, www.pace2010.com, will soon feature the PACE News Break, where web surfers can read the latest news on PACE, including press releases, exhibitor news, product announcements, and program changes. If you are a PACE exhibitor or sponsor, contact Michael Kline at kline@pace2010.com or Liz Werle at werle@pace2010.com to contribute news to this section.

The preliminary conference program will be published soon on the PACE website.

PACE 2010 will be the final joint SSPC-PDCA mega coatings show. The annual event debuted in January 2005 in Las Vegas, NV. SSPC will resume its annual conference and exhibit, with a renewed focus on industrial coatings, on February 1–3, 2011, at the Mandalay Bay Resort in Las Vegas, NV.

How to Set Up Ventilation in Confined Spaces

How do you set up ventilation equipment for worker protection where access is difficult, such as manholes?

Steve Wierzchowski, RLS Solutions Inc

Proper ventilation of a confined space, such as a manhole, is a critical component of any Confined Space Entry Program. Almost all manholes, whether they be for sewer, telecommunications, water, or gas services, fit the definition of a permit-required confined space, as defined by the Occupational Safety and Health Administration (see 29 CFR 1910.146 and 1910.268(o)(2)). When fatal confined space accidents occur, more than one element of the safety system has typically failed, including, most often, the accurate monitoring of the atmosphere. OSHA estimates that 85% of permit space accidents would be eliminated by entry personnel reviewing atmospheric testing before entry. While these tests and controls are critical, there are many other possible hazards in a confined space. Ventilation requirements hinge on accurate monitoring.

Once the atmospheric hazards of a space have been identified through testing and site evaluation, the next step is to implement controls, such as isolation and ventilation, to mitigate the hazards. Isolation can be accomplished in manholes by blocking or plugging entry points of toxic, flammable, or oxygen depleting/displacing gases. However, in some situations, not all hazard sources can be blocked, and proper ventilation is thus critical. The following are some key points to ventilating manholes.

• Ventilation equipment must be properly sized

Properly sizing manhole ventilation equipment is a fairly simple process. The average manhole, at 4 ft (1.2 m) diameter x 10 ft (3 m) depth, contains only about 125 ft^3 of atmosphere. A standard portable blower produces about 600 CFM of air at the end of a 15 ft (4.5 m) x 8 in. (0.2 m) duct. Using this equipment effectively changes the atmosphere in such a manhole over 200 times per hour, greatly exceeding the minimum recommendation of twenty.

Additionally, it is recommended to allow at least seven air changes to sufficiently purge a structure, which in this case would take about two minutes. When dealing with large structures, the calculations become more critical but most portable ventilation equipment is suitable for manholes less than 15 ft (4.5 m) deep.

• Ventilation must draw from a source of safe supply air

Ensuring a clean air source is as important as providing sufficient airflow. Using positive pressure from a clean source is the best way to ensure that fresh air is distributed into the space. Entry points and blower locations must be examined for sources of hazards to avoid introducing the hazards into the atmosphere inside the structure. Many manholes are located near vehicular traffic that can produce large amounts of carbon monoxide, so a blower should be positioned away from traffic flow and idling vehicles. A common practice in the sewer industry is to place a negative pressure ventilator on an adjacent manhole and draw air through the pipeline and entry manhole. While this practice can produce effective airflow, this method does not isolate the structure from hazards that can be drawn in from connecting pipelines. OSHA's published position is that the required continuous forced-air ventilation specified in 29 CFR 1910.146 paragraph (c)(5)(i)(B) means a delivery system or device that provides positive pressure for the space where the employees are working (typically requiring a blower at the manhole entrance).

• Effective ventilation of the entire structure must be verified

Verification of adequate ventilation is accomplished by rechecking the structure's atmosphere following the initial purge time. It is critical to check each area of the structure to ensure that effective air changes are occurring in all accessible spaces. Using extended pick-up tubes or hoses and the necessary electric or manual air pump(s), start from the top of the manhole and perform a check every five vertical feet all the way down to the floor or invert. Always allow time for the pump to pull the air sample from the end of the tube/hose to the test device before moving on to the next test location. Many toxic and oxygen-displacing gases are heavier than air and can accumulate at the bottom of a manhole, even if fresh air is being introduced at the entry point. Blower ducts should be inserted to a depth that ensures delivery of fresh air to the lowest point. Also, irregular spaces within a manhole may require special ducting or additional blowers to distribute fresh air to adjoining spaces

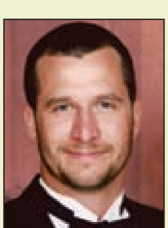
Continued

(never use a blower within a confined space unless it is rated for hazardous locations).

• Ventilation must be maintained at all times

Ventilation should always be maintained while the structure is accessible. While this is good common practice, it is also required when there is the possibility of an atmospheric hazard. Once in place, a ventilation system should never be turned off or removed until all entrants have exited the space and the entry point is secured.

Of course, there are many other issues when dealing with entry into manholes. Employers and workers need to be aware of the hazards, how to test for them, and how to safely and effectively mitigate them. Ventilation is a key component of any safety program and should not be undervalued, even when dealing with relatively simple structures like manholes. Check with your local safety equipment supplier for recommendations that suit your needs and meet the criteria to provide a safe work environment. Ultimately, ventilation of confined spaces should be a component of a comprehensive Confined Space Entry Program, which is required by federal law for any employer who exposes personnel to confined spaces that meet the criteria set forth by OSHA.



Steve Wierzchowski is the technical director for Raven Lining Systems (RLS). RLS provides Raven and AquataPoxy epoxy coatings for the protection and renewal of water and wastewater infrastructure and also manages the nationwide network of Raven Certified Applicators.

Ryan Webb, The Brock Group

There are a number of different ways to ventilate areas that are difficult to access. Options for ventilation are air horns, dust collectors, air conditioners, coppus blowers, and dehumidification equipment. Along the Gulf Coast, we commonly use dehumidification equipment to perform this function, as well as help with corrosion control.

The question presented brings to mind a situation of working on the interior of a small tank or vessel. In this situation, forced ventilation (via flexible trunking) should be used. Assuming the tank being worked on has only two manways, we would set up the ventilation equipment to have one access for worker entry and use the other access for running the trunking through. The manway used for the trunking would then be completely sealed. The trunking should be arranged so that air moves continuously in all areas and no dead air spaces exist. Please note that whether you are in the process of blasting or painting, the ventilation must be arranged so as not to reintroduce abrasive dust and solvent vapor into tanks; consult with the equipment supplier for directions on placement of ventilation equipment.

In a situation where there is only one manway on the tank or vessel, we would use the manway for worker access and run all duct/hoses through any piping where flanges have been dropped and the diameter of piping is large enough to allow access for ductwork.

With either one or two manways, air should be changed often enough to properly protect workers (depending on the activity they are performing—e.g., blasting or painting). To do this, calculate the volume of the area being working on and then decide, depending on the project, how many air changes per hour are needed to be safe and obtain the production needed for each individual activity of the project. We utilize the product MSDS for ventilation recommendations and guidance, along with equipment suppliers recommendations for number of air changes per hour.

Ryan Webb is a program specialist for The Brock Group (Beaumont, TX). He has six years of industrial coatings experience and is a NACE certified level 2 coating inspector.

Brendan Fitzsimons, Pyeroy Group Ltd.

The process of working in a confined space is complex, and extreme caution must be taken before the task is undertaken. A risk assessment of the task is essential and must be conducted by a competent person. The aspects of a confined space job that the risk assessment should look at include the process of work; the type of work to be conducted; the location, tools and materials used; the duration of works, and COSHH (Control of Substances Hazardous to Health) assessments. Once the information is compiled, the risk to the workers has to be evaluated and a proper risk plan and method statement produced, all of which must be fully understood by the workers.

The area and volume of the confined space must be calculated and a ventilation plan developed, along with an emergency evacuation plan and ways of monitoring the process.

The ventilation plan should consider the cubic area of the location and the location and size of the access or manhole. The supplier of the equipment should indicate the relevant extraction capacity of the equipment, taking into consideration the size of the area and the ducting size and length. The concentration of dusts or fumes created (i.e., volume of paints/solvents used in area/time) can be also calculated and taken into account. The information can

Continued

be tabulated so that monitoring can be conducted on a continuous basis. The monitoring is generally done manually.

Worker training is essential for tasks such as surface preparation, coating application; training is also essential for working in confined areas. Workers rely on the management and supervision to have "done their homework" for them in advance of the job.

The equipment supplier should be able to advise for the full specification of the equipment used and the power requirements. (The user, however, must consider how this fits in with the work patterns/shifts.) The hose length and size are also important to ensure adequate fresh air is supplied, and when calculating the number of air changes per minute, remember this is based on a "non-obstacle" basis (i.e., the space is free of anything that could impede the easy flow of air).

A plot plan demonstrating the size of equipment in cubic feet per minute and required air changes per minute is useful. In critical contracts, it is worth setting up a two-part demo process off the jobsite: one part before site installation without obstacles, and the second part a live set up with obstacles. Dust or fumes can be monitored by in situ equipment or attached to working personnel.

The quality of ducting can vary, so it is important to purchase it from a recognized source. Holes and damage of even a few inches can make dramatic changes to air movement. The same can be said for bends.

Confined spaces should have two means of escape, and the means of access should never be blocked unless the obstacle is easy to remove instantly. The extraction equipment has to be working correctly and placed in the correct location (usually lower sections of an area).

There is no doubt that most of the work must be conducted at supervisory and management level well before the task is conducted. Having the correct procedures in place will ensure potential problems are dealt with in advance.

Brendan Fitzsimons, director of the Industrial Services Division of Pyeroy Limited, is a qualified Protective Coatings Specialist (NACE). He has authored several publications, including The Protective Coatings Inspection Manual, The Visual Comparison Manual, and The Atlas of Coatings Defects.

The Case of the Shop Job:

Coated Equipment Sent North but Coating Performance Went South

By Jayson L. Helsel, P.E., KTA-Tator, Inc.
Richard Burgess, KTA-Tator, Inc., Series Editor

A coating failure had occurred in the past two years on a very large piece of newly constructed cement batching machinery at a construction site in a remote area of Canada. The machinery was constructed of steel and contained miscellaneous other equipment such as motors and piping. The steel was fabricated, constructed, and painted in the U.S. during the previous year. The failure, which was first observed after the winter months, was delaying the start of work at the site.

Background

The machinery was shop painted during the summer in the U.S. and delivered to the site in Canada during the late fall. As is many times the case for preparing industrial equipment, the specified surface preparation for the metal surfaces was SSPC-SP 1, "Solvent Cleaning," followed by SSPC-SP 2, "Hand Tool Cleaning," or SSPC-SP 3, "Power Tool Cleaning." The specified non-lead bearing coating system consisted of an alkyd primer applied at 2 to 4 mils dry film thickness (DFT) and an alkyd finish applied at 2 to 4 mils DFT.

After delivery, the equipment was stored outside at the intended job site over the winter months. During the following spring, coating failure in the form of cracking and delaminating paint was observed. The majority of the white-colored finish coat was delaminating to the steel substrate, with a lesser amount delaminating to the dark red-colored primer.

Fig 1: Nearly all of the coating had delaminated or was cracked and loosely adhered to the steel surface. Photos courtesy of KTA-Tator, Inc.

The problem needed to be remediated as soon as possible so the machinery could be put into service. Consequently, an independent third-party investigation of the coating problems was requested.

Field Investigation

A consultant visited the Canadian site in late spring to investigate the problem. The machinery consisted of a number of large parts constructed primarily of steel and coated with a white finish.

The worst areas of delaminating coating were on large flat surfaces of the equipment. When viewed close-up, it was apparent that the coating had either delaminated or was in the process of flaking off over nearly all of the area (Fig. 1).

Where the white finish was not delaminating, much of the coating was cracking. In most instances, the cracking and delaminating white finish also removed what appeared to be an underlying red primer (i.e., the white finish remained adhered to the primer), resulting in exposed steel in the majority of places where the coatings had delaminated. The exposed steel had a layer of partially adherent black mill scale apparent over much of its surface with rusting present. There was also some rust staining in cracks and on the intact white finish coat. When the exposed steel surfaces were scraped, loose rust and what appeared to be mill scale were removed.

The total DFT of the coatings was measured at various locations over the surfaces using an electronic gage. Measurements ranged from 4.5 to 23 mils with an average thickness of approximately 12 mils. There was a pattern of cracking of failing coating in areas of greater coating thickness, although this was not uniformly the case (Fig. 2, on page 16).

The number of coats present and the thickness of each were also determined using a Tooke Gage. This is a hand-held gage with a microscope (50X) that destructively measures the thickness of each coat in multi-coat systems. Observing a coating cross-section created with a cutting tip of known angle shows the coating thicknesses of discernable individual coating layers in addition to intercoat contamination, voids, underlying rust, mill scale, and pinholes. These measurements showed two coating layers: a red primer typically ranging from 1 to 4 mils and the white finish typically ranging from 4 to 6 mils. The substrate was also examined at Tooke gage locations and other destructive sample acquisition areas. The substrate beneath the coating system had a black colored layer of mill scale scattered over the surface.

Coating adhesion testing was performed in accordance with ASTM D3359 Method A (X-cut). Adhesion results were poor to fair (ratings of 0A to 2A) in nearly all areas, with the tape removing the coatings to steel in most

Continued

cases. Adhesion was also assessed by subjective probing with a utility knife, which also demonstrated the coating's poor adhesion. When coated surfaces were scraped with the knife, the finish and/or primer could be removed to the substrate with little difficulty. Representative samples of the coatings were removed from both failing and non-failing areas for further laboratory analysis.

Laboratory Investigation

Further investigation in the laboratory consisted of visual and microscopic evaluation of the coating samples collected. The microscopic examination of representative samples was conducted using a digital microscope with magnification capabilities up to 200X.

The samples used in the laboratory were white on the front and a dark red on the back. When the front of the sample was viewed at 150X magnification, the sample was white and contained brown, yellow, and black spots on the sample. When the back of the sample was viewed at 150X magnification, the chip was black with red spots (Fig. 3, on page 16). There were also some white spots on the back surface as well as visible air pockets. When the cross section was viewed at 150X magnification two layers were visible: the red primer ranging from 4.3 to 4.7 mils and the white finish ranging from 8.5 to 9.1 mils.

The black color observed on the back of samples indicated that the mill scale from the steel surface had been removed along with the primer. The thickness observed was consistent with field observations and measurements of the coating thickness.

Summary of Findings and Discussion

A summary of the key items resulting from the field investigation and laboratory analysis are as follows.

• The total coating system thickness typically exceeded the specified range of 4 to 8 mils, particularly for the finish coat, which was often twice its specified thickness (of 2 to 4 mils).

- There was a pattern of more cracking and delamination of coatings with increased total coating thickness.
- The coating adhesion was fair to poor in all areas.
- Exposed steel surfaces were rusting and included non-adherent mill scale.

The nature of the failure—delamination to the steel substrate that in some cases removed mill scale—was an indication that inadequate surface preparation was the primary cause of the failure. The presence of mill scale on the back of delaminating primer suggests that all loose mill scale was not removed from the steel as required by the hand and power tool cleaning standards. Failure to do so would have led to marginal adhesion between the primer and substrate as was observed.

The high total coating thickness was a contributing factor to the failure. The excessive coating thickness, particularly of the finish coat, created problems with proper curing of the coating film, as evidenced by cracking in the white finish. With alkyd coatings, which cure by oxidation (reaction with atmospheric oxygen) and solvent evaporation, the outer portion of the coating film can dry too quickly, which does not allow adequate curing through the entire film, particularly with overly thick films. This can lead to various problems including cracking. Additionally, the excessive thickness would have imposed additional stresses on the entire coating system, which when coupled with poor adhesion, exacerbated the problem.

The cold weather and associated moisture/freezing exposure conditions expected at the Canadian site likely contributed to accelerating the coating failure. Although alkyd coatings can generally withstand freezing

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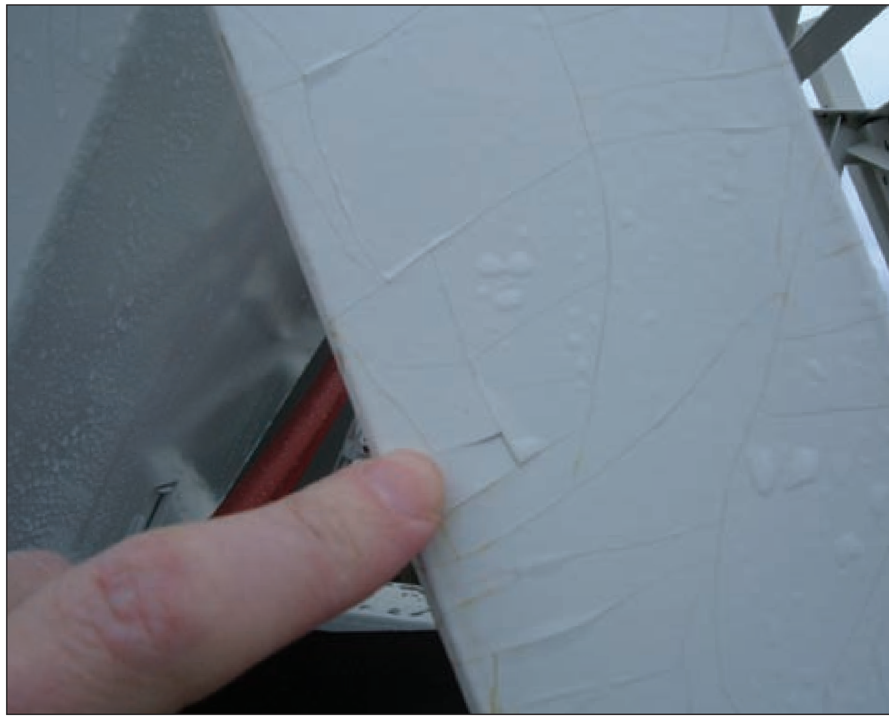


Fig 2: More cracking in the coating system was observed in areas with increased coating thickness.

conditions, once the coating began to fail, the exposure conditions would have imposed additional physical stresses on the coatings, which increased the degree of cracking and induced loss of adhesion of the coating system.

It should be noted that, even though alkyds are known to withstand freezing conditions, and even if the specification was followed to the letter (with proper surface preparation and coating cure)—the specification written for this job might have been inadequate and led to coating failure. Perhaps a more appropriate coating system for this application would consist of a primer, applied at 2–4 mils, and two coats of the finish coat, with each applied at 2–4 mils and cured properly.

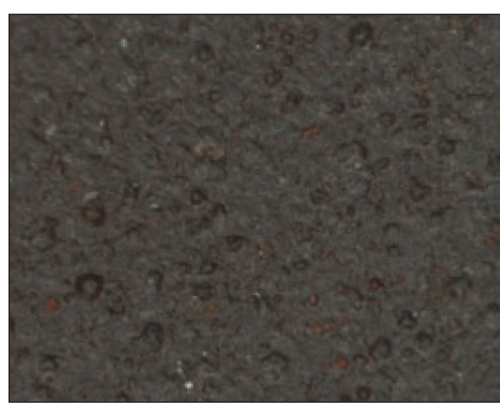
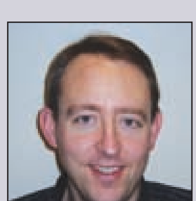
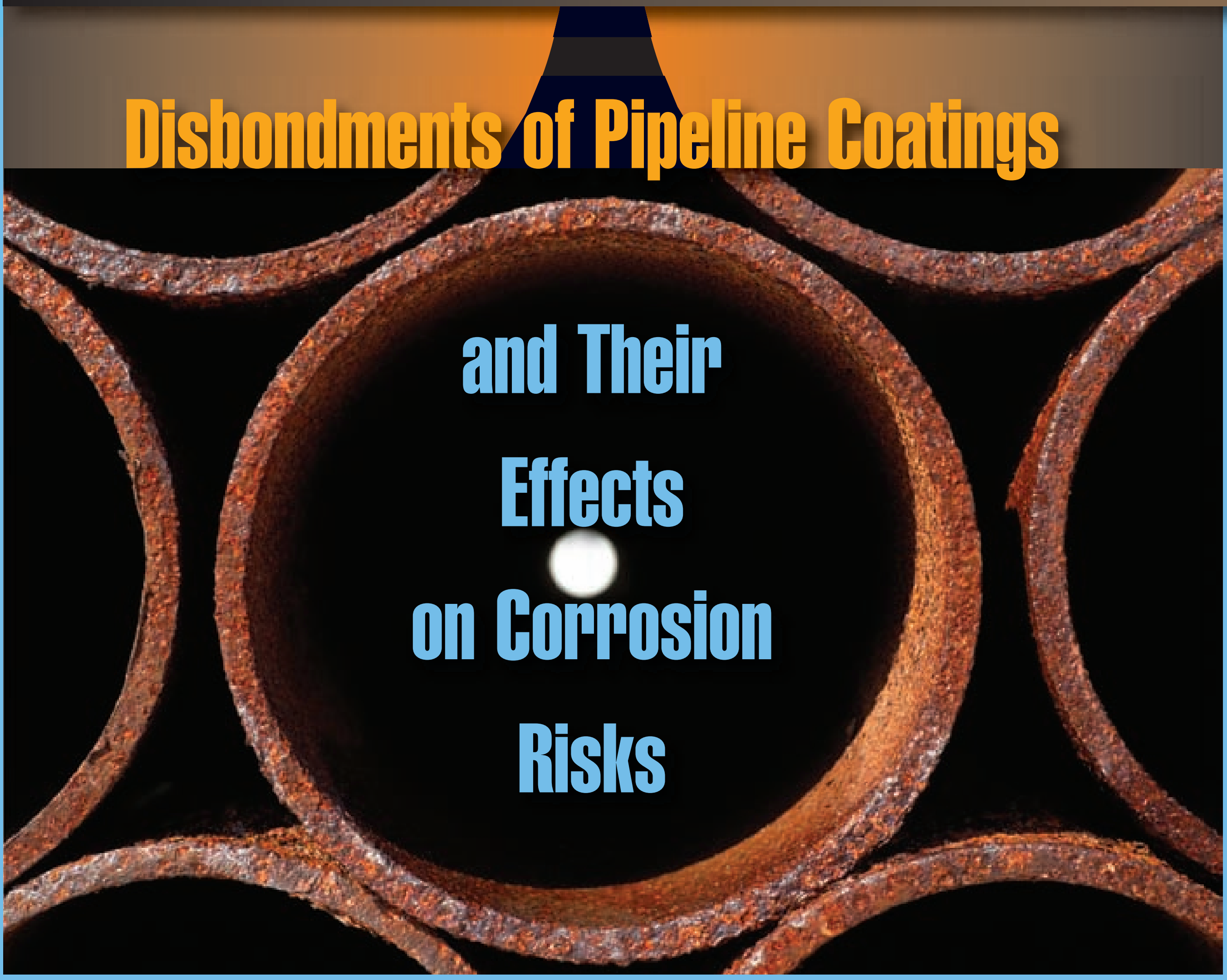


Fig 3: Magnified view of back side of a coating sample showing a black color with spots of red (primer).



Jayson Helsel, P.E., a senior coatings consultant with KTA-Tator, Inc., manages failure investigations and coatings projects and is involved with coatings surveys and inspection of industrial structures. He holds an MS in chemical engineering from the University of Michigan, is a registered professional engineer, and is a NACE Coatings Inspection Technician. He has been published in the past in *JPCL* and in the *The Journal of Architectural Coatings*, which featured his monthly column, "Getting It Right."

Disbondments of Pipeline Coatings and Their Effects on Corrosion Risks



By D. Melot, G. Paugam, and M. Roche, Total SA, France

Buried and submerged pipelines are protected from external corrosion by a coating system, which is considered passive. Coatings are practically always applied to pipe lengths in specialized coating plants, and continuity of coverage is ensured after girth welding through field joint coatings (FJC). Cathodic protection (CP) is an essential, complementary, "active" protection system aimed at preventing corrosion at coating defects, where the pipe steel surface is exposed to the corrosive electrolytic environment. As long as coatings remain bonded to steel and CP is correctly applied, monitored, and maintained, no corrosion risk exists.

The majority of known corrosion cases result from disbonding of coatings, which may prevent access of the cathodic protection current to steel. The cause of failure, known as the "CP current shielding effect," appears to be a concern limited to buried pipelines onshore. Cases of corrosion and stress corrosion cracking (SCC) on old buried pipelines coated "on the ditch" with coal tar or asphalt enamels or cold-applied tapes have been known for a long time. No case of external corrosion of pipelines immersed in seawater has been detected so far using in-line inspection (ILI), despite, most likely, the existence of some coating disbondment. Despite the assumption of some coating disbondment in seawater, corrosion protection is maintained, probably because the high conductivity and homogeneity of seawater make it easier for the CP current to access the exposed steel and protect it.

Summaries of our company's past experience with various kinds of pipeline coatings have been presented in previous papers.[1–9] In particular, at the 16th International Conference on Pipeline Protection in Paphos, the authors presented a paper on failures recently discovered on "newer" coatings such as heat-shrinkable sleeves, three-layer polyethylene (PE) coatings, and fusion-bonded epoxy (FBE) coatings.[10] The present article first updates and completes the information presented at the Paphos conference on the recent cases of coating failures encountered. It also summarizes the results obtained from some laboratory test programs aimed at trying to explain the problems for improving the future choices and the specifications of the company.

Recent Feedback on Disbonding of Pipeline Coatings

Various practical case studies follow. Cases related to heat-shrinkable sleeves (HSS) used for field joints and which overlap the factory-applied 3-layer PE/polypropylene (PP) are the most important as far as corrosion is concerned. Even if the problems related to loss of adhesion of 3LPE/PP coatings do not lead to significant corrosion, the phenomenon must be better understood to prevent the risk for the future.

Heat-shrinkable Sleeves Used for Field Joint Coating

Recent in-line inspections (ILI) carried out on a series of buried pipelines have shown massive disbonding of HSS with significant corrosion underneath after 10 to 15 years of operation in the ground. These coating failures and subsequent corrosion have been noticed principally at moderately elevated temperatures (about 50–60 C [122–140 F]) and on coating systems that had been applied to a wire brush-cleaned surface specified at St 3 cleanliness level (~SSPC-SP 3, Power Tool Cleaning), with or without application of a liquid epoxy primer before the PE/PP. Specific examples of such failures are given below.

18-Inch Oil Pipeline in Gabon

In this case, presented earlier,[10] external corrosion was detected through ILI on the first 15 km, which is the hottest side (>55 C [131 F]) of the 18-inch Rabi-Batanga oil pipeline, after 15 years of operation in the ground. The pipeline is buried in wet, compacted sand (pH of sample, 5.4). Heat-shrinkable sleeves were the hot-melt adhesive type and were applied on a fast-curing liquid epoxy (of nominal maximum operating temperature 80 C [176 F]). Wire brush cleaning as per St 3 was used for surface preparation. The application was fully surveyed by a company inspector.

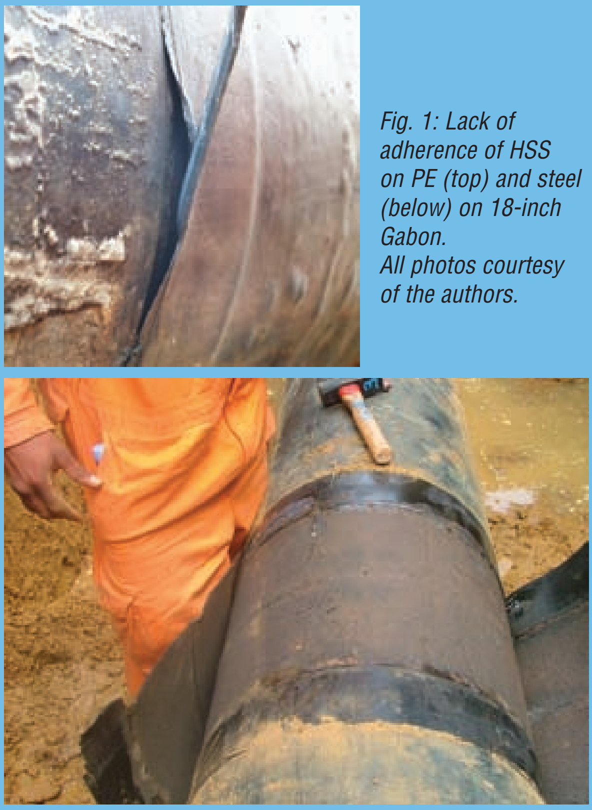


Fig. 1: Lack of adherence of HSS on PE (top) and steel (below) on 18-inch Gabon. All photos courtesy of the authors.

Massive disbonding of HSS on the steel surface together with poor bonding of HSS on the 3LPE plant-applied coating at the overlaps had allowed water to penetrate at the steel surface, leading to corrosion because of the "CP shielding effect" (Fig. 1).

Further excavations of the pipeline revealed that the HSS residual adhesion to the steel was also practically zero on sections at lower operation temperature (down to 35 C [95 F]) but without significant corrosion.

16-Inch Oil Pipeline in Syria

ILI operations carried out on a 16-inch x 7.1 mm wall thickness oil export pipeline operated in Syria for about 12 years have revealed severe external corrosion at many girth weld areas. These areas had been coated with HSS (hot-melt adhesive type) applied directly to a wire brush-cleaned surface, without liquid epoxy primer (Fig. 2). Excavations have confirmed the indications of ILI and revealed several corrosion craters underneath the surface of the field joints with significant presence of mill scale. Corrosion is clearly due to disbondment of HSS. The surface preparation was poor and the HSS overlap on the PE plant-applied coating was too small (1 cm).

The soil is very aggressive (brackish water with a chloride concentration of 2 g/liter) and crystals of salt were observed under the disbonded HSS.

Fig. 2: Heavy corrosion under disbonded HSS (16-inch Syria)

The soil is especially aggressive near the Al Furat river, where the major defects were found. The area near the river is very saline and has been intensively irrigated for a few years. In addition, the temperature is high (> 55 C [131 F]) on the first 20 km of the pipeline, the most affected part. The corrosion appears to have been very high. The value of 0.7 mm/yr estimated as the maximum corrosion rate under the disbonded coating at 50 C [122 F] in the laboratory study detailed below roughly corresponds to the maximum corrosion rate that could have been occurring here over 10 years of operation.

Other Cases

Similar cases were discovered recently, again using ILI, on the 12-inch Coucal-Rabi pipeline, again in Gabon, and on a 6-inch oil pipeline in France (Paris basin). Again, the operating temperature was about 50 C [122 F] in both cases.

Disbonding of 3LPE/PP Used in Plant-Applied Coatings

Massive losses of adhesion of 3LPE coatings between the epoxy layer and the steel after 10 to 15 years' operations have been observed since 2004 through excavations carried out after the detection of corrosion at field joints under disbonded HSS. The disbondments of 3LPE have been noticed most often when the operating temperature of the pipeline is about 50–60 C (122–140 F) in wet environments. So far, no significant corrosion has been found underneath the disbondment of the 3LPE.

18-Inch Oil Pipeline in Gabon

Also presented earlier,[10] disbonding of a 3LPE coating occurred on the same 18-inch Rabi-Batanga pipeline in Gabon. The coating was a low-density PE. It was applied partly by the side extrusion process (with PE adhesive applied by extrusion) and partly by the longitudinal extrusion process (with PE adhesive applied by powder). The application was in compliance with the company specification requiring a minimum of 70 micrometers FBE beneath the PE.

The 3LPE plant-applied coating generally appeared to be correct externally but was found fully disbonded between the FBE and steel when cut for inspection with a tool at the excavation locations in the hottest part of the pipeline. Except for the presence of a layer of magnetite on the steel surface, no significant corrosion of the steel was noticed. Excavations showed that in a few cases, where some minor corrosion was reported by ILI on a few pipe lengths, the PE coating was found longitudinally

Fig. 3: Disbonding of 3LPE at 35 C ([95 F] 18-inch Gabon)

Table 1: Test on 3LPE Coated Pipe Samples Stored During 15 Years

Tests	Temperature of test	Longitudinal extrusion	Side extrusion
Average peel strength (N/10 mm)	23 C (73.4 F)	94 ± 9	226 ± 34
	60 C (140 F)	38 ± 3	142 ± 13
Cathodic disbonding @ - 1.5 V, 28 days (radial length in mm)	23 C (73.4 F)	6.3 ± 0.7	6.6 ± 0.4
	60 C (140 F)	32.2 ± 1.6	28.6 ± 4.1

cracked and open at the 3 o'clock and 9 o'clock positions. Measurements on PE samples taken at these locations revealed a significant thermal aging effect (as shown by loss of elongation at break, increase of viscosity, Shore D hardness and IR spectrum).

In addition to the details previously given,[10] it has been further noticed that loss of adhesion existed at temperatures as low as 35 C (95 F), as shown in Fig. 3. In this case, as compared with what was discovered at higher temperatures, the epoxy primer was more visible and no magnetite had been formed.

Fig. 4: Disponding of 3LPE (16-inch Syria)

Also, it has been demonstrated that this loss of bonding occurred with the two supplies of coated pipes, with two different coating processes and with two different epoxy powders. Peel strength and cathodic disbondment measurements carried out on spare pipes that had been stored directly exposed to UV and atmospheric equatorial conditions gave the results summarized in Table 1, which demonstrates again that the loss of adhesion in the ground is related to exposure to soil conditions (especially water diffusion). It is also notable that peel strength is much higher with lateral extrusion as compared with longitudinal extrusion (the difference is related to the type of adhesive) but that cathodic disbondment is of the same order of magnitude (no significant difference between the two epoxy powders), with the value measured at 60 C (140 F) being very high.

Other Cases

Local disbondment has been observed on the 16-inch Syrian oil pipeline on which severe corrosion was found under HSS (Fig. 4). In France, a short length of pipeline with a 3LPP coating operating at ambient temperature has suffered complete loss of adhesion without any corrosion. In this case, because all other inspected parts in close vicinity did not show disbondment, this observation tends to demonstrate that this loss of adhesion could be due to a specific application problem.

In Indonesia, a section of a 3LPP coated offshore pipeline (with concrete weight coating) operating at about 80 C (176 F) has been cut out for inspection related to internal corrosion. Disbondment of 3LPP from the steel was observed, showing that disbondment seems to be possible offshore also.

Laboratory Studies and an Engineering Approach

A Parametric Study of the "CP Shielding Effect" under Disbonded Coatings

Gaz de France (Direction de la Recherche) and Total have carried out studies in the Gaz de France laboratories to assess the influence of the main parameters governing the corrosion rate underneath a simulated coating disbondment. In particular, the study assesses corrosion as a function of the distance from the point where a direct contact exists with the external electrolyte. Parameters studied were the height of the gap between the steel and the simulated disbonded coating, whether the water was stagnant or changed, the resistivity of water, the application of various levels of cathodic protection, and the absence of cathodic protection. All tests were carried out at ambient temperature. The main results are discussed below. More details may be obtained in published papers.[11,12,13]

The test plan is summarized in Table 2. The detrimental effect of renewal of water was clearly demonstrated. In the case of stagnant water, the corrosion rate becomes practically zero, with or without cathodic protection within a few centimeters of the artificial coating defect. Of course, this testing does not take into account any possible development of microbiologically induced corrosion (MIC) that could occur in the actual situation. This result is easily explained by consumption of dissolved oxygen through the corrosion process. Any renewal of water increases the corrosion rate when the distance from the artificial defect increases, even when cathodic protection is applied. Some posi-

Table 2: Parameters of Corrosion Tests under Artificial Coating Disbondment*

Test n°	Water renewal	Cathodic protection	Gap height	Electrolyte	Bubbling
1	+	–	–	–	–
2	–	–	–	+	+
3	+	+	–	+	–
4	–	+	–	–	+
5	–	–	+	+	–
6	+	–	+	–	+
7	–	+	+	–	–
8	+	+	+	+	+
Upper Level (+)	0	- 850 mV	0.5 mm	water	aerated
Lower Level (-)	1.5 cm/min	-1200 mV	4 mm	saline	deaerated

**Key: The + symbol refers to the upper level of the parameter, and the – symbol refers to the lower level.*

tive effect can be seen when CP level is enhanced. The detrimental effect of increasing the height of the gap between the steel and coating in the studied range explains why disbondments seem to have generally no detrimental consequence on corrosion with three-layer polyolefin (3LPO) systems: the gap in the 3LPO systems remains very low, compared to the case of other coatings such as coal tar or asphalt enamels, tapes or heat-shrinkable sleeves (HSS).

Analysis of the results shows a Gaussian shape distribution of around 0.15 mm/yr with the maximum corrosion rate reaching 0.35 mm/yr. This distribution of corrosion rates may be interpreted as the same as seen on a buried pipeline, at ambient temperature, that may be subjected to coating disbonding without knowing the specific combination of influencing parameters. This distribution also corresponds to values commonly found in practice. For instance, NACE RP0502-2002[14] states that a corrosion rate of 0.4 mm/yr under disbonded coating may occur in the absence of any specific data. Taking into account a general rule that the corrosion rate is roughly multiplied by 2 when the temperature is increased above 30 C (86 F), we may assume that the average corrosion rate could be about 0.3 mm/yr and the maximum about 0.7 mm/yr at 50 C (122 F).

Field Joint Coatings

It is believed that disbonding of HSS may be due to surface preparation by brush cleaning and the effect of higher temperature. Corrosion under disbonded HSS may be due to

- the penetration of water through disbonded overlaps on plant-coating;
- the shielding effect preventing CP, together with a too weak "true" level of CP; or
- an increase in the corrosion rate because of the temperature.

For the time being, it has been decided (at our company) to require, as a minimum before HSS application, Sa 2 ½ abrasive blast cleaning of girth welds and a liquid epoxy primer applied for onshore buried pipelines or when the temperature is higher than 50 C (122 F). However, the general trend is to apply, instead of HSS, liquid polyurethane (PUR) or epoxy-modified polyurethane as a field joint coating onshore, which is currently being done on a major gas pipeline in construction in Yemen (Fig. 5). The system used a PUR-type product designed for 80 C (176 F) maximum operating temperature. The application parameters, equipment, and personnel had been accepted after a full qualification process comprising a Procedure Qualification Trial (PQT) at the coating application contractor premises and verification in the field at the start-up through a Pre-Production Trial (PPT).

Tests carried out on samples taken from the qualification trials were carried out by a third party laboratory, mainly based on measurement of adhesion by pull-off test as per ISO 4624 and cross-cut tests before and after immersion in tap water at various temperatures (up to 80 C [176 F]) and after various durations

Fig. 5: FJC with epoxy-modified PV applied on 3LPE-coated pipes

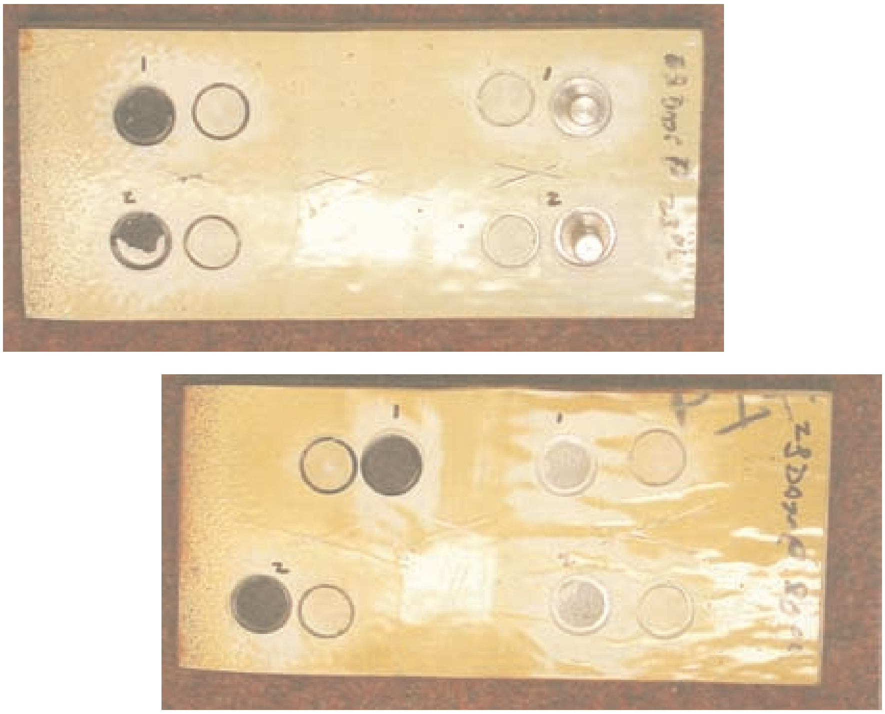


Fig. 6: Pull-off and cross-cut tests at ambient temperature on PU-type product on steel (below) and PE (above) surfaces after immersion in tap water for 28 days and 80 C ([176 F] below) and at 23 C ([73 F] above)

(up to 28 days). Figure 6 illustrates such a series of pull-off tests. As shown in Table 3, values obtained on the PE plant coating as well as directly on the steel surface were found to be fully acceptable when the parameters of application were optimized (especially the substrate temperature). Surface preparation was abrasive blast cleaning to Sa 2 ½ on steel and abrasion without any complementary treatment on the PE.

In addition, Total is launching a comparative program for an in-depth study of various field joint coatings (PE/PP-based HSS, liquid PUR or epoxy, flame sprayed PE/PP, etc.), especially through hot water resistance testing and evaluation of the compatibility of the HSS with plant coatings in wet environments. For the HSS, two surface preparation levels will be tested: Sa 2 ½ (blasting to near white metal, SSPC-SP 10) and St 3 (very thorough power tool cleaning, SSPC-SP 3 level of cleaning). For liquid products, various surface treatments for the plant-applied coating will be tested: with and without oxidative flame and/or other proprietary treatments. Tests will consist of: cathodic disbonding (28 days at 23 C and 80 C [73 F and 176 F], and 48 hrs at 65 C [149 F]); peel tests on steel and plant coating at 23, 60, and 80 C and 100 C (for PP only); impact tests per ASTM G14; immersion tests for 28 days in deionized water at 40 (104 F), 60, and 80 C; and, after immersion, peeling tests on steel and overlap. Total will be happy to share this program with any interested party.

Efforts to Explain Disbondment Problems of 3LPE/PP Coatings

Possible explanations for disbonding of 3LPE are

- water and oxygen diffusion through PE;
- water saturation and diffusion in FBE layer, depending on the type of epoxy;
- superficial corrosion of steel surface forming magnetite;
- all these steps being accelerated by temperature; and
- the possible effect of internal stresses in PE/PP due to the thermal history during application, which could help explain why such massive disbondment does not occur with FBE coatings. (FBE is not subject to thermal aging during application.)

Significant corrosion under disbonded 3LPE only occurs when it is also cracked due to thermal ageing, which leads to a significant gap between the disbonded coating and steel. The gap allows renewal of aggressive species and the CP current shielding effect.

Since 2006, the efforts contributing to the explanation of this phenomenon have concentrated on the following.

- Launching of a fundamental study as Ph.D. work on adhesion mechanisms of epoxy, as illustrated in another paper presented at the 17th International Conference on Pipeline Protection[15]
- Participation in a study on the development of a new accelerated test ensuring a better qualification that could predict long term behavior (carried out for EPRG, European Pipeline Research Group). Conventional peeling tests and cathodic disbonding tests used up to now failed for such a prediction. This study is still running and the results are confidential for the time being
- A study of water sensitivity of six epoxy powders, carried out by IFP (French Institute of Petroleum). The

Table 3: Adhesion Tests After Immersion for 28 Days of PE Coated with Liquid Applied PU-type at FJC

Water temperature	Adhesion on steel (MPa)	Adhesion on abraded PE (MPa)
23 C (73.4 F)	15 to 20	5 to 15
60 C (140 F)	15 to 20	5 to 11
80 C (176 F)	15 to 20	5 to 10

results of these tests are summarized in a paper also presented at the 17th International Conference on Pipeline Protection.[16]

Hydrothermal Aging of LDPE

Thermal aging of various PE materials (low density stabilized by ethylene vinyl acetate (EVA) or not, 2 types of medium density) from various suppliers has been studied in wet conditions, whereas the present methods used for qualification are restricted to dry conditions. The question was: Does physicochemical thermal aging happen to PE up to 100 C (212 F) in water?

The tests were carried out by Korrosionstechnik Heim. The following test conditions were used: dry air at 100 C (212 F); demineralized water at 60 (140 F), 80 (176 F), and 100 C; and air saturated with water vapor at 60 and 80 C. The effect of aging was assessed using elongation and tensile strength at break and Melt Mass Flow Rate (MFR). No significant change was noticed after 5,000 hours of testing for all products and all test conditions. Consequently, no explanation has been given so far for what was noted on the Rabi pipeline where cracking of PE topcoat in some locations led to corrosion. Loss of the EVA additives is still the proposed answer, but not a proven explanation. A bad batch of PE could be involved in this issue.

Conclusion: Present Situation and Future Work

The major corrosion problems are related to disbondment of heat-shrinkable sleeves applied on field joints of buried pipelines. For Total, abrasive blast cleaning is now mandatory before application of HSS and not only "recommended" for new onshore pipelines. In addition, the general trend is to apply, instead of HSS, liquid polyurethane (PUR) or epoxy for field joint coating onshore.

It is of utmost importance to demonstrate whether an improvement of the adhesion safety margin of 3LPO coatings is possible or not. If not, modification of Total's basic choice could be changed in favor of FBE, in spite of the better mechanical resistance of 3LPO coatings (generally considered as a plus by pipe laying contractors). Parameters related to the composition of epoxy powders have been studied. Methods such as measurement of "Wet Tg" and the use of two-layer FBE/adhesive coatings are very promising approaches from lab studies. However, the differences noted in water intake do not correlate with the severe loss of adhesion of the coating when immersed in water, especially when water temperature is above ambient. For the time being, the following criteria have been introduced in Total's general specifications for selection of epoxy primer: water absorption lower than 10% after 28 days at 80 C and "Wet Tg" greater than maximum operating temperature +10 C above the operating temperature.

The future work necessary for a better knowledge of the problem of 3LPO disbondment will be researched through a continuation of the studies at IFP, especially on test samples taken from actual pipes recently coated for various projects, and also on other epoxy powders and surface preparation systems. The Ph.D. work launched to better understand the mechanism of bonding of epoxy to steel will address factors such as mechanical vs. chemical anchor, surface preparation and treatment, and internal stresses within the coating. In addition, the study carried out in the U.S. on the internal stresses will be highly profitable for the development of knowledge.[17]

Continuation of field experience feedback will be organized in order to better know the influence of parameters such as temperature or soil humidity. All possible efforts will be made to push operating subsidiaries to perform excavations and field measurements in order to contribute to and assess correlations between disbondment and soil and operating parameters.

A more relevant accelerated aging test allowing a better prediction of long term behavior remains to be established (especially through EPRG collaboration) and implemented in the future revision of ISO 21809 standards currently on the way of completion based on a conventional approach.

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Preparing Repair Mortars for Wastewater Service: Broom Finish or Blasted Surface?

By Vaughn O'Dea and Rick Schwab, Tnemec Company, Inc.

Concrete is inherently durable and is used extensively in municipal wastewater construction.[1] The deterioration of concrete and reduction of its service life can result, however, when exposed to conditions frequently found within these environments including abrasion, corrosion of steel reinforcement, and biogenic sulfide corrosion.[2,3] The rehabilitation and protection of concrete within these aggressive exposure conditions has consistently been a challenge given the fact that no hydraulic cement, regardless of its composition, will long withstand a pH 3 or lower.[4,5] This problem is exacerbated by increasing concentrations of hydrogen sulfide (H_2S) gas rising beyond the levels protected by traditional protective barrier systems, ultimately negating the protection of the cementitious substrate from biogenic sulfide corrosion.[6,7,8] As a result, high-performance lining systems have emerged specifically for severe wastewater environments.[9]

The protective coatings industry has also paid special attention to the repair of concrete using cementitious resurfacing mortars—both thin overlays and shallow depth replacements—before applying high-performance linings.[10] Resurfacing improves the film quality of a protective coating by providing a contiguous surface for topcoating and ensures a monolithic protective barrier film at a specified nominal thickness. Because of this expanding repair market, cementitious resurfacing materials and repair methods are being introduced at an increasing rate for use under high-performance protective coatings. Unfortunately, as the repair market expands, one result has been conflicting manufacturers' instructions and deviations from many industry standards regarding the curing, finishing and preparation (e.g., broom finish vs. blasted surface) of various cementitious materials, even those that are generically similar. In fact, commonly, manufacturers of repair mortars recommend a broom finish to create a "profiled" surface before applying the lining. Less commonly, manufacturers recommend that the cementitious mortars be blast cleaned or otherwise mechanically profiled to impart a mechanical profile before applying the lining. In the following article, the authors summarize the results of an investigation to quantitatively assess adhesion of a protective lining when applied to a broom finish surface versus a mechanically profiled concrete surface.

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Background on Adhesion

The Importance of Surface Profile for Lining Adhesion

When applying a high-performance protective lining directly to new concrete, it is widely accepted that profiling increases the surface area available for bonding the protective lining to the concrete substrate. Profiling also enhances the mechanical adhesion at the concrete/coating interface and helps the lining resist peeling and shear forces. (This premise excludes the effects of a chemical adhesion bond obtainable by some polymer-modified repair mortars.) It seems logical that mechanically profiling a cementitious resurfacing mortar would offer similar benefits to the lining performance. But because broom finishing is still common in wastewater repair, the question arises: does a broom finish profile provide similar adhesive properties to those of a blast cleaned (mechanically profiled) surface (a more expensive and time consuming process)?

Tensile Strength and Adhesion

To be effective in the rehabilitation and protection of concrete, a protective system, which includes both the cementitious repair mortar and protective lining, must develop and maintain adhesive and cohesive direct tensile strengths greater than the surface tensile strength of the parent concrete. This criterion ensures that the system is able to withstand the stresses imposed on, and the processes of deterioration associated with, severe wastewater environments.

A cementitious resurfacer exhibiting weaker surface tensile strength properties than the parent concrete surface potentially compromises the integrity of the protective system and is prone to cause the system to fail prematurely. The repair mortar's surface tensile strength, or bond zone strength, which refers to the surface of the mortar that will be in contact with the coating, is not as well understood as it should be. Because of the diverse finishing/preparation recommendations oftentimes encountered within the wastewater repair industry, there is a need for a more comprehensive understanding of the general surface tensile behavior of the various hydraulic resurfacing composites for use under high-performance protective linings. Specifiers and users of cementitious repair materials would clearly benefit from information that quantifies the bond zone strength of popular cementitious mortars.

Laitance and Adhesion

New concrete—along with other cementitious substrates—commonly has a weak surface layer, called laitance, resulting from use of too high a water/cement ratio, drawing of fines to the surface during surface finishing, the exudation of fines with bleed water, or improper curing. Laitance will have a weaker tensile strength than the rest of the concrete substrate, and if not removed, will weaken the concrete's ability to provide an adequate surface for lining adhesion. It is possible that like concrete, cementitious repair materials form a laitance layer that could similarly interfere with the adhesion of the lining and the success of the complete repair system.

Unfortunately, the presence and the depth of laitance typically cannot be detected visually, but must nevertheless be removed to create a surface profile that will enhance lining adhesion.

Mechanically Profiled Surface and Laitance

The value of a mechanically profiled concrete surface before applying a lining reflects the prevailing view that the removal of the laitance is paramount to achieving maximum bond strength of the lining.[11,12] Moreover, a recent study by

Measuring Bond Strength

It is well established that the development and maintenance of a sound bond between the coating and the concrete substrate is an essential requirement for heavy-duty, high-performance protective lining systems. Tensile pull-off tests are becoming increasingly favored in laboratory and site quality control/quality assurance testing. Various industry consensus guidelines recommend that pull-off adhesion tensile testing should result in substrate (parent) concrete cohesive failure as most desirable for coatings applied to concrete. In this case, the pull-off stress (adhesion) is considered exceeding the direct tensile strength of the substrate concrete. There are two popular ASTM testing methods describing tensile pull-off testing.

ASTM D 7234 *Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers* (formerly recommended for coatings on concrete under ASTM D 4541) stipulates scoring of the coating down to the surface of the substrate. As reasonably interpreted, the substrate is considered any cementitious material (i.e., cast concrete substrate, cementitious repair mortar, etc.). This "limited" scoring, however, causes stress non-uniformity due to the concentration of tensile stress at the dolly periphery at its interface with the substrate. This leads to a corresponding increase in the substrate stress at this position, which extends into the concrete (or cementitious mortar) beyond the dolly perimeter. This may provide an explanation to the small degree of 'overbreak', whereby the tensile stress extends beyond the dolly perimeter and results in higher measured tensile strength of the cementitious repair mortars (often exceeding the actual tensile strength values of the concrete substrate).

ASTM C 1583/C 1583M *Standard Test Method for Tensile Strength of Concrete Surfaces and the Bond Strength or Tensile Strength of Concrete Repair and Overlay Materials by Direct Tension (Pull-off Method)*, on the other hand, requires partial core drilling through the cementitious mortar and into the concrete substrate a minimum one-half inch. Partial coring reduces stress variation and ensures a reasonably uniform distribution of concrete stress over the full depth of the coring. Unlike ASTM D 7234, the failure plane is usually located at the end of the drilling core – reflecting actual direct tensile strength. The failure load (measured tensile strength) tends to be slightly lower when using this method compared to ASTM D 7234.

the author found that most cementitious repair mortars commonly used for wastewater rehabilitation increased their surface tensile properties when externally cured, that is, with a curing membrane applied in accordance with ACI 308R.[13,14] The study further concluded that the adhesion of a high-performance protective lining was maximized when the surface of these repair mortars was mechanically profiled, which removed the laitance layer and curing compound, where present. (Adhesion of the lining over a broom-finished surface was not addressed in the earlier study.)

Broom Finished Surface Profile and Laitance

Research suggests the broom finish profile for linings may have originated from the concrete repair industry practices (when no lining is involved) to improve the bond of the mortar to itself. When rehabilitating concrete using cementitious mortars in multiple lifts, it is common practice to thoroughly roughen, cross hatch, or rake the surface of the first lift of the repair mortar to promote additional mechanical bond for the subsequent lift (Fig. 1).[15-18] Despite the common use of broom finishing to profile repair mortar before lining application, the authors found no literature suggesting whether or not this finishing technique categorically alleviates the formation of laitance, the weak surface layer that may affect the bonding of a protective lining system.

Objectives of the Study

Because of the lack of available research on repair mortars and laitance, the study described in this article was undertaken to address the following questions. Is it possible that a broom-finished surface eliminates the formation of a laitance layer on cementitious repair mortars? And is the surface tensile strength of a broom-finished surface equal to or greater than the surface tensile strength of the parent concrete so that the mortar can properly receive a high-performance lining?

Fig. 1: Typical broom-finished surface

Experimental Method

Cementitious Mortars

Cementitious mortars using ingredients that most closely match those of concrete are the best choices for repair materials.[17] Based upon this principle, the authors surveyed 100 wastewater projects and found the four cementitious repair composites most commonly specified for use in concrete repair under protective lining systems.[19] These cementitious composites are generically classified as:

- epoxy-modified cementitious mortars,
- acrylic-modified cementitious mortars,
- portland-based cementitious mor-

Table 1: Cementitious Resurfacing Materials Included in Surface Bond Strength Evaluation

Product Designation	Cementitious Mortar Type	Minimum Thickness	Maximum Thickness	Mfgr's Recommended Finishing Technique(s)	Mfgr's ACI External Curing Requirements
Mortar 1	Epoxy-modified	1/16"	1/4"	Rubber float, steel trowel, masons brush	None
Mortar 2	Epoxy-modified	1/16"	1/8"	Rubber float, steel trowel, masons brush	None
Mortar 3	Epoxy-modified	1/16"	1"	Conventional concrete finishing tools	None
Mortar 4A	Acrylic-modified	1/4"	2"	Wooden or rubber float, trowel	ACI 308
Mortar 5	Acrylic-modified	1/4"	3/4"	Trowel	ACI 308
Mortar 6	Acrylic-modified	1/8"	1.5"	Wooden or rubber float, trowel	ACI 308
Mortar 7	Portland-based	1/4"	1/2"	Broom	<5-8 hrs apply coating; >8 hrs ACI
Mortar 8	Portland-based	3/8"	2"	Wooden or rubber float, trowel	ACI 308
Mortar 9	Portland-based	3/8"	1.5"	Wooden or rubber float, trowel	ACI 308
Mortar 10	Calcium Aluminate-based	1/2"	3"	Broom	ACI 308
Mortar 11	Calcium Aluminate-based	1/2"	1"	Broom	<70% R.H. Curing Required; >70% None
Mortar 12	Calcium Aluminate-based	1/2"	3"	Trowel or broom	Not listed

tars, and
• calcium aluminate-based cementitious mortars

Three commercially available repair materials from each generic composite type were procured for this research study. The mortars vary in their respective surface preparation requirements, minimum application thicknesses, curing requirements (and durations), surface finishing technique(s), and subsequent surface preparation required to receive a high-performance coating (Table 1 on p. 34). Testing matrices were developed to compare the surface tensile properties of the twelve mortars when applied at their respective minimum recommended thickness.

Bond Strength Testing

The surface tensile strength properties of the selected repair materials—with and without a high-performance topcoat— were assessed in accordance with ASTM D 7234 (Fig. 2).[20] This test method delineates a procedure for evaluating the direct tensile strength (commonly referred to as adhesion) of a coating on concrete (or other cementitious substrate). The test determines either the greatest perpendicular force (normal stress, σ) that a surface area can bear before a plug of material is detached.[21] The uniaxial testing instrument used for this tensile strength assessment was the self-aligning tensile pull-off adhesion tester using 50-mm (2-in.) diameter dollies. Tension was applied until failure was achieved, and the maximum normal stress and the location of the failure were recorded. The peak loading for this instrument using 50-mm diameter loading fixtures (dollies) after conversion is 560 psi. (See sidebar on p. 33)

Failure occurs along the weakest plane within the system. The test results were reported as determined by observing the bottom of the dollies with the following designations:

- *Concrete substrate: A*
- *Mortar: B*
- *Epoxy topcoat: C (where applied)*
- *Adhesive (glue): Y*
- *Loading Fixture (Dolly): Z*

Cohesive failures and the percent of each were denoted as A, B, C, or Y. Adhesive failures by the interfaces at which they occur where denoted A/B, B/C, C/Y, etc.

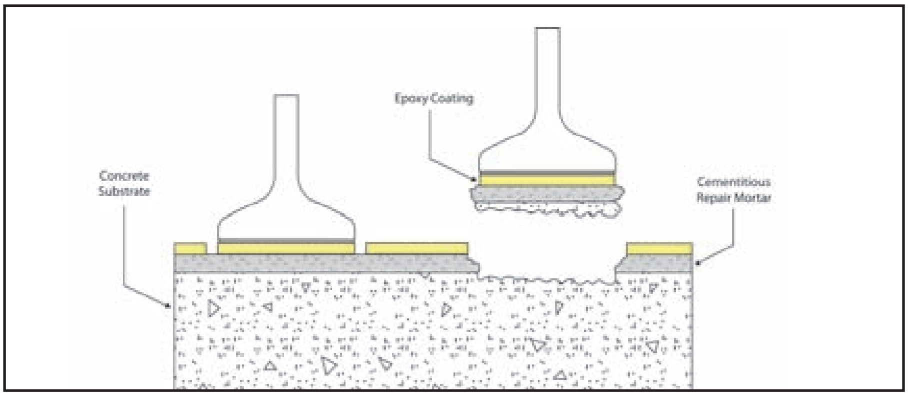


Fig. 2: Tensile strength testing, ASTM D 7234

• Concrete Substrate Panels: In laboratory work it is common to produce a high strength substrate to maximize the chance of obtaining adhesive bond failure as opposed to a tensile (cohesive) failure of the concrete substrate. Non-reinforced concrete panels were cast 24 in. x 24 in. x 2 in. to provide a common substrate for testing. The concrete was a high-strength 5,500 psi Portland Type I design mix conforming to ASTM C 387.[22] The top faces of the panels (exposed side) were finished and membrane cured per ACI 308R[14] using two coats of an acrylic membrane-curing compound conforming to the requirements of ASTM C 309.[23] The concrete panels were both cast and cured in a controlled laboratory environment (72 F and 48% RH) and remained in the forms for 7 days; the panels were demolded and maintained in laboratory conditions. After a period of 28-days, the concrete panels were prepared by dry-abrasive blasting the top face of the panels to an SSPC-SP 13/NACE No. 6 surface condition,[12] and achieving an ICRI-CSP5 surface profile.[24] The concrete substrate panels serve as the parent concrete for our study.

• Epoxy Coating (EP): A high-build, 100% solids, two-component, high-functionality amine epoxy was used as a representative high-performance protective lining used over cementitious mortars in aggressive environments. The epoxy was applied in a single coat to a dry film thickness (DFT) of 30 mils.

This commercially available high-performance lining is recommended for use over concrete and steel in highly corrosive wastewater and other chemically aggressive environments. The suggested thickness range for this product is 30–80 mils DFT. When applied directly to properly prepared concrete, the technical data sheet indicates that the adhesion exceeds the tensile strength of concrete (cohesive concrete failure).

• Concrete Control Panel (CCP): A single, randomly selected concrete substrate panel was withheld for use as a control in accordance with the sampling procedures outlined in ASTM D 3665.[25] The concrete panel was 24 in. x 24 in. x 2 in., finished, membrane cured, and prepared consistent with the panels and methods described above.

The upper-half of the concrete panel—Section A (Fig. 3 on p. 37)—was designated as the Concrete Control Panel-A (CCP-A) and remained unchanged from the surface preparation condition (SSPC-SP 13/NACE No. 6, ICRI-CSP5). CCP-A was used to determine the tensile strength of the concrete control panel. The lower half of the concrete panel section—denoted CCP-B—was topcoated with 30 mils' DFT of the epoxy coating and allowed to cure for 7 days. After the 7-day cure, sections A and B were evaluated for bond strength using methods outlined in ASTM D 7234 using the adhesion tester with 50-mm diameter dollies (Figs. 4a, 4b, and 4c on p. 38). The CCP-B was used to determine the tensile strength of the representative parent concrete substrate using the uniaxial testing instrument when a 100% solids epoxy barrier system was applied directly to the prepared substrate. Both CCP-A and CCP-B serve as the control for this study. The baseline tensile adhesion values are outlined in Fig. 3. As Fig. 3 shows, in the tensile strength tests, all failures of the lined concrete were cohesive, occurring within the concrete, not within the lining or at the lining-concrete interface. Hence, as indicated in the lining manufacturer's data sheet, the lining adhesion exceeded the tensile strength of the concrete substrate. These results confirm that proper preparation and application procedures were followed.

CCP Section	System	Surface Preparation	Avg. Tensile Strength *(psi)*	Failure Mode *(Pull 1)*	Failure Mode *(Pull 2)*	Failure Mode *(Pull 3)*
A	Concrete	SSPC-SP13/ NACE No. 6, ICRI-CSP5	**521**	100% A	100% A	100% A
B	Concrete/ 100% solids EP	SSPC-SP13/ NACE No. 6, ICRI-CSP5	**538**	100% A	100% A	100% A

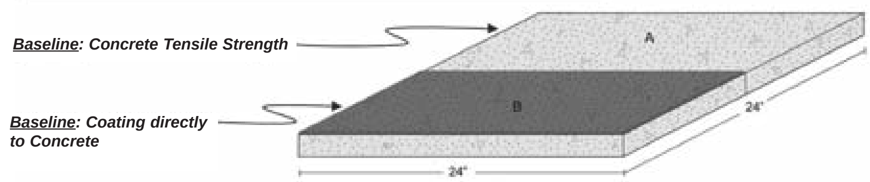


Fig. 3: Concrete control panel–tensile strength

After the tests, the bond strength of broom-finished and mechanically profiled coated mortar test panels would be compared to CCP-B to determine whether or not the coated cementitious repair mortar exhibits properties equal to the coated concrete control, and if finishing technique affects the soundness of the surface of the repair mortar and its ability to properly accept the coating.

Testing Matrices

Two testing matrices were developed to determine which surface finishing technique (e.g., blasted surface or broom finish) maximizes adhesion of the protective lining applied to the twelve repair mortars. The results were then compared to the tensile strength of CCP-B, which represents a coating applied directly to properly prepared concrete.

- Mechanically Profiled Surface Matrix: This testing matrix comprises eight quadrants (concrete panel sections) that compare the bond strengths of the twelve repair mortars by evaluating the influences of curing/no curing, mechanical preparation/no preparation, and topcoating/no topcoating with a high-performance lining system (Fig. 5 on p. 38). Excerpts from the research study on the effects of curing and mechanically profiling these cementitious repair mortars are presented below.[13]

Fig. 4a: Testing surface tensile strength properties using 50-mm-diameter dollies in accordance with ASTM D 7234

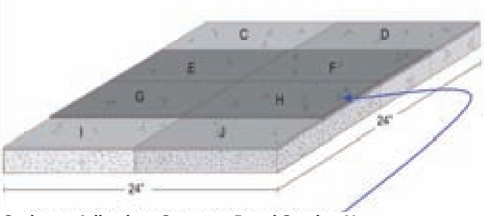
Fig. 4b: Testing surface tensile strength properties of Concrete Control Panel A (SSPC-SP 13/NACE No. 6, ICRI-CSP5 prepared concrete panel) using 50-mm-diameter dollies in accordance with ASTM D 7234.

Fig. 4c: Evaluating surface tensile strength properties of Concrete Control Panel B.

Each of the twelve selected cementitious mortars was applied to the concrete substrate panels at their respective minimum recommended thickness. The concrete panels were first dampened with potable water to achieve a saturated surface dry (SSD) condition. A scrub coat of each mortar was then applied to the prepared concrete substrate panel followed by the immediate application using a rubber float. The mortars were finished using a steel trowel to obtain a smooth, uniform finish. In order to test the effect of mortar hydration with and without external curing, an acrylic membrane-curing compound was applied to half of the mortar (Fig. 5). The left half of the concrete panel—Sections C, E, G, I—received no external curing; the right half of the panel—Sections D, F, H, J—were cured using two coats of an acrylic curing compound in accordance with ACI 308R.

After the proper curing (hydration) period for each respective cementitious mortar, the lower sections G, H, I, J were blasted to an SSPC-SP 13/NACE 6, ICRI-CSP3 profile to remove the curing compound (where used) and weak laitance layer of the mortar (where present). The 100% solids epoxy coating was immediately applied to the middle sections E, F, G, H of the panel and allowed to cure for an additional 7 days.

Concrete Panel Section	Mortar System[1]	Acrylic Membrane Cured (ACI 308)	Subsequent Surface Preparation[2]
C	Concrete/ Mortar X	No	None
D	Concrete/ Mortar X	Yes	None
E	Concrete/ Mortar X/ 100% solids EP	No	None
F	Concrete/ Mortar X/ 100% solids EP	Yes	None
G	Concrete/ Mortar X/ 100% solids EP	No	ICRI-CSP3
H	Concrete/ Mortar X/ 100% solids EP	Yes	ICRI-CSP3
I	Concrete/ Mortar X	No	ICRI-CSP3
J	Concrete/ Mortar X	Yes	ICRI-CSP3



Optimum Adhesion: Concrete Panel Section H determined to yield optimum bond strength

[1]Cementitious Resurfacing Mortars, Refer to Table 1.
[2]Mortar surface preparation to produce an ICRI-CSP3 surface profile.

Fig. 5: Bond strength matrix—trowel finished/mechanically profiled

Following the 7 days' cure of the epoxy coating, each panel section was tested for bond strength using ASTM D 7234 adhesion tester using 50-mm diameter dollies. Each section was tested in triplicate, and an average value was reported for the respective mortars.

• Broom-Finished Surface Matrix: A testing matrix composed of four quadrants (concrete panel sections) was established to assess the effects of broom finishing of the 12 repair mortars with and without topcoating. Each panel section compared the surface bond strength of the mortar upon receiving a broom finish by evaluating both the influences of curing/not curing and topcoating/not topcoating with a high-performance lining on the repaired surface (Fig. 6 on p. 40).

Each of the twelve selected cementitious mortars was applied to the concrete substrate panels at their respective minimum recommended thickness. The concrete panels were first dampened with potable water to achieve a saturated surface dry (SSD) condition. A scrub coat of each mortar was then applied to the concrete panel followed by the immediate application using a rubber float. The mortars were finished using a mason's brush to produce a broom finish profile. In order to test the effect of mortar hydration with and without external curing, an acrylic membrane-curing compound was applied to half of the mortar (Fig. 6 on p. 40).

The left half of the concrete panel—Sections K, M—received no external curing; the right half of the panel—Sections L, N—were cured using two coats of an acrylic curing compound in accordance with ACI 308R. Upon the proper curing (hydration) period for each respective cementitious mortar, the 100% solids epoxy coating was applied directly to the lower sections M, N of the panel and allowed to cure for an additional 7 days. Following the 7 days' cure of the epoxy coating, each panel section was tested for bond strength using ASTM D 7234 adhesion tester using 50-mm diameter dollies (Figs. 7a, 7b, and 7c on p. 40).

Analysis

Blasted (Mechanically Profiled) Surface Matrix

Of the mechanically prepared sections, Concrete Panel Section H (membrane cured and blasted profile) achieved the maximum bond strength when topcoated with a protective lining system. This is not entirely unexpected given that liquid membrane-curing compounds prevent the loss of moisture from the mortar, thereby allowing the development of surface tensile strength properties. Membrane curing is the most practical method of curing vertically- and overhead-placed repair mortars common to wastewater rehabilitation where job conditions are not favorable for wet-curing in accordance with ACI 308R. What's more, membrane curing compounds must be removed prior to the application of the lining system in accordance with guidelines of the protective coatings industry.[12]

Broom-Finished Surface Matrix

Of the broom-finished sections, the results for the twelve cementitious repair mortars suggest that Concrete Panel Section M (broom-finished profile and no membrane curing) achieved the maximum mortar surface bond strength when topcoated with a protective lining system. A few of the mortars actually yielded higher adhesion values in Concrete Panel Section N (broom finished and membrane curing compound). Upon closer examination, it is plausible that the anomalous improvement in tensile strength derived from proper curing exceeded any diminished bonding of the lining system to the mortar by the presence of the membrane "bond breaker." Nevertheless, when canvassing the candidate repair mortars used in this study, it appears that a broom-finished surface is not recommended to receive a membrane curing compound if topcoated

Concrete Panel Section	System[1]	Acrylic Membrane Cured (ACI 308)	Subsequent Surface Preparation
K	Concrete/ Mortar X	No	None
L	Concrete/ Mortar X	Yes	None
M	Concrete/ Mortar X/ 100% solids EP	No	None
N	Concrete/ Mortar X/ 100% solids EP	Yes	None

[1]Cementitious Resurfacing Mortars, Refer to Table 1.

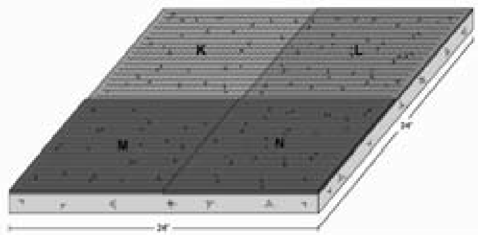


Fig. 6: Bond strength matrix—broom finished

Fig. 7a: Typical broom finish profile using mason's brush

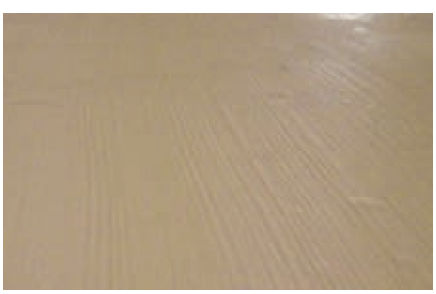


Fig. 7b: Lining over broom-finished mortar

Fig. 7c: Surface tensile strength failure planes were determined by observing the bottom of the 50-mm dollies.

with protective lining systems. That is, a curing membrane is supposed to be removed before coating; otherwise, the membrane may form an adhesion "bond breaker" between the mortar and the topcoat. The advantages of the broom-finished profile would be lost, however, during the required removal of the curing compound.

The results of these testing matrices can now be evaluated to determine which surface finish optimizes the adhesion of a high-performance lining to a cementitious repair mortar. The surface tensile strengths of Concrete Panel Section H *(Prep/Coat)* and Concrete Panel Section M *(Broom Finish/Coat)* have been juxtaposed in Figs. 8–11 (p. 42), along with the Concrete Control Panel B *(CCP-B)*. Recall, the optimum surface tensile strength (pull-off adhesion) value for coatings over mortar test panels in our study is greater than or equal to the adhesion of a high-performance protective lining applied directly to properly prepared concrete (CCP-B). The baseline coating pull-off adhesion for CCP-B for use in our study, is 538 psi (Fig. 3).

Tensile Strength Comparisons of Mortar Panel Sections H vs. M

For each of the four repair composite types tested, Figs. 8–11 compare the coating pull-off adhesion values of Panel H (mechanical preparation) against those of Panel M (broom finish). Figures 8–11 also show the coating adhesion values of panels H and M relative to 538 psi for CCP-B, our baseline coating adhesion value.

Conclusions

Our findings indicate that a blasted (mechanically profiled) surface offers superior adhesion to that of a broom-finished (profiled) surface when preparing cementitious repair mortars to receive high-performance lining systems. In sum, 7 of the 12 mechanically profiled panels had surface tensile strengths equal to or greater than that of properly prepared concrete, as indicated by the coating pull-off adhesion values in Figs. 8–11. In contrast, 8 of the 12 broom-finished mortars yielded near-surface tensile strengths significantly lower than that of properly prepared concrete. Adhesion of coatings over most broom-finished mortars didn't even meet the benchmark surface tensile strength 538 psi of CCP-B Control for the optimum bonding of the lining system. Based on the coating adhesion values, the epoxy cementitious composites were the only mortars that, when broom finished and mechanically profiled, exhibited tensile strengths comparable to each other and to CCP-B.

Further, it was concluded a broom-finished surface generally forms a weak upper surface (laitance) layer on the majority of the cementitious composites tested in this study. This conclusion was drawn from observing a clear pattern of preferential failure in this surface zone, which indicates that the repair material, when broom finished, was generally the weakest link in the repair system. (An exception to this finding was the epoxy cementitious composite, possibly because the epoxy polymerization prevents the formation of the laitance layer.) A laitance layer manifests as a weakened or decreased surface tensile strength compared to properly prepared cementitious mortar, and requires removal in accordance with standards set forth by the protective coatings industry.[11,12]

It should be noted that this study contrasted mortar surfaces prepared to an ICRI-CSP3 profile only to detect a weak upper surface (laitance) layer. Greater surface rugosity (amplitude) may be required by the coatings manufacturer for long-term adhesion performance within wastewater environments.

Buyers beware! Beware of exaggerated claims of experience with surface

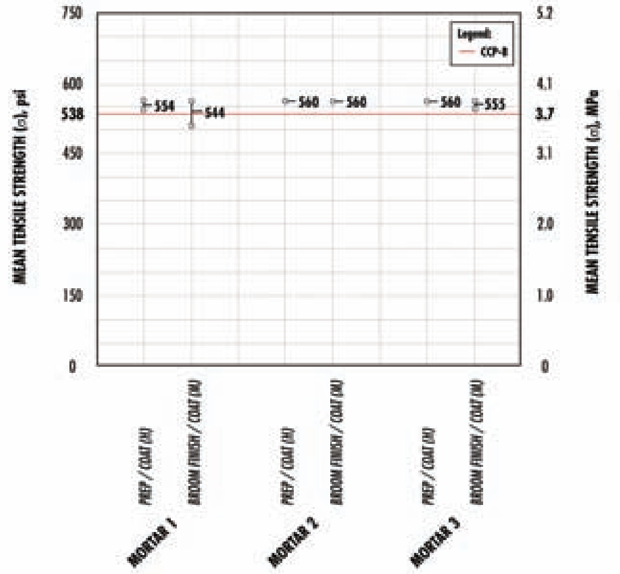


Fig. 8: Epoxy-modified cementitious mortars

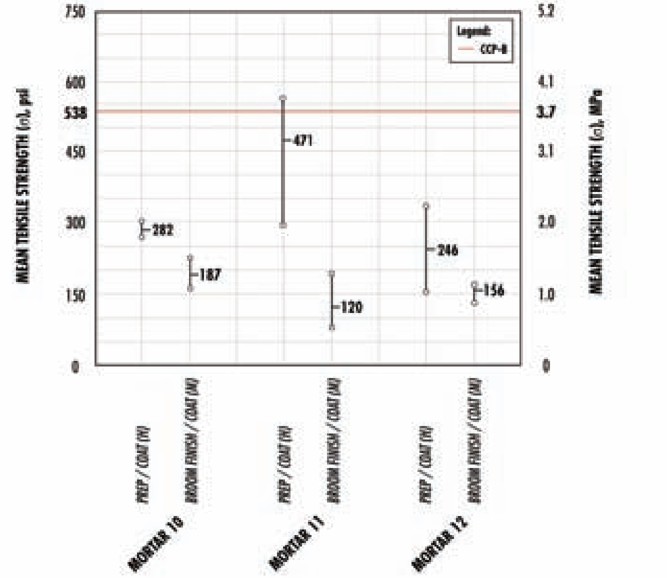


Fig. 11: Calcium aluminate-based cementitious mortars

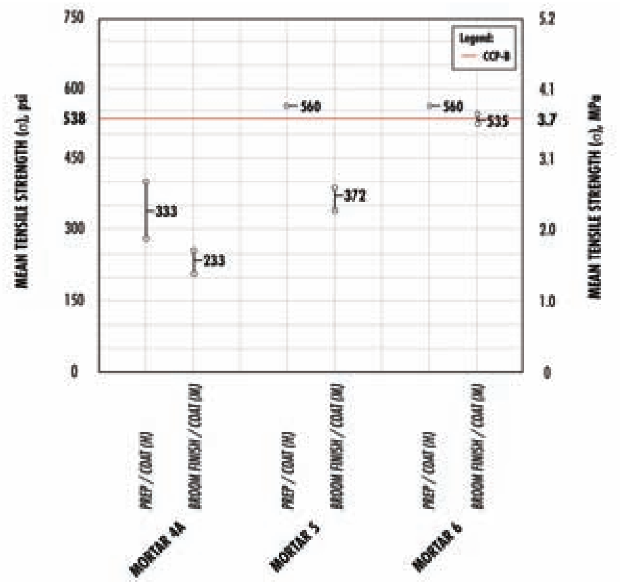


Fig. 9: Acrylic-modified cementitious mortars

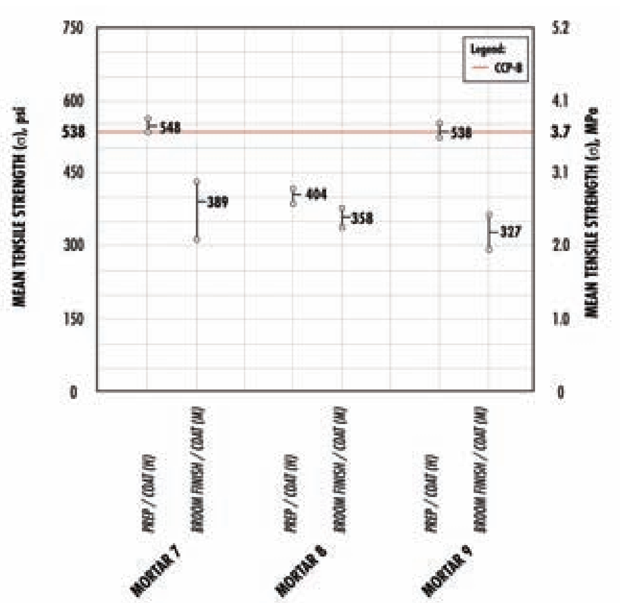


Fig. 10: Portland-based cementitious mortars

finishing of cementitious repair materials. Beware of anecdotal evidence as means of a repair mortar's capability. Beware of crotchets or other forms of unorthodox experience as evidence of success. Instead, request that manufacturers submit testing of compatibility of the entire system in accordance with industry consensus standards. Request that manufacturers provide laboratory testing to substantiate surface finishing and preparation requirements when topcoated with high-performance lining systems. Require manufacturers to provide clear instructions for curing, finishing, and preparation in application instructions and on component labels of cementitious repair materials. And lastly, be diligent and perform testing of onsite mock-ups of candidate cementitious repair mortars when topcoated with high-performance protective lining systems.

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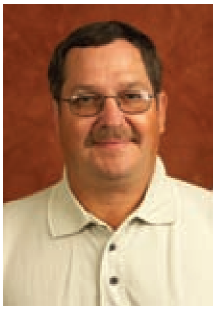

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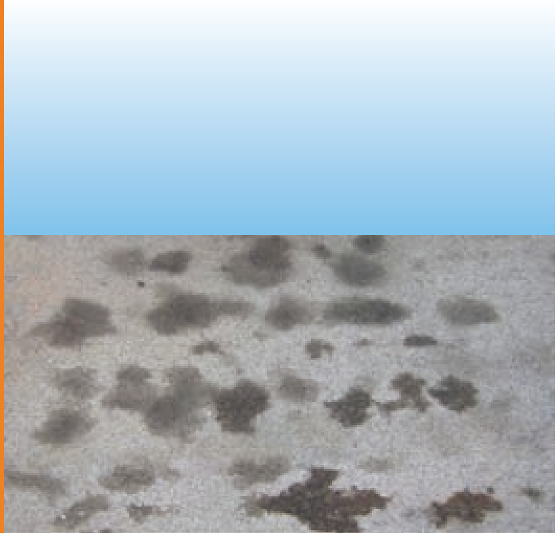
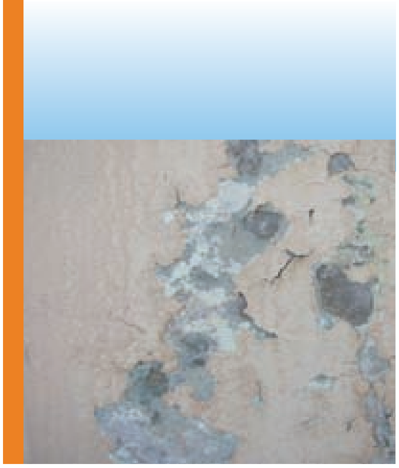

The Basics of Deteriorating Concrete at Wastewater Plants: Tips on Causes, Repair, and Resources

By Heather Bayne, SSPC

Wastewater treatment plants are among the harshest of environments for high-performance protective coatings. In a wastewater facility, there is never only one cause for a structure to degrade; there are numerous causes, and because of the multiple causes, once a structure starts to degrade, it does so rapidly.

This article gives a basic introduction to, and review of, the chemical and other aggressive exposures within wastewater facilities; how the exposures can cause degradation of a structure; how to diagnose a corrosion or deterioration problem; how to repair the structure; and how to prevent corrosion from recurring. The article will use an example of a wastewater clarifying tank made of hydrated Portland cement concrete to illustrate the above.

Corrosive Environments in Wastewater Treatment Tanks

Wastewater clarifying treatment tanks need to be protected and maintained because their environment exposes them, on a daily basis, to chemical attack, abrasion erosion, chloride ion-induced corrosion, and freeze-thaw conditions, summarized below. (For detailed discussions of causes of deterioration in wastewater treatment structures, see R. A. Nixon, "Deterioration of Wastewater Treatment and Collection System Assets," *JPCL,* October 2006, pp. 50–63; and G. Hall, "Out of Sight, Out of Mind, and Often Out of Order," *JPCL,* October 2004, pp. 40–48.)

Photos, top, left to right: Oil contamination (left); coating delamination (center); bare concrete with bugholes exposed (right). Courtesy of SSPC. Photo, bottom: Wastewater clarifying tank (underground). Courtesy of Sauereisen, Inc.

Chemical Attack

Sewage in a wastewater storage tank must receive chemical treatment, biological treatment, or both. The chemicals used are manufactured acids, which, when discharged into the wastewater, lower its pH, causing acid attack of the hydrated Portland cement concrete.

Sewage contains sulfate ions. Sewage traveling through the wastewater systems leaves behind a layer of sludge. The sludge contains sulfate-reducing bacteria (SRB). The SRB react with oxygen in the sulfate ions, forming sulfide ions, which are released back into the wastewater. Through chemical reactions in the wastewater system, the sulfide ions combine with hydrogen to form hydrogen sulfide, which further reacts and forms hydrogen sulfide gas. The gas reduces the pH of the concrete.

Once the concrete pH is reduced from approximately 12 to 9.5, sulfuric acid can be formed. Its formation occurs because at wastewater facilities, the atmosphere around the concrete structures contains moisture and ample oxygen. With the combination of the moisture, oxygen, and lower pH, sulfur oxidizing bacteria (SOB) can colonize on the concrete substrate. The SOB use the oxygen and hydrogen gas present to form sulfuric acid, which will cause acid attack of Portland cement concrete.

Concrete wastewater storage tanks also undergo sulfate attack and carbonation of the concrete in the headspaces. In sulfate attack, the sulfates react with the hydrated Portland cement paste and form a by-product, which promotes expansion of the concrete through solid volume increases. Carbonation is a natural occurrence in concrete exposed to the atmosphere. Carbon dioxide in the atmosphere reacts with the hydroxide in the hydrated Portland cement paste to form a carbonate, which causes shrinkage of the cement paste. Expansion from sulfate attack and contraction from carbonation weaken concrete tanks.

Abrasion and Erosion

Wastewater can also contain suspended solid material, such as sand, rocks, ice, or silt. The solid materials impinge on the surface of a concrete clarifying tank during turbulent water flow conditions, causing an abrasive breakdown of the concrete and leaving a smooth wear pattern on the substrate.

Chloride-Induced Corrosion

When concrete is placed around reinforcing bars (rebar), the steel surface initially corrodes. Then, a tightly adherent oxide film forms over the surface to protect it from further corrosion, provided the film remains intact. The highly alkaline environment of hydrated Portland cement in the concrete can maintain the passive protection film. But the protective film will be destroyed if moisture, chloride ions, and oxygen penetrate pores or cracks to reach the reinforcing steel surface. Local corrosion cells are then established, and rust forms on the surface of the reinforced steel, increasing the volume of steel, which in turn creates tensile forces within the concrete. Because the tensile strength of concrete is relatively weak, the concrete will crack to relieve the tensile stresses. Once the concrete begins to crack, water, oxygen and aggressive chemicals can freely enter the concrete and further attack the embedded rebar, escalating the deterioration.

Heather Bayne is a protective coatings professional in SSPC's Product Development Department, where she is responsible for technical writing, contributing articles to *JPCL*, responding to scientific inquiries, and generally acting as a technical resource for SSPC members. She is a member of SSPC, the American Chemical Society, ASTM, and NACE International. Ms. Bayne is a graduate of the University of Pittsburgh.

Freeze-Thaw Deterioration

It is inevitable that concrete will degrade over time when exposed to differential thermal conditions (cold and hot) and humidity cycling (wet and dry) on opposing sides of the structure or to intermittent water immersion along with freezing temperatures.

When Corrosion Occurs—Steps for Repairing a Wastewater Clarifying Tank

There are four basic steps in the repair of a deteriorated wastewater clarifying tank.

1. Assess the condition of the concrete structure.
2. Diagnose the problem.
3. Develop the repair specification.
4. Develop an inspection and maintenance program.

Step 1—Assess the Condition of the Concrete Structure

A basic understanding of causes of concrete corrosion is essential to performing a successful repair of a concrete tank and its lining system. In addition, if available, the history of the wastewater treatment tank may provide clues to causes of the present condition. A review of the plant's history of operations may reveal periods of high operating temperatures or other aggressive conditions. Answers to questions such as the following may help you diagnose problems.

- When was the tank built?
- What surface preparation method and coating system were used (if any) and when?
- Was there a third party QA inspector during construction or coating of the tank, and is documentation from the inspection available?

If the history of the tank is not available, proceed directly to the next part of assessing the structure, performing a condition survey.

Condition surveys are typically conducted before writing a repair specification. They include comprehensive and systematic visual and analytical analyses of the existing conditions.

There is no one single method or format that may apply for every structure or job; however, the more detailed the survey and the more experienced the surveyor, the more reliable will be the budget and specification prepared from the survey. Some facility owners have their own qualifications and requirements for performing the survey. (Reminder: Though concrete coating assessments and surveys are normally conducted by experienced concrete surveyors, this article is written for those who desire an introduction to, or review of, the survey process.)

The following are two main reasons for periodically conducting surveys of structures in a wastewater facility.

- Detecting early concrete or coating deterioration and gauging its progress
- Determining what maintenance/repair actions may become necessaryj

In general, two basic types of surveys are used to determine the condition of existing concrete structures to formulate plans for maintenance actions: the visual survey and the detailed survey. Each survey type has its own purpose and limitations. In a visual survey (described in this section), a surveyor gathers information through observation, with no testing or sampling. In a detailed survey (see Step 2 on p. 51), a surveyor incorporates the information gathered through the visual survey and investigates deterioration further by collecting samples and conducting tests.

The principals conducting surveys must have expertise in coatings and must carefully follow standard test method procedures.

One tool that can be used when beginning a survey is the ACI 201.1R, *Guide for Making a Condition Survey of Concrete in Service* (American Concrete Institute, www.aci.org). It presents a systematic approach for surveying. It defines 10 types of cracking, 31 types of deterioration, and 17 surface defects, and it contains 49 photographs of concrete distress. Summarized from ACI 201.R, the following guidelines for a minimum walk-through (visual survey) are valid for all concrete substrates but are especially important for wastewater treatment tanks and other structures in severe service.

A minimum walk-through consists of a visual assessment of the overall conditions of substrates and coatings on plant structures. Surveyors record the types, extent, and distribution of defects and failures using standard terms and a standard rating system. Surveyors pay attention to special patterns, such as whether deterioration is concentrated on the sunny side of a structure, on the ocean exposure, near the ground, or in hard-to-reach places. The minimum walk-through is intended to provide a benchmark for comparison with later surveys, including a detailed survey. Key components of a minimum walk-through include, but are not limited to, the following.

- Obtaining all relevant information on the structure, coating and past/present exposure conditions, such as physical exposure, chemical exposure, and temperature
- Determining if the structure has aesthetic value (rarely a concern with wastewater treatment tanks), is primarily an industrial structure, or both, and then visually assessing and documenting the exposure and age of the concrete/coating
- Visually surveying the entire layout of the structure. If knowledgeable facility representatives are available, ask them to accompany you on your preliminary investigation and record their known information as well as your own initial observations. (A tape recorder may be useful.)
- Drawing a diagram of manageable sectioned-off zones
- Photographing all pertinent physical conditions and recording them, per zone

A visual walk-through of a wastewater treatment tank will allow the surveyors to see, for example, if there areas of spalling and pop-outs, indicating chloride-induced rebar corrosion and freeze-thaw deterioration. The headspace of the tank might also show signs of degradation.

Step 2—Diagnose the Problem

After condition assessment, a detailed survey is needed to fully diagnose the problem. In a detailed survey, zones of coated areas (diagrammed in the visual survey) are further subdivided, and physical measurements are made of the coating to assess its condition. Detailing the coating condition includes, but is not limited to, the following actions.

1. Determine and record the condition of the substrate/surface, e.g., cracks or delamination per zone. Tests of bond strength, vapor emissions, pH, and other factors may be needed.

2. Determine and record the depth of contamination by taking a concrete core sample.

3. Determine and record the condition of the protective coating system per zone (if applicable). Coating condition assessment also requires various tests to be performed including a concrete/coating bond/cohesive test. Obtain dry film thickness per SSPC-PA 9 (www.sspc.org) on both failed and intact areas of existing coating.

4. Identify and record the environmental conditions, per zone, under which the coating system will be required to protect the substrate.

5. Measure and record the areas of concrete failure per zone for repair.

6. Measure and record areas of coating failure per zone.

7. Measure and record total surface area to be coated.

8. Prioritize repair/coating time lines per zone.

9. Take samples of the substrate, coating, corrosion by-products, and other contaminants per zone if required for laboratory analysis.

10. Write a comprehensive analysis of findings based on all acquired accurate information

A detailed survey of a wastewater clarifying tank may, for example, indicate that moisture is present (to be expected), that degradation from an acidic environment due to an acidic pH has taken place in the headspace area, and that the existing coating on the structure is an epoxy (could be determined by laboratory analysis of a paint chip sample from the site). Core samples from each deteriorated area may give further diagnostic information, such as the quality of the adhesion of the existing coating and the porosity of the concrete matrix.

Step 3—How to Repair a Deteriorated Structure?

Once the cause of corrosion is known, a repair method can be developed. Below is a summary of general steps for surface preparation of the substrate and substrate repair (which includes installing repair materials and protective coatings). The sidebar describes measures for repairing deterioration caused by rebar corrosion.

- Surface Preparation Basics: SSPC-SP 13/NACE No. 6, “Surface Preparation of Concrete” (www.sspc.org), provides a detailed description of surface preparation and should be consulted. SSPC-SP 13/NACE No. 6 is relevant to preparing all concrete for lining but is especially critical for concrete in severe service such as wastewater treatment. The standard is summarized below.

The mechanical bond between the substrate and the coating system is

Repairing Chloride-Induced Rebar Corrosion

Chloride-induced corrosion of rebar is a common cause of concrete degradation and must be addressed before further repair measures can be taken. This form of corrosion is usually displayed as spalling on the concrete surface. Spalling is the chipping or fragmenting of a surface or surface coating caused by differential thermal expansion or contraction. Rebar corrosion is often found in wastewater clarifying tanks. To repair concrete and rebar after chloride-induced corrosion, follow ICRI Guideline No. 310.1 (International Concrete Repair Institute, www.icri.org), summarized below.

1. Remove all concrete that is loose or delaminating.
2. Undercut exposed corroded rebar by creating a minimum ¾-inch clearance between the exposed rebar and surrounding concrete.
3. Extend concrete removal along the rebar until an area is reached that is free of bond-inhibiting corrosion and is well bonded to surrounding concrete.
4. Take care to not disrupt non-corroded rebar exposed during undercutting.
5. Secure loose reinforcement to secured bars.
6. Remove corrosion from rebar by abrasive blasting.
7. Repair concrete using an appropriate material that also contains an inhibitor for chloride-induced corrosion.

One class of inhibitors—penetrating corrosion inhibitors—can be used in several ways to slow chloride-induced rebar corrosion. For example, a liquid amino alcohol-based penetrating corrosion inhibitor additive can be incorporated into the concrete aggregate, sprayed directly onto the finished concrete surface, or drilled into an existing structure to effectively decrease the rebar corrosion.

For the drilling method, a hole is drilled into the cured concrete structure and the additive is inserted into the hole. The hole is then repaired using a cementitious mortar. When the penetrating corrosion inhibitor reaches the rebar, it forms a protective layer around the steel.

It should also be noted that the effectiveness of chloride-induced corrosion inhibitors is dependent upon the permeability of the concrete and the amount of inhibitor reaching the rebar. This corrosion prevention method is fairly new; therefore, only a small amount of published literature on its effectiveness is available.

essential to secure functionality. To achieve proper adhesion and prevention of corrosion of a substrate, several surface cleaning and preparation methods should be chosen, based on the condition of the concrete and the requirements of the coating system to be applied. (All prepared concrete surfaces need to be repaired to the level required by the coating system in the intended service condition.)

One of the first steps when preparing a concrete surface is removal of protrusions such as burrs, sharp edges, fins, and concrete spatter. All concrete that is not sound must be removed. All contamination, form-release agents, efflorescence, curing compounds, and existing coatings determined to be incompatible with the coating to be applied must be removed. Detergent water cleaning and steam cleaning are used to remove oils and grease from concrete. Power tool methods, including circular grinding, sanding, and wire brushing, can remove existing coatings, laitance, other weak concrete, and protrusions in concrete. Impact-tool methods are also used to remove existing coatings, laitance, and weak concrete. These methods include scarifying, planing, scabbling, and rotary peening.

Dry or wet abrasive blasting, vacuum-assisted abrasive blasting, shot blasting, and water jetting are also among the methods that can be used to remove contaminants, laitance, and weak concrete, to expose subsurface voids, and to produce a sound concrete surface with adequate profile and surface porosity.

The acceptance criteria for concrete surfaces after surface preparation should be specified, but SSPC-SP 13/NACE No. 6 provides some guidance.

Where concrete deterioration is severe, structural integrity may need to be restored prior to application of protective lining barriers.

- Repair Basics: To improve a porous concrete matrix in a deteriorating waste-water clarifying tank, filler compounds are used to fill voids, irregularities, and air pockets in the concrete. A filler compound is a viscous material that has the consistency of a "putty" and is applied using a smooth plasterer's rubber float trowel. Once the material is applied, any excess material is removed using the edge of the rubber float trowel.

Once the voids, irregularities and air pockets are filled, creating a (relatively) smooth surface, it is necessary to fill in any cracks that would allow water infiltration. This is accomplished be use of rapid-setting mortar or hydroactive grouts. The material is mixed and immediately applied

Table 1: Repair Products

Material	Fast Set	High Strength	High Elasticity	Application Method	Purpose
Portland Cement and Modified Calcium Aluminate	✔	✔		Gunite, trowel, cast-in-place	Resurfacer
Portland-based Cementitious		✔		Pumpable for wet-spray application	Resurfacer
Hydraulic Water Plug	✔			Hand	Waterproofing
Catalyzed Hydrophobic Injection Liquid	✔	✔		Injection	Waterproofing
Elastomeric Asphalt Modified Urethane Lining			✔	By hand using a glove	Waterproofing

by injection to the area displaying leakage.

Table 1 lists some repair products used for the interior of a wastewater tank. [*Editor's note: For a detailed study of surface preparation of repair materials before lining application in wastewater environments, see the article by V. O'Dea in this issue on pp. 32–45.*]

One approach to repairing and resurfacing a wastewater clarifying tank is to use a Portland cement and modified calcium aluminate material. This fast-set material might be chosen if a quick return to service is needed. The material can be applied by trowel and can cure within 5 hours. Once the resurfacer cures, the tank should be checked for areas of water infiltration. If water infiltration is found, the affected areas can be corrected by injecting a catalyzed hydrophobic liquid. For the headspace of the tank, an elastomeric asphalt-modified urethane lining can be applied by hand using a glove. Because the headspace is prone to deterioration from hydrogen sulfide gas, the urethane system could be chosen for its strong resistance to this gas.

Once a proper substrate barrier exists, it is time to apply a protective coating system. Depending on the coating system chosen, application can be accomplished by trowel, airless spray, or plural-component spray. The coating system should be applied per the manufacturer's product data sheet (PDS) to ensure optimum physical properties and a uniform surface without pinholes or holidays.

For wastewater clarifying treatment tanks, the chemical resistance of the coating is extremely important. Epoxy coatings offer a high degree of chemical resistance and ease of application if the surface is prepared and the coating is applied appropriately. For example, two to three coats of a polyamide epoxy might be suitable for lining a wastewater tank.

Other coating technologies such as polyureas, urethanes, and vinyl esters also offer a high degree of chemical resistance, but often are not environmentally friendly or easily applied. You can consult

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coating manufacturers and other experts for all commonly recommended protective coatings for concrete substrates and wastewater treatment facilities, in particular. Be sure to ask about the advantages and disadvantages of each system.

Step 4—Develop an Inspection and Maintenance Program

To reduce costly and timely repairs, it is important to develop an inspection and maintenance program for the structure. Again, such a program is relevant to any structure but is particularly important for structures in severe service such as wastewater treatment tanks.

The inspection and maintenance program should include a procedure for conducting surveys of structures in a wastewater facility periodically to enable early detection of concrete or coating deterioration.

A tool that can be used to help develop a quality inspection and maintenance program is the *SSPC Guide for Planning Coatings Inspection* (www.sspc.org). It is intended to assist coating and lining inspection companies, contractor quality control (QC) personnel, and owners in developing a key tool to ensure that coating and lining inspection is the best it can be. This tool will provide the contractor with guidance on how to plan to do comprehensive QC, which will provide a record of objective evidence that the work has met contract requirements.

The quality inspection and maintenance program should consist of inspection hold points, which are critical periods during the project when work is stopped until the work-to-date has been inspected and the contractor has been authorized to proceed. Hold points will vary, but the ones listed here should be considered as basic for most work, including wastewater treatment tank jobs.

- Pre-Surface Preparation
- Post-Surface Preparation
- Coating Conditions for Application
- Coating Application
- Post-Application of Coating
- Post-Curing

Summary

Wastewater treatment creates severely corrosive environments that call for protection of all structures at wastewater plants. This article gave an overview of concrete deterioration, diagnosis of its causes, repair, and prevention, using a concrete clarifying tank to illustrate key points. If corrosion is detected on a structure, it is important to determine what the cause of corrosion is and create a repair method to stop corrosion from continuing or recurring. There are steps that can be taken to prevent corrosion or detect it in its early stages to reduce structural problems and the costs of their repair. **JPCL**

SSPC Training Spans the Globe

SSPC has reported on five of its courses held recently in Asia and the U.S.

The Abrasive Blasting (C7) Class was held in Singapore, July 21–22, 2009. The class, hosted by Ash Marine Pte Ltd. (SSPC-QP 1-certified), was led by SSPC Instructor Tom Jones. This was the first C7 class to be held in Singapore.

SSPC also held two of its training courses in Japan, both at the U.S. Naval Ship Repair Facility in Yokosuka. Both courses were led by SSPC instructor Tom Jones. The first was SSPC's Abrasive Blasting Program (C7), held July 27–28. Twelve students attended. The second course was the Marine Plural Component Program (MPCAC), held July 29–30. Fourteen students attended.

On July 20–25, SSPC held its Protective Coatings Inspector (PCI) Course. Hosted by KTA-Tator, Inc. in Pittsburgh, PA, 20 students attended the class. Bill Corbett of KTA and Heather Bayne of SSPC were the instructors. There are 325 certified PCI inspectors around the world.

Chris Lovelace taught an SSPC Lead Paint Removal (C-3) Class in July 2009 in Duluth, GA. Eighteen students attended. To date, SSPC has trained over 3,100 Lead Paint Removal Supervisors.

SSPC's C-7 (left) and MPCAC (right) Courses at the U.S. Naval Ship Repair Facility, held in July in Yokosuka, Japan. Tom Jones was the instructor for both.

(Above): Ash Marine Pte. Ltd. hosted the C-7 Course in Singapore in July. (Top Right): Lead Paint Removal (C-3) Course, held in Duluth, GA, in July. (Bottom Right): Also in July, KTA-Tator hosted the PCI Course at its Pittsburgh, PA, facility.

Facility Owner Reviewers Sought for Standards Committees

Facility owners who have purchased or specified polyurea or polyurethane coatings are encouraged to join the reviewing groups within the polyurethane and polyurea committees that are developing three new SSPC performance-based standards for these coatings. Owner representatives are needed to balance the number of coating manufacturer representatives who have already expressed interest in being voting members of these committees. Until a balance of user and supplier representatives is achieved, no additional coating manufacturer/supplier representatives can be accepted as voting members on these committees at this time.

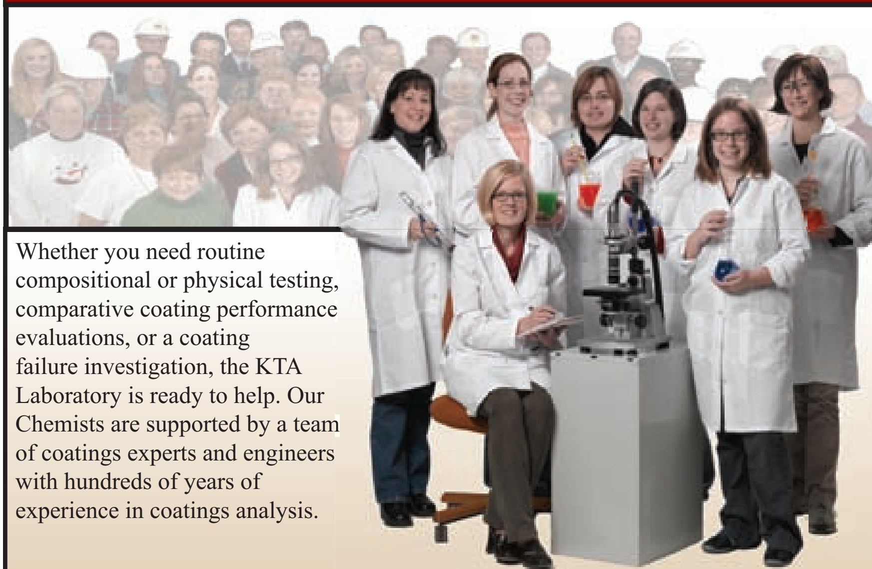
The standards are as follows.

- Three-Coat Moisture-Cure Polyurethane Coating System, Performance-Based (development project through the C.1.3.D Polyurethane Coatings Committee)
- Standard for Two-Component, Aromatic Thick-Film Polyurea and Polyurea/Polyurethane Hybrid Coating Systems, Performance-Based (>50 mil DFT) (development project through the C.1.9 Polyurea Coatings Committee)
- Standard for Applying Polyurea and/or Polyurethane Thick Film Coatings to Concrete and Steel (development project through the C.1.9 Polyurea Coatings Committee)

To join the reviewing groups, contact Aimée Beggs at beggs@sspc.org.

SSPC to Revise QP 1 in 2009

SSPC is planning to begin revising SSPC-QP 1, Standard Procedure for Evaluating Painting Contractors (Field Application to Complex Industrial Structures), in September 2009. Those persons interested in participating in the review process should contact SSPC—tel: 412-281-2331. Facility owners using QP 1 are encouraged to participate.



On Units for Measuring Chloride Contamination

I thoroughly enjoyed the article "Accelerated Corrosion of a Pedestrian Bridge" in the June 2009 issue (Cases from the F-Files, pp. 9—15). I would like to suggest, however, that the use of the "parts per million" (ppm) measure of the chloride surface contaminant analysis might be more useful and more aptly suited if it were instead converted to a microgram per square centimeter presentation. PPM indicates only an amount of chloride in a solution and does not relate a particular quantity for a specific surface area. To be of real value, the measurement should identify a quantity of chloride for a given area. Here in the U.S., the commonly used measure is micrograms per square centimeter, and, in Europe, it is common to state the level in milligrams per square meter.

Regis Doucette, Chlor*Rid International

The Author Responds

Thank you for your comments. You are correct that micrograms/cm^2 (milligrams/m^2) is more meaningful when describing surface concentrations of chloride contamination. However, since the sample collected was not a surface sample, but rather corrosion and coating products removed from the structure, the actual surface area was unknown, which is why the results were reported in ppm. The concentration is based upon the weight of the sample tested.

Cynthia O'Malley, KTA-Tator, Inc.

Editor's Note: Letters to the editor should be addressed to Karen Kapsanis, editor, *JPCL*, kkapsanis@protectivecoatings.com; 2100 Wharton Street, Suite 310, Pittsburgh, PA 15203. Letters intended for publication should be so marked. *JPCL* reserves the right to publish such letters at the editor's discretion, to edit letters for length and conformity to *JPCL* style, and to allow authors of articles the opportunity to read the letter and respond in these pages.

Custom Platform Was Key in Lining Power Plant Stack

By Daryl Fleming, Assistant Editor, *JPCL*

A 450-foot-tall chimney at a lignite-coal-fired power plant in Texas was blasted, cleaned, lined with insulating block for corrosion protection, and inspected, all with the aid of a powered float platform custom-designed for the job. The round platform, 31 feet in diameter, provided workers with close access to the interior wall of the plant's stack. The lining work was performed at the newly constructed power plant from September 2008 through January 2009 and from March through June 2009. As of press time, the plant is "in commissioning"—producing electricity during test runs.

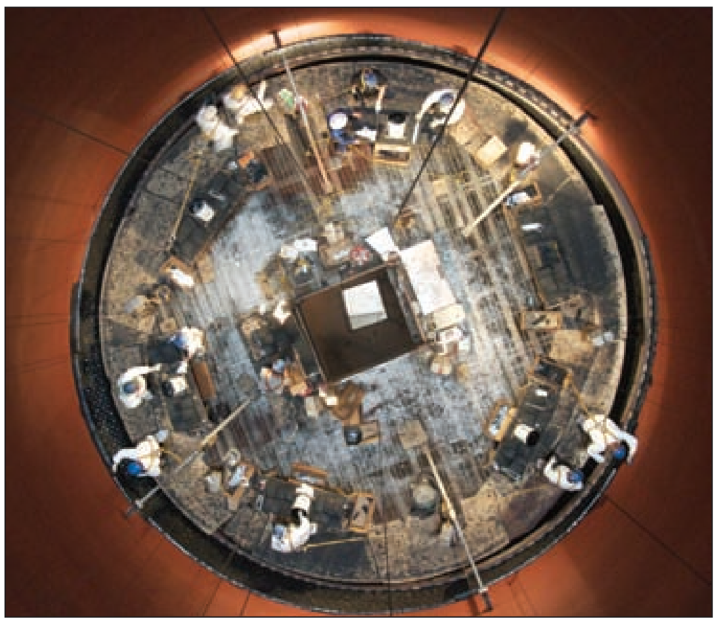


Fig. 1: Viewed from above, the custom-designed work platform. Note the many workers on the platform at once, and the four-foot-square hole in the center of the platform. Photos courtesy of Hadek Protective Systems

The work platform, equipped with nine traction hoists and having a 13,500 lb capacity, was designed and installed by a large North American manufacturer and distributor of access and safety equipment (Fig. 1). The platform was supported by nine wire ropes connected to structural steel installed at the top of the chimney. This steel was removed once the chimney was lined.

A four-foot-square access hole at the center of the work platform with an attached independent work basket allowed workers and materials to be transported from the ground beneath the platform to its topside while the platform remained at the desired work elevation. This feature was essential because the material used to adhere the insulating block to the steel interior wall of the chimney had to be mixed at ground level and quickly transported back to the platform for application.

Another key feature of the platform was its grated decking, which allowed the abrasive material to sift through the platform during surface preparation.

Additional lining work was performed on the breaching duct to the stack (the extension of the duct from chimney shell to chimney flue). This section was accessed by "conventional" scaffolding.

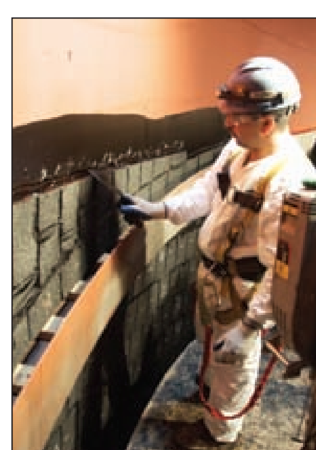


Fig. 2: A block layer applies blocks around that ring collector—part of the liquid collection system necessary in a wet stack.

The lining work began by controlling and maintaining ambient conditions; all the openings in the stack were closed so that work was largely unaffected by the weather, which the contractor reports included high temperatures, humidity, heavy rains, and high winds. The temperature variations were tackled with the use of high-capacity environmental control equipment, including heaters, dehumidifiers, and air conditioners. Three times per shift, temperature and humidity measurements were taken and documented using electronic equipment. Despite heavy rainfall and high winds, only one workday was reportedly lost, and that was because of lightning, according to the contractor.

Once the proper ambient conditions were achieved, the steel surface of the stack interior was abrasive blasted with red garnet size 30/60. The substrate was blasted to SSPC-SP 10/NACE No. 2, Near-White Blast Cleaning, with a profile of 1.5–2 mils. After blasting, abrasive was vacuumed from the stack interior floor, the steel substrate was cleaned using shop-vacs, an inspection was carried out, and any weld seams greater than 3 mm (⅛ in.) were ground to avoid offset in the block installation.

After the inspection, the clean substrate was primed with an etching red wash primer. The 15%-solids-containing primer was spray-applied to a wet film thickness of 5—10 mils and a dry film thickness of 0.6—1.1 mils.

Once the primed substrate was inspected, the blocks were applied using an adhesive membrane (a two-component urethane-asphalt mastic), to bond the block to the substrate. A "double buttering" technique is used, when applying the blocks. All joints, side and back joints, have a minimum thickness of ⅛ in. (Fig. 2). According to the company that markets it, the block is an inorganic foamed borosilicate glass block, lightweight and impermeable to acidic liquid and gasses. The total installed weight is less than 3 lb/sq ft, the lining contractor says.

Fig. 3: A view of the stack with lining work complete

An inspector from the lining contractor carried out continuous quality inspections during abrasive blasting, priming, and the block installation process. After block application, a final inspection of the lining was carried out, and any necessary repairs were done. No additional coatings were applied on the blocks (Fig. 3).

A representative from the general contractor (more precisely, the engineering procurement and construction company, or EPC) reports that the subcontracted block lining work on the stack was done well and on schedule. The lining contractor reports that the work performed from September 2008 through January 2009 was completed on schedule, but that more personnel than initially planned were required to meet the deadline; and that the work performed from March through June of this year was completed 10 days ahead of schedule.

Hadek Protective Systems (offices in Rotterdam, The Netherlands, and Pittsburgh, PA) performed the block lining work at the power plant. Spider, a division of SafeWorks (Seattle, WA), designed and installed the work platform and all scaffolding. The abrasive blasting equipment was supplied by Marco (Houston, TX). Henkel Corporation (Lester, PA) manufactures the block lining system.

associations

WEFTEC Celebrates Its 82nd Year in Orlando

The Water Environment Federation (WEF) will hold its 82nd annual technical exhibition and conference, WEFTEC.09, this fall. The conference portion is scheduled for October 10–14 and the exhibition is set for October 12–14, both at the Orange County Convention Center in Orlando, FL.

Photo courtesy of Orange County Convention Center, Orlando, FL

WEF describes this event as a leading source for water quality developments, research, regulations, solutions, and cutting-edge technologies. The Federation expects more than 20,000 water and wastewater professionals to attend, including collection systems manager, consultants, environmental engineers, chemists, scientists, equipment manufacturers, suppliers, utility managers, and more.

According to the Federation, there will be approximately 122 technical sessions, 31 workshops, and 9 facility tours. Attendees can earn up to 35 contact hours for a maximum of 2.6 CEUs and 9 PDHs.

One workshop that might be of interest to professionals in the industrial maintenance coatings field is W205 WEF/WERF Understanding Odor and Corrosion in Collection Systems: The State of the Science. This workshop will take place on Sunday, October 11 from 8:30 a.m. to 5:00 p.m. and is worth 0.6 CEUs. The chair and co-chair are Raymond Porter and Matthew Ward, respectively.

Some of the issues to be addressed are odor and corrosion assessment, measurement, characterizations, monitoring, and prevention. Scheduled presentations and presenters are as follows:

- Greetings and Introduction, Ray Porter, CH2M HILL
- Overview of Odor and Corrosion in Collection Systems, Jim Joyce, OCTC
- Liquid Phase Treatment of Dissolved Sulfide, Chris Easter, CH2M HILL
- Gas Phase Treatment Systems for Collection Systems, Bob Bowker, Bowker & Associates
- Air Flow Movement in the Headspace of the Sewer, P. Wolstenholme, B&C
- Overview of Phase 2 WERF Research Activities, Dirk Apgar, King
- Research Gap—Movement of Air, Matthew Ward, CH2M HILL
- Research Gap—Compounds other than H2S, Rob Morton, LACSD
- Participants' Break-Out Session and Workshop Project, Ray Porter, CH2M HILL

In this session, participants will be asked to solve a workshop problem, requiring them to build upon knowledge gathered from the workshop. The workshop is designed for owners, operators, consultants, and professionals who want to understand odor and corrosion in the collection system.

WEF expects over 1,000 companies in the exhibition this year. Among them, several coatings and related companies that serve the water and wastewater industry will exhibit. The following are brief descriptions and booth numbers for some of the companies known to *JPCL* at press time.

- A.W. Chesterton Company (Groveland, MA) provides sealing devices, wear, and corrosion coatings. Booth #4415, Hall B
- AP/M Permaform/ConShield Technologies (Johnston, IA) will exhibit Centrifugally Cast Concrete Pipe (CCCP) with PL-8000 concrete liner, Permacast for manhole renewal, and ConShield, an additive for concrete that stops microbiological corrosion. Booth #3303, Hall A
- Carboline Company (Saint Louis, MO) offers coatings, such as chemically-resistant linings and coatings with high-performance finishes. Booth #2888, Hall A
- C.I.M. Industries, Inc. (Peterborough, NH) will have its CIM 1000 coating on display, as well as other elastomeric linings for concrete. Booth #2803, Hall A
- Concrete Sealants, Inc. (New Carlisle, OH) is a manufacturer of sealants to the concrete construction industry, including NSF-listed sealants and damp-proof coatings. Booth #2078, Hall A

Continued

News

Photo courtesy of Induron Coatings Inc.

• Induron Coatings Inc. (Birmingham, AL) will exhibit its line of ceramic epoxy coatings. Permasafe 100 is a solvent-free, immersion-grade lining, and Ceramasafe 90 is a high-solids, immersion-grade cycloaliphatic amine epoxy coating. Both are designed for corrosion protection of steel and concrete. Booth #2918, Hall A

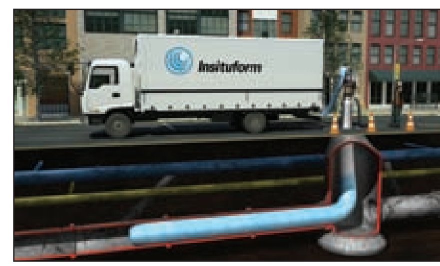


Photo courtesy of Insituform Technologies, Inc.

• Insituform Technologies, Inc. (Chesterfield, MO) specializes in trenchless technologies for the rehabilitation of underground pipelines and is the pioneer of the cured-in-place pipe (CIPP) industry. Booth #4005, Hall B

• Prime Resins, Inc. (Conyers, GA) makes chemical grouts that stop leaks in manholes, sewer pipes, cofferdams, reservoirs, and tanks. The company also makes pumps and injection accessories. Booth #3309, Hall A

• Quadex Inc. (N. Little Rock, AR) is a manufacturer and supplier of engineered protective coating systems for use in structural restoration of wastewater manholes, pump stations, and treatment plant structures. Booth #4104, Hall B

Photo courtesy of RLS Solutions Inc.

• RLS Solutions Inc. (Broken Arrow, OK) will display its Raven and AquataPoxy lines of 100%-solids epoxy coating solutions for the protection and renewal of water and wastewater infrastructures. Booth #1639, Hall A

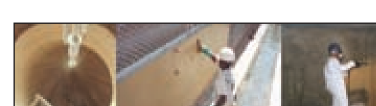


Photo courtesy of Sauereisen, Inc.

• Sauereisen, Inc. (Pittsburgh, PA) specializes in protective materials for municipal wastewater infrastructure. Products include substrate repair materials, cementitious sealants, and polymer linings. Booth #3010, Hall A

• The Sherwin-Williams Company (Cleveland, OH) offers a complete line of coatings and linings for municipal and industrial water and wastewater treatment facilities. Booth #4033, Hall B

• Spectrashield Liner Systems (Jacksonville, FL) will exhibit its patented SpectraShield® liner, which is a spray-applied, silicone-modified polyurea system used to rehabilitate and protect wastewater structures. It is a multi-layered system. Booth #2932, Hall A

Photo courtesy of SpectraShield Liner Systems

Photo courtesy of Wasser

Photo courtesy of Sprayroq

• Sprayroq, Inc. (Birmingham, AL) will display Sprayshield Green, an environmentally friendly, renewable compound used for corrosion coatings in municipal wastewater collection and treatment systems. Booth #4114, Hall B

• SSPC: The Society for Protective Coatings (Pittsburgh, PA) will have information about upcoming conferences and training courses, as well as the advantages of its professional certification programs. Booth #4062, Hall B

• Tnemec Company, Inc. (Kansas City, MO) offers high-performance lining systems for the protection of steel and concrete infrastructure for severe wastewater environments, including 100% solids epoxies and specialty concrete resurfacing materials. Booth #4103, Hall B

• Wasser (Auburn, WA) will exhibit Polyflex 201 PW (NSF 61), a high-performance polyurea coating with zero VOCs, and MC-TAR 100, a moisture-cure urethane with a low VOC rating. Booth #3528, Hall B

For more information, or to register for WEFTEC.09, visit www.weftec.org.

Continued

Three New Fall Standards Unveiled

The American Society of Safety Engineers (ASSE) recently announced that the American National Standards Institute (ANSI) has approved three new fall protection standards aimed at preventing three significant workplace exposures and hazards: slips, trips, and falls. The three standards are ANSI/ASSE Z359.6-2009, "Specification and Design Requirements for Active Fall Protection Systems"; ANSI/ASSE Z359.12-2009, "Connecting Components for Personal Fall Arrest Systems"; and ANSI/ASSE Z359.13-2009, "Personal Energy Absorbers and Energy Absorbing Lanyards." The documents are voluntary consensus standards.

Citing the Bureau of Labor Statistics (BLS), ASSE says that out of the 5,657 fatal on-the-job injuries in 2007, 847 were attributed to falls. Aimed at preventing injuries and death due to falls, ANSI/ASSE Z359.6-2009 specifies requirements for the design and performance of complete active fall protection systems, including travel-restraint and vertical-horizontal fall-arrest systems. ANSI/ASSE Z359.12-2009 establishes requirements for the performance, design, marking, and qualification of connectors as well as requirements for test methods for them and for their removal from service.

The intention of the ANSI/ASSE Z359.13-2009 standard is to require all energy-absorbing lanyards and personal energy absorbers to reduce the forces implied on the user to less than 10 times the normal gravitational pull of the earth.

"Years in the making, Z359.12 and Z359.13 expand on existing standards in which connecting devices and personal energy absorbers were initially addressed," said Randall Wingfield, the ANSI/ASSE Z359 Accredited Standards Committee (ASC) Chair and president and CEO of Gravitec Systems Inc. "Standards devoted solely to these components were necessary because new research and testing have provided us with a better understanding of how these products are used. The new Z359.6 standard tackles fall protection systems design for the first time and is intended for engineers with expertise in this area."

The three new standards will be available soon and will become part of the ASSE Fall Protection Code, with an effective date of November 16, 2009. The ASSE Fall Protection Code currently includes six standards.

Founded in 1911, the Des Plaines, IL-based ASSE is a professional safety organization committed to protecting people, property, and the environment.

ASTM Provides Instant Access to Standards

ASTM International (W. Conshohocken, PA) now offers web portals, powered by Citation®, that are interactive sites, including a specific collection of ASTM standards and other standards and documents chosen by the user. The portals allow users to link between standards, add notes for others to view, and make side-by-side comparisons. Currently, biodiesel and environmental due diligence and transportation are available, with more sector-specific portals under development.

For more information and a free demo, visit www.astmproducts.com/portal.html.

CPMA Elects Chairs, Board Members

The Color Pigments Manufacturers Association, Inc. (CPMA) elected new chairs and board members at the Annual Meeting in Washington, D.C., on June 16. Luiz Vieira of EMD Chemicals Inc. was elected to a two-year term as chairman and Dan Van Kampen of FlintGroup Pigments was elected to a two-year term as vice chairman. Vieira served as the vice chairman for the past two years and Van Kampen was a member of the CPMA Board of Governors.

Luiz Vieira

J. Lawrence Robinson was reelected as president, secretary, and treasurer for another one-year term. Also elected to serve one-year terms as members of the Board of Governors were Mike Klein (Dominion Colour), Chuck Jones (Clariant Corporation), Bob Lane (The Shepherd Color Company), Dave Klebine (Apollo Colors), Myron Petruch (Sun Chemical Corporation), Dan Swiler (Ferro Corporation), Roger

Online Registration Open for Coating East

Coating East 2009 will be held on September 30 and October 1, 2009, at the Gaylord Opryland Resort in Nashville, TN. Registration for the technical conference programming is now open and available at www.thecoatingshow.com.

Twenty-five conference sessions are planned covering pretreatment technologies, liquid coating technologies, corrosion testing, powder coating, and related topics. A representative of Harley-Davidson will give the keynote address. Two plant tours are also planned and are available on a limited basis. One is a tour of MetoKote's plant in Lebanon,TN, where attendees will see the monorail electrocoating lines and a powder coating line. The second tour is of A.O. Smith's Ashland City facility to see porcelain enamel and liquid painting lines in operation.

Coating East 2009 is sponsored by the Powder Coating Institute and Chemical Coaters Association International.

Weaving (Aceto Corporation), and Phil Webb (BASF). Continuing on the Board is Ron Levi (Bruchsaler Farbenfabrik GmbH & Co.)

NACE Starts New Inspector Course

In June, NACE International held the first of its new Nuclear Power Plant Training for Coating Inspectors course at its headquarters in Houston, TX. The week-long course stressed the challenges presented by the restrictive and safety-related environment of nuclear power plants and covered 30 ASTM and ANSI standards as well as legal requirements, plant operations, and more.

The new course will be offered every other month at NACE headquarters and several times a year at various locations in North America, Asia, and Western Europe.

For more information, visit www.nace.org.

Safety Engineers to Host Conference

The Central Florida Chapter of the American Society of Safety Engineers (ASSE) will host a one-day ergonomics professional development conference on November 4, 2009, at the Orlando Repertory Theater. The conference is to identify and reduce exposures to risk factors that cause work-related musculoskeletal disorders. The conference will include two general sessions and four concurrent sessions.

Visit http://centralfl.asse.org for details.

ASTM Updates G85 Salt Fog Standard

ASTM International announced in August that it revised ASTM G85, Standard Practice for Modified Salt Spray Fog Testing. The practice is suitable for ferrous and nonferrous metals as well as to organic and inorganic coatings. The variations described in the modified standard are useful when a different or more corrosive environment than the salt fog described in Practice B 117 is desired, says ASTM.

According to the scope of G85, the practice describes five modifications in salt spray (fog) testing: continuous acetic acid-salt spray, cyclic acidified salt spray, seawater acidified spray, cyclic seawater acidified, cyclic sulfur dioxide SO2 salt spray, and dilute electrolyte cyclic fog dry test.

The standard, says ASTM, "does not prescribe the type of modification, test specimen or exposure periods to be used for a specific product, nor the interpretation to be given to the results."

For details, contact ASTM at www.astm.org.

Continued

companies

Woodrow Wilson Bridge Project Honored

Bayer MaterialScience LLC (Pittsburgh, PA) selected the Woodrow Wilson Bridge (WWB) Project as the winner of the 2009 Gustav Lindenthal Medal and presented the award at the International Bridge Conference, held June 14–17, 2009, in Pittsburgh, PA.

The WWB spans the Potomac River, connecting Virginia and Maryland. The project was honored for resolving a transportation bottleneck through technical innovation, environmental stewardship, capacity and efficiency improvements, and transit alternatives. The project was completed in 2008 on time and within the $2.5 billion budget.

The award was presented to the Maryland State Highway Administration (MSHA) and the Virginia Department of Transportation (VDOT) by Dr. Karsten Danielmeier, vice president of business development for coatings, adhesives, and specialties at Bayer. It was presented in June during the annual International Bridge Conference in Pittsburgh, PA.

Program and construction management support to MSHA and VDOT came from Potomac Crossing Consultants (PPC), a joint venture of Parsons Brinckerhoff; URS; and Rummel, Klepper & Kahl, LLP.

The bridge features the largest movable span in the world, according to Bayer, and has eight drawspans designed to close within a 1/8-inch tolerance. The design has an arch appearance. The bridge is also environmentally significant, and as part of the project, five artificial reefs were created in the Chesapeake Bay, more than 52 new acres of wetlands were created, and more than 94 acres were restored or preserved.

The Gustav Lindenthal Medal was created in 1999 to honor recent outstanding achievement that demonstrates technical and material innovation with aesthetic merit, harmony with the environment, or successful community participation.

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News

Oil and Gas Board Adds Leighs Paint Rep

Paul Clayton, marketing director for Leighs Paints (Bolton, UK), has become a member of the International Oil and Gas Business Advisory Board (IOGBAB). He was invited to join the board to reflect the views of small and medium-sized companies within the industry.


Paul Clayton

The Board is part of UK Trade & Investment (UKTI), which draws members from across the energy sector and supports the development of the UK Energy Excellence initiative into international markets.

CCP Hires Product Manager

Cook Composites and Polymers (CCP), headquartered in Kansas City, MO, has hired Eric Dumain as the product manager for new product development.

Dumain has over 20 years of experience in the coatings industry, with expertise in new product commercialization, business development, and technology transfer. He currently holds four patents in the powder coatings resin field and has published and presented several papers internationally.

Dumain holds a BS in chemical engineering from the University of Rochester and an MBA from the University of North Carolina at Chapel Hill.

Rodda Will Distribute Jotun Coatings

Rodda Paint Co. (Portland, OR) has been named the exclusive distributor of Jotun Marine Coatings for the northwestern U.S. The agreement is effective immediately.

Rodda will be stocking product at its Michigan St. industrial/marine store in Seattle, WA, and plans to sell coatings in Washington, Oregon, and Alaska. The store has been equipped with color matching and specialty colorant tinting capabilities.

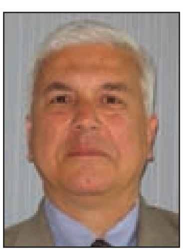
AkzoNobel Fills Corporate Director Control

AkzoNobel (Amsterdam, the Netherlands) has appointed Hans de Vriese as the new corporate director control, effective September 1, 2009. Vriese replaces Martin Potter.


Hans de Vriese

Vriese was previously the chief financial officer for General Motors Corporation, Asia Pacific. He holds a degree in electromechanical engineering and an MBA, both from the University of Leuven, Belgium.

Eliokem Appoints Business Manager


Andrea Valenti

Eliokem (Villejust, France) appointed Andrea Valenti as the global oilfield chemicals and coatings business manager.

Valenti has been with the company since 1986, with his most recent position being the global marketing manager for oilfield chemicals. He will still hold this position in addition to his new role.

Valenti has a degree in economic studies from the University Bocconi in Milan, Italy.

Buckman Changes Name

Buckman (Memphis, TN) has changed its name from "Buckman Laboratories" to just "Buckman." The company says the change is meant to reflect its growth from a small laboratory into a global supplier of chemicals.

Lubrizol Hires Account Manager

Lubrizol Advanced Materials, Inc., a subsidiary of The Lubrizol Corporation (Wickliffe, OH), has appointed Mark Ruch as the strategic account manager for the paints, coatings, and adhesives business in its Performance Coatings product line.

He will be responsible for the northeastern U.S. and will lead the sales team as well as manage the needs of direct customers, distributors, and agents. His office will be in Snyder, NY.

Ruch has 20 years of sales and management experience, with expertise in printing, packaging, and related industries. He holds a bachelor's degree in economics from the University of Buffalo.

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IRL Publishes Profile of Chinese Paint Industry

Information Research (IRL), located in London, UK, has published Profile of the Chinese Paint Industry, 5th Edition, outlining China's 6.4 million-ton paint market.

IRL states that China is increasingly self-sufficient in paints and coatings, with the exception of high-tech and specialized types.

Industrial coatings represent the majority of the market at 70%, and architectural coatings make up the largest single segment, accounting for 30% of all national coatings demand. The architectural segment is expected to reach 2.6 million tons by 2013, and the protective segment is predicted to reach 2.3 million tons.

For more information on the profile, visit www.informationresearch.co.uk.

Bayer to Close Resins Operations in WV

Bayer MaterialScience LLC, headquartered in Pittsburgh, PA, has announced plans to close the Coatings, Adhesives, and Specialties (CAS) resins operations in New Martinsville, WV. The location is scheduled to cease production by the end of 2009.

The closure will affect approximately 40 of the 300 employees at the facility. The site will continue to manufacture a range of polyurethane raw materials and a line of thermoplastic polyurethanes.

Huntsman Receives Coatings Award

Huntsman was named a winner in the Two-Component Systems category by *Paint & Pintura Magazine* in the publication's 13th annual awards program. The awards are based on a comprehensive survey throughout Brazil.

According to Adalberto Lopes, South America sales director for Huntsman Advanced Materials, "We are pleased to receive this award as confirmation that our innovative products and dedicated customer support are viewed so positively throughout the Brazilian coatings industry."

Paint & Pintura Magazine is the leading publication serving the Brazilian coatings market sector. Huntsman is a global manufacturer of chemicals to several different industries, including paints and coatings.

R&D Awards Include Technology for Coatings Industry

Several companies involved with the coatings industry are among the winners of the 47th annual R&D 100 awards for innovative technology,

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according to www.rdmag.com, the web site of awards sponsor *R&D Magazine* (Rockaway, NJ).

The awards acknowledge top technology of the year. Editors of *R&D* and an independent panel of judges select each year's winners. The following companies and products are among the winners listed and described on www.rdmag.com.

Atlas Material Testing Technology, LLC (Chicago, IL) developed the Ultra-Accelerated Weathering System (UAWS) in partnership with the National Renewable Energy Laboratory (NREL) and the Institute of Laser Technology (ILOT). The UAWS tracks the sun while concentrating reflected sunlight on mounted test specimens. The system allows for very high concentrations of UV energy without excessive heating.

PPG Industries (Pittsburgh, PA) was honored for its innovative manufacturing process for powder coatings. The process creates coatings by dispersing the resins, pigments, and other components in water. The new method of mixing and matching color prior to pulverization and application is more accurate and predictable than conventional approaches while also being less time consuming.

The Dow Chemical Company (Freeport, TX) received an R&D 100 award for developing block copolymers that have predictable, controllable chains of blocks that alternate between hard and soft segments. The materials provide improved compression set and elastic recovery properties with the flexibility of polyolefin plastomers and elastomers along with the heat resistance of high-density polyethylene.

All awards will be formally presented at an Awards Banquet in Orlando, FL, slated for November 12.

Published seven times a year, *R&D Magazine* reports on advances in science and technology, new instruments and techniques for research and development, and trends in research. For more information, visit www.rdmag.com.

products

Epoxy from Sherwin-Williams for Mildew Resistance

Sherwin-Williams (Cleveland, OH) has introduced Tile-Clad® High Solids Mildew Resistant epoxy polyamide, an industrial coating that

protects against mildew growth on exterior surfaces where dampness and humidity are of concerns.

The two-package product is designed for areas such as clean rooms, laboratories, institutional kitchens, and chemical processing equipment where mildew growth must be prevented to maintain operations. It can also be used in a wide variety of applications where mildew growth may occur, such as water tank exteriors, structural and support steel, power plants, nuclear power facilities, offshore structures, and fuel storage tanks, thus reducing the need for labor-intensive cleaning and the need to re-coat, should mildew damage the finish, the company says.

Suitable for a variety of substrates, including steel, galvanizing, and concrete, the coating features a gloss finish and is available in a wide variety of safety colors.

For details, visit www.sherwin-williams.com.

Hempel Introduces Cargo Hold Coating

Hempel (Kgs. Lyngby, Denmark) has introduced Hempadur Ultra-Strength

47500, a new epoxy coating for ship cargo holds. The coating protects cargo holds from both mechanical damage and severe abrasion caused by loading hard cargos, the company says.

The coating is 75% volume solids, has low VOC content, and has a 10-year repair interval. It can be applied year-round in most temperatures and has a high glass transition temperature, so that the coating remains hard even when exposed to warm coal cargos, the company says.

For more information, visit www.hempel.com.

Tnemec Develops Fast-Cure Epoxy

Tnemec (Kansas City, MO) has introduced a fast-cure modified polyamine epoxy lining for concrete and steel in water storage and treatment facilities. Series FC22 Epoxoline is a 100% solids, thick film epoxy that cures rapidly at 75 F and can be returned to service within 24 hours, the company says.

According to the company, the epoxy is certified by NSF International in accordance with ANSI/NSF Std. 61, and it conforms to the American Water Works Association (AWWA) D 102 Inside Systems No. 1 and No. 2 as well as AWWA C 210 standards.

The epoxy is also offered in a new touch-up kit that requires a 26:1 thrust ratio gun and disposable static mixer. The company says that unused material can be retained in the tube for future use.

For more information, visit www.tnemec.com.

MSA Offers Adjustable Respirator

MSA (Pittsburgh, PA) has introduced the Advantage 420 Respirator that allows users to quickly adjust the mask according to individual needs. The AnthroCurve™ II face-seal design adapts to different head sizes and facial

Continued

contours and has been tested against the proposed new NIOSH fit-test panel, according to the company.

The patent-pending UniBond facepiece helps to eliminate leak paths, and the textured sealing surface reduces facepiece slippage in hot, humid conditions. The mask also features a yoke and harness design that enable an easy switch between lock-down and drop-down harness options.

Visit www.msanet.com for more information.

Two New Water Jet Pumps from Jet Edge

iP60-100s

iP36-280DS

Jet Edge, Inc. (St. Michael, MN) recently introduced two new water jet pumps. The iP60-100S is a single intensifier version of the 100hp water jet pump. It operates at 60,000 psi and features a tie-rod design.

The iP36-280DS is a diesel-powered water jet intensifier pump. It is available in 36,000 psi or 55,000 psi units and is built on a skid-mounted frame with lifting eyes and forklift guides. According to the company, the 280hp Cummins turbo diesel engine meets domestic and international Tier 3 emissions standards.

For more information, visit www.jetedge.com.

DeFelsko Adds Bluetooth to Gage

DeFelsko Corporation (Ogdensburg, NY) has added Bluetooth® Wireless Technology to the PosiTector 6000 Coating Thickness Gage. Readings can be wirelessly transmitted to a Bluetooth compatible device up to 33 ft away. Readings do not require line-of-sight to communicate and can pass through solid objects such as walls, according to the company.

For details, visit www.defelsko.com.

New Book Details Paint Analysis

Paint Analysis, by Roger Dietrich, presents analytical techniques and their applications in the coatings industry. According to publisher Vincentz Network, the information in this new book can be used for performing failure analysis, production control, and quality control. It can also be used as a reference for finding a solution to a coating failure.

For details, go to www.european-coatings.com.

Measure Gloss and Color without Contact

X-Rite, Incorporated (Grand Rapids, MI) has introduced its VS450 spectrophotometer, a quality control instrument that measures color and gloss of paint samples and other products, without touching the test surfaces. According to the company, the product can accurately measure a wet or dry sample from 1.5 inches away.

The instrument uses line-of-sight visibility and active visual targeting to project an illuminated target ring onto the sample for measurements. There are two aperture sizes, 6 mm and 12 mm, which can be switched without recalibrating the instrument.

For more information, visit www.xrite.com.

DeVilbiss Introduces Touch-Up Gun

DeVilbiss (Glendale Heights, IL) has introduced the Compact MINI, a gravity spray gun suitable for solvent-borne and waterborne paints, stains and varnishes, inks and dyes, and lacquers.

According to the company, the touch-up gun is available with HVLP or Trans-Tech air cap technologies. The gun features an aluminum body, stainless steel fluid tips and needles, nickel-plated brass knobs, a balanced air valve design, and an anti-static plastic cup with a threaded lid.

DeVilbiss plans to immediately replace the SRI touch-up gun with the new MINI touch-up gun. The company says that replacement parts for the SRI touch-up gun will be available for the next five years.

For more information, visit www.devilbiss.com.

Industrial Scientific Helps Manage Hazards Online

Industrial Scientific Corporation (Pittsburgh, PA) has introduced iNet Control, a hosted software application for managing gas detector fleets. It is a service hosted over the Web and does not require any software or hardware. It is included with every iNet subscription.

When an alarm event happens, the product shows which gas detectors had an alarm, when and where the alarm happened, what the gas hazards were, and how much gas was present, according to the company. The iNet uses docking stations to automatically perform gas detector testing, calibration, and bump testing.

When a new feature is added, the company says that iNet subscribers will have instant access to it the next time they log in.

For more information, visit www.indsci.com.

Corps of Engineers Awards Tainter Gate Coating Contract

By Brian Churray, Paintsquare

The United States Army Corps of Engineers, Pittsburgh District, awarded a contract of $5,629,560 to American Ornamental Iron Corporation (Saltsburg, PA) to recoat existing steel gates at two lock and dam facilities on the Monongahela River. The contract, which required SSPC-QP 1 certification, includes abrasive blast cleaning and refinishing three movable-crest tainter gates, two nonoverflow tainter gates, and two emergency bulkhead units at Charleroi Locks and Dam (pictured), as well as portions of four nonoverflow tainter gates at Braddock Locks and Dam. The upstream, bottom, and interior surfaces of the gates will be thermal-spray metallized with 85/15 zinc/aluminum. All of the gate surfaces will be coated with a moisture-cured urethane system. The surface preparation includes lead-based paint abatement for the interior surfaces of the movable-crest gates.

Photo courtesy of USACE

Astoria Bridge Update/Correction

The Oregon Department of Transportation announced an award for coatings inspection services related to the Astoria-Megler Bridge painting project, which was first reported in the August 2009 issue of *JPCL*. The earlier report incorrectly identified the portion of the 21,474-foot-long bridge that will be refinished under this effort. Awarded to SSPC-QP 1- and QP 2-certified Abhe & Svoboda, Inc. (Prior Lake, MN), the project involves recoating a 2,474-foot-long section of steel truss spans on the northern end (Washington State side) of the bridge, not the cantilever spans, as was originally reported. The Oregon DOT more recently awarded a contract of $986,000 to West Coast Coating Consultants (Berkeley, CA) to perform an estimated 17,000 hours of related coatings inspection services.

Alaska Department of Public Safety Awards Drydocking

The Alaska Department of Public Safety awarded a contract of $242,882 to Seward Ship's Drydock, Inc. (Seward, AK) to drydock and repair a 121-foot-long by 28-foot-beam steel-hulled vessel. The repair work includes coating steel hull and aluminum superstructure surfaces. Photo courtesy of Alaska Department of Public Safety

North Carolina DOT Lets Bridge Painting Project

V.H.P Enterprises, Inc. (Tarpon Springs, FL) was awarded a contract of $3,069,000 by the North Carolina Department of Transportation to recoat the Manns Harbor Bridge. The 14,265-foot-long steel bridge spans Croatan Sound to connect the mainland to the Outer Banks. The project involves recoating approximately 393,685 square feet of structural steel with an organic zinc-rich primer and an acrylic finish. The contract, which required SSPC-QP 2 certification, includes abatement of the existing lead-bearing coatings within a Class 2A containment structure (SSPC-Guide 6).