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The Voice of SSPC: The Society for Protective Coatings

Cover photo courtesy of General Dynamics NASSCO

Also this month

From the Offices of SSPC

The Society For Protective Coatings

SSPC recently launched an all-new sspc.org! For quick access, use your smart phone to capture this barcode.

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Getting Workers into the Coatings Industry

Many times I have heard contractors say that one of the biggest challenges they face is recruiting workers into the industry. We have an aging workforce that gives the issue a greater sense of urgency. Every employer wants a worker who will do the job, be a team player, and give you the productivity you need to meet a project deadline. Also, everyone wants a long-term employee who will be an asset for his or her entire career with you. In my old life, I was a leadership instructor, and we taught Maslow's Hierarchy of Needs. I think the Hierarchy remains a valid tool in understanding human motivation, management leadership, and what people desire in their development. Too often we think that the prime motivator is money, but many studies have shown it is not. Maslow's Hierarchy has five levels. From most basic to most sophisticated, the levels are:

I. Biological and Physiological needs: basic life needs—air, food, shelter, warmth, sex, sleep

II. Safety needs: protection, security, order, law, limits, and stability

III. Belongingness and Love needs: family, affection, relationships, work group

IV. Esteem needs: achievement, status, responsibility, and reputation

V. Self-Actualization: personal growth and fulfillment

According to Maslow, more basic needs had to be met before one could advance to the others.

When a worker comes to you, it can be assumed that his or her level one needs have been met. You then move to level two. In job interviews, potential employees often ask about the stability of the company and its reputation. If you cannot say you are financially stable and are reputable, why should that candidate work for you? The young employee is looking for stability, especially in these tough economic times. This information is often available on the Internet, so don't try to fool the person—the person being interviewed will have a good idea of your company's reputation. The person is then looking for a work group, or a team to be part of. He or she will try to sense whether your company will provide the desired "family atmosphere." I know a fourth generation, large industrial painting contactor in the Northwest who puts out a newsletter to employees that tells them not only what is going on in the company, but also information about birthdays and anniversaries of employees. That newsletter gives the employees the feeling of belonging to a team or "family."

The next level is esteem. The best way to make employees feel that they have achieved something is to give them training and certification. They now feel a sense of worth and pride in what they do. The military does a great job of this. It gives the person continuous training at every level, including formal schooling every three to four years. The military also awards people ribbons, badges, or patches for valor, achievement, skills, and even the operations the service member has participated in. The rank and decorations are clearly visible; they not only give the recipient the feeling of self esteem, but also the younger service persons who see these awards has the feeling that they can go to the top if they, too, work hard enough.

In our industry, the Coating Application Specialist (CAS) program was started with motivation, self-esteem, and personal growth in mind. If a worker earns the CAS certificate, they should have a high sense of self-esteem about our industry and about what they do. They can now walk around and say, "I am a certified Coating Application Specialist," not just, "I am an industrial painter." A next step can be working towards becoming a foreman. CAS was developed with the intent of moving the industry forward and hopefully helping the worker recruitment problem.

I was also in a meeting where one of the owners of a large contracting firm said, "We are sometimes our own worst enemy when it comes to retaining workers. We put them on the job, and tell them to shovel grit day after day." The new employees then perceive their jobs as routine work that no one else wants or will do. Again, the workers lack self-esteem and feel they can never reach Maslow's last level of self-actualization or fulfillment. If you, as an employer, properly communicate that there are possibilities for upward mobility, and that future training and certification opportunities, such as CAS, will be available, workers may then begin to see the coatings industry as the stable environment and future they are looking for. Look at Maslow's material in greater detail; you might get some good ideas.

Bill Shoup
Executive Director, SSPC

Webinars on Contractor QC Programs and Coating Costs Set for December

Alison Kaelin of KTA-Tator will present a webinar on setting up contractor quality programs that will meet SSPC certification requirements on Dec. 14 from 11:00 a.m. to Noon EST.

The webinar is entitled, "Basic Steps in Creating a Contractor Quality Program: Comparison of Documentation, Hold Point, and Quality Control Training Requirements in Various SSPC Contractor QP Standards."

After providing a general overview of SSPC's QP standards that are used in the Painting Contractor Certification Program (PCCP), Kaelin will describe the scope and content of QP 1, QP 3, QP 6, and QP 8.

She will then explain training requirements, hold point observations, and QC documentation. The webinar is sponsored by SSPC.

The final SSPC/*JPCL* Education Series Webinar of the year, "Calculating Coating Lifetime Costs," will be given by Jayson Helsel of KTA-Tator on Dec. 19 from 11:00 to Noon EST. This webinar will explain how to identify coating systems for various service environments, estimate their service lives, calculate the installed cost, and determine the most cost-effective system on a long-term basis.


Alison Kaelin


Jayson Helsel

Sherwin-Williams is the sponsor of this webinar.

SSPC is an accredited training provider for the Florida Board of Professional Engineers (FBPE). PEs in Florida can now submit SSPC Webinar Exam CEUs to the FBPE. If interested in submitting Webinar Exam CEUs to the FBPE, you must download the FBPE CEU form and successfully pass the Webinar Exam.

Participation in the webinars is free, but for those who wish to receive continuing education credits from SSPC, a test is available after each webinar. Cost of the test service is $25. You can register through the SSPC Marketplace.

These final 2011 webinars are part of the 2011 SSPC/*JPCL* Education Series, providing continuing education for SSPC re-certifications as well as technology updates on important topics.

Bechtel's Fultz to Head SSPC in 2013

Industry veteran Benjamin Fultz, of Bechtel Corp., has been elected Vice President of the SSPC Board of Governors, positioning him to become President of the organization in 2013.


Benjamin Fultz

Fultz was appointed to the Board in February 2008 to fill the unexpired term of Brian Castler in the Facility Owner demographic. In July of that year, Fultz was elected to a full four-year term.

On Sept. 20, 2011, he was elected Vice President at SSPC's Board of Governors meeting in Pittsburgh, PA.

Fultz was also recently named one of 24 *JPCL* Top Thinkers: The Clive Hare Honors, an honor that recognizes a select group of the industry's thought leaders worldwide.

Fultz has been a member of SSPC since 1995. He has 45 years of experience in both technical and production management of protective coatings uses and applications. He also has experience in cathodic protection and material selection, marine, refinery, chemical processing, and nuclear application and has written more than 40 articles for various publications. Fultz has a BS in chemistry from Spring Hill College and was a recipient of the 2007 SSPC Technical Achievement Award.

Fultz will become the President of SSPC on July 1, 2013, following the terms of Robert McMurdy (2011-2012) and Stephen Collins (2012-2013).

To see Fultz discuss his career with Marian Welsh, publisher of *JPCL*, capture the following barcode with your smartphone, or visit www.paintsquare.com.

Barton Names Regional Sales Manager

Barton International, a supplier of garnet abrasives for waterjet cutting and blast media, has announced the appointment of Ray Lindberg as regional sales manager for the Western Great Lakes region. This territory includes Illinois, Indiana, Tennessee, and Wisconsin.

Lindberg has more than 20 years of technical sales experience in the abrasive, tooling, machining, and machine tool equipment industries. As regional sales manager, his goals are to educate the waterjet and blast media markets in the value of Barton garnet abrasives and to maximize customer satisfaction.

Ray Lindberg

WJTA-IMCA Elects Board, OKs Hose Color Coding Scheme

The WaterJet Technology Association—Industrial & Municipal Cleaning Association (WJTA-IMCA) has chosen new leadership for the next two years, and named a new board chairman, president, and other officers.

Bill Gaff

Bill Gaff, VP of sales and marketing for Vacuum Truck Rentals, was elected the 2011-2013 board chairman at the groups' recent Conference and Expo in Houston, TX.

George A. Savanick

Consultant George A. Savanick, Ph.D., was elected president for the 2011-2013 term.

Also elected for the 2011-2013 term were Pat DeBusk of Inland Industrial Services Group LLC as vice president; Hugh Miller, Ph.D., associate professor of Colorado School of Mines, as secretary; and Larry Loper, vice president of marketing and sales at High Pressure Equipment Co., as treasurer.

Newly elected board members are Kay Doheny, owner of Jack Doheny Supplies, Inc.; Luis Garcia, president and CEO of Channel Safety & Marine Supply Inc.; Kathy Krupp, managed services leader at The Dow Chemical Company; and Kerry Petranek, CEO of StoneAge Inc.

Forrest Shook, president of NLB Corp., was re-elected to the board. Mohamed Hashish, Ph.D., and Gary Noto will continue to serve their remaining terms. Hashish is senior VP of technology at Flow International Corp., and Noto is EVP and COO of Veolia Environmental Services.

On Sept. 18, the board of directors approved the addition of wording regarding a color coding scheme for pressure hoses to the "Recommended Practices for the Use of High Pressure Waterjetting Equipment." The goal of the new wording is to help ensure job safety by making the various hoses more easily identifiable. The effective date for implementation is Jan. 1, 2013.

Online *JPCL* Coatings Guide Is Searchable

The searchable version of the 2011 *JPCL* Annual Coating Systems Buying Guide is now available online at www.paintsquare.com. The Guide lists more than 5,200 recommendations for protective and marine coating and lining systems provided by more than 250 coating manufacturers. Search by industry, exposure, substrate, and company or product trade name.

PPG, RPM, AkzoNobel Expand European Portfolios

RPM International, AkzoNobel, and PPG have expanded their European industrial portfolios, with RPM acquiring the Spanish fire-protection business Grupo P&V, AkzoNobel's acquisition of Germany's Schramm Holding, and PPG's purchase of Dryup A/S of Denmark.

Grupo will continue to be led by its current management team and owners. The company recently extended its own range of products when it acquired the bankrupt Asoes Condal.

AkzoNobel recently acquired more than 95% of the shares of coatings manufacturer Schramm Holding AG. The deal was originally announced in June, and AkzoNobel intends to finalize its related purchase of Korean SSCP's coating business by Nov. 1. SSCP took over Schramm in 2007.

PPG recently announced that it has finalized the purchase agreement to acquire Denmark-based Dyrup A/S from its owner, Monberg & Thorsen. Both parties have agreed on a closing date of Jan. 5, 2012.

Dyrup produces architectural coatings and specialty products.

For more information on these acquisitions, read the full story at www.paintsquare.com.

Removing Coal Tar Epoxies

What is the preferred method to remove 25-year-old coal tar epoxy from a carbon steel tank in order to reline it?

From Doug DeClerck
MES

The answer depends on whether the coating is a “hot enamel” coal tar or a conventional coal tar epoxy. If the coating is a hot enamel, then it probably was dumped out and mopped on, so it could be extremely thick (1/4 in. or more). It will get quite sticky in hot weather. The best approach is to do the work in cold weather, chip off the material, and then abrasive blast clean.

If it is a conventional coal tar epoxy and is under 30 mils, then abrasive blast cleaning out of the gates should work. It may take more abrasive than you think, so plan accordingly. If it is a conventional coal tar epoxy and is thicker than 30 mils, approach the work like a hot enamel removal. In any case, protect the workers. The dust can be very aggressive. Workers will need respiratory protection as well as protection against skin contact.

From Vikraman Govindraj
Rigmetals L.L.C

Because it’s a 25-year-old coal tar, do the preparation in three steps. First, chip and hammer to remove the old rust. Second, sweep blast to open the face of paint. Third, blast with new garnet to achieve the required grade. This process will be time consuming but will give good results and safe work.

From Jesse Chasteen
Schriener Construction

If the coal tar was applied in the state-of-the-art fashion available 25 years ago, the best way is to protect your crew first. Then, send them in with air scrapers and pull off as much of the bulk material as possible before you start abrasive blasting to the required specification. The coal tar will range from 20 mils to greater than 200 mils on this, I would bet. Skin protection and air changes are the key to worker comfort and protection because the removal of this coating has got to be in the top three for miserable.

From Gary Peterson
Blason Industries

Chip the coal tar away with either air tools or electric ones. Abrasive blast the walls, and shot blast the floors using steel shot mixed with grit.

From Lee Edelman
CW Technical

Abrasive blasting or UHP waterjetting can be used. Blast media selection is important if abrasive blasting is selected. If waterjetting is selected, depending on the thickness of the coal tar, pressures can range from 30,000 psi to 50,000 psi to get a WJ2 surface condition. A dehumidification unit will help if the process is done during the winter. Proper personal protective equipment and confined spaces permits or certifications will be required.

***Editor’s Note:** The above Problem Solving Forum (PSF) question was posted on the free daily electronic newsletter,* PaintSquare News *(PSN), on behalf of* JPCL. *PSF responses submitted through* PSN *as well as those sent directly to* JPCL *are selected and edited to conform to* JPCL *style and space limitations. Send questions and answers to Karen Kapsanis, editor,* JPCL, *kkapsanis@protectivecoatings.com.*

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RETAINING PRE-CONSTRUCTION PRIMERS DURING SHIPBUILDING

By J. Peter Ault, P.E., PCS, Elzly Technology Corporation, Ocean City, NJ

Inspection of the in-service performance of a coating applied over a retained pre-construction primer
Courtesy of the author

Priming of carbon steel plates, beams, angle irons, and other shapes before their fabrication into parts of industrial and marine structures has progressed from its earliest stages of fabrication to the current block stage, or module process. The earliest practices used the full thickness of both organic and inorganic primers intended to be the first coat in multi-coat systems. It was recognized that these full coat primers impeded the progress of welding and led to porosities in the welds, compromising the integrity of the entire coating system. Extensive damage during the fabrication process led to a need for quicker processes with fewer intercoat adhesion problems.

The coatings industry met this need with more efficient inorganic zinc primers. The industry adopted thinner films and films with less zinc content to meet the production requirements of the fabricators—predominantly shipyards. While some organic pre-construction primers (mainly waterborne inhibitive epoxies) have been used, they did not match either the production efficiencies or the protection of the carbon steel afforded by inorganic zinc pre-construction primers (PCPs) during the fabrication process, which often extends beyond a year. The major problems were extensive burn back from the weld area, fabrication damage, and noxious fumes during welding and cutting processes.

Editor's Note: This article is based on a paper the author gave at SSPC 2011 (Jan. 30–Feb. 2, 2011), the conference of SSPC: The Society for Protective Coatings and is available in the conference Proceedings (sspc.org).

Inorganic Zinc Pre-construction Primers (PCPs)

Inorganic zinc pre-construction primers (PCPs) are a special class of inorganic zinc primers. Depending on the manufacturer, permanent inorganic zinc primers are formulated with zinc pigment content ranging from 45% to 92% and an end use requirement of 2–4 mils' (50–100 μm) dry film thickness (DFT). All inorganic zinc PCPs have a drastically reduced zinc pigment content with an end use requirement of 0.6–0.8 mils' (15–20 μm) DFT. PCPs are designed to withstand the welding processes and handling damages during the fabrication process of blocks or modules before incorporation into the permanent finished structure. PCPs provide corrosion protection, but only from their application until the fabricated components are welded into modules. Application of the permanent protective coating system varies according to the shipyard's individual production process. It may involve application of just the first coat of the permanent protective coating system just before the module stage or application of the

Continued

first and second coats. The finish coat of the permanent system is rarely applied before the module stage.

Zinc content of PCPs is typically in the 28–48% range. Zinc content is chosen based on a tradeoff between welding issues (favors lower zinc content) and corrosion protection during storage (favors higher zinc content). Other factors, such as cost and usability, will also contribute to the final formulation. A common solution in the lower cost versions is to replace some of the zinc with inhibitors like zinc phosphate, molybdates, chromates, etc. One of the first of the inorganic PCPs recommended for immersion service of more than 15 years without sweep blasting had zinc oxide, vitreous silica, and kaolin in its formula.

PCP selection is driven by welding as well as coating issues. The primer can have an effect on welding speeds and quality. The composition of the primer can have health and safety implications for the welding process. A 1973 National Shipbuilding Research Program (NSRP) report discussed these issues.[1]

Shipyards in the Far East and Europe often use weldable zinc silicate PCPs in the block construction. Undamaged primers, after block erection, are not removed but given a secondary surface preparation designed to permit good adhesion of the full protective system. Areas of damage, through welding or erection, are either blasted to Sa 2½ during block construction or power tool cleaned to St 3 after erection of the blocks, followed by the full coating system.

This article highlights some of the research work that has been carried out to support this practice and describes some "standards" in use around the world.

Global PCP Standards

Material Standards

A significant challenge in the industry is that there is no standard for PCP material. A variety of coating materials have been marketed as PCPs. In the absence of a global standard, classification societies such as ABS, DNV, Lloyds, etc., issue type approval certificates for PCPs. These certificates indicate that the materials meet the class society's requirements for PCPs but do not establish a standard or meet a global standard. Competition among the societies for dominance in a particular market creates the potential for less stringent standards.

The nearest thing to a standard is the International Maritime Organization

LITERATURE REVIEW

The debate over whether to retain PCPs is not new. NSRP has sponsored a number of studies over the past 30 years that have looked at the issue. Several commercial shipyards outside the U.S. have recently performed testing in support of the IMO PSPC regulations. The following is a brief review of selected studies.

A 1985 NSRP report assessed what was then called the "Japanese methodology" to see if it could provide adequate corrosion protection to their ships, given a 20-year life cycle of a ship.[2] A key consideration of this methodology was never removing the PCP to bare metal. The investigators visited four different ships, all at a different period in their life cycles. The ships included a container ship at one-year service life, a large tanker at six years into its life, a car carrier at eight years of service life, and a bulk cargo ship with 14 years of service. At each inspection, assessments were made (whenever accessible) of coating condition on the freeboard, deckhouse, underwater hull, internal tanks, and engine room coatings. Finally, chief chemists of two large Japanese coating manufacturers were interviewed. The general message from this report was that the Japanese coating systems are standard, simple, and designed for maintainability at predictable intervals with shipyard production in mind. As such, they are "good enough" to get a ship 20 years with "adequate" corrosion protection. Other salient points of the report include:

- Assembly blocks are completely outfitted before attachment; therefore, dust must be kept at a bare minimum. Open blasting is virtually eliminated in construction; heavy emphasis is placed on secondary surface preparation, typically disc sanding.
- The Japanese shipyards utilized standard coating systems (for very specific reasons), unlike in the U.S., where several coating types of varying sophistication are employed. For example, PCPs consist of low-film build (0.6 mils' DFT typically), alkali silicate primers with zinc dust, allowing for fast cutting and weld-thru times. Higher build, zinc-free PCPs (1.5–2.0 mils' DFT) can lead to slower cutting and welding, unacceptable fumes, and weld porosity. The standard ballast tank coating is coal tar epoxy. The standard exterior hull coating above the boot-top (freeboard) consists of chlorinated rubber, which is recoated very easily every four years. The standard underwater hull system is coal tar epoxy, followed by a vinyl tar tie coat to an ablative anti-fouling layer.
- The four ships all exhibited varying signs of coating breakdown and wear, based on the age and service area of the coating. The coatings selected and the quick turn-around maintenance (never removing the PCP to bare metal) provided "adequate" corrosion protection for the ships' design life of 20 years.
- Other specific points are that the thin film PCPs used above the waterline did not provide adequate corrosion protection from undercutting, as evidenced after one year. There was a heavy dependence on secondary surface preparation, followed by touch-up with organic zinc coatings.

NSRP sponsored two laboratory test programs during the same time as the aforementioned visit to the Japanese shipyard. One study involved topcoating a number of inorganic zinc primers with

(IMO) Resolution (MSC215(82)), Performance Standard for Protective Coatings for Dedicated Seawater Ballast Tanks in all Types of Ships And Double-side Skin Spaces of Bulk Carriers (PSPC). This resolution, which became mandatory through an amendment of the SOLAS convention, applies to ships contracted on or after July 1, 2008. It specifies inhibitor-free zinc silicate shop primer or equivalent. (At least one zinc-free shop primer has been approved.) Equivalence is not defined; therefore, the determination of equivalence must be proved by the manufacturer of the PCP and submitted to the classification society, which will issue a Type Approval Certificate. However, it should be noted that this is only recognized by the Class issuing the certificate; it is not universally approved. This Resolution is based on specifications and requirements intended to provide a target useful for a coating life of 15 years for the entire coating system. The actual useful life will vary, depending on variables including actual service conditions.

The specific requirements of the IMO PSPC Resolution relating to PCPs include:

• Shop-primer is defined as "the prefabrication primer coating applied to steel plates, often in automatic plants (and before the first coat of a coating system)."
• "The shop primer shall be zinc containing, inhibitor free zinc silicate based, or equivalent."
• "Shop primer compatibility with main coating system shall be confirmed by independent testing of the complete system carried out for the coating manufacturer."
• The complete coating system comprising epoxy based main coating and shop primer shall have passed a prequalification certified by test procedures in annex 1. The annex describes a 180-day test of panels installed in a simulated ballast tank with wave movement.
• If the complete coating system, including PCP, has been approved, "the retained shop primer shall be cleaned by sweep blasting, high-pressure water washing, or equivalent method."

Process Standards

The Japan Ship Technology Research Association (JSTRA) published its Standard for the Preparation of Steel Substrates for PSPC-2008 (SPSS for PSPC). This photographic collection of surface preparation examples is intended as a reference when implementing

Continued

various epoxy topcoats and subjecting them to various immersion performance tests to see if delamination and blistering occurred.[3] In a second study, four performance tests were carried out on six coating systems (coal tar epoxy, polyamide epoxy, inorganic zinc, chlorinated rubber, vinyl, and bleached tar) applied to retained and removed PCP.[4] The tests included: (a) six-month, 150 F salt water immersion; (b) three 17-day cycles each consisting of 14 days' immersion at 80 psi and three days of atmospheric exposure; (c) two-month alternating cycles of UV, heat, and immersion; and (d) 2000-hour cyclic salt fog testing per ASTM B-117. The laboratory testing did not lead to any conclusive position on the retention of PCP, but both studies contained detailed observations on the effect of various topcoats and zinc loadings in the primer.

NSRP also sponsored two tests of PCP retention in simulated ballast tanks. A study completed in 1982 included retained PCP as part of a project looking at various coating systems with and without cathodic protection.[5] After one year, no depletion of the inorganic zinc PCP was observed, along with minimal loss of zinc anode. The author concluded that this system, based on the mock-up test, probably could last 20 years without replacement of the zinc anodes. The other systems had diminished performance with the soft coatings performing so poorly that they were removed from the testing phase a few months into the test.

Another project involved a series of four simulated ballast tank assemblies, which were fabricated at NASSCO (San Diego, CA) in November 1998. Each tank was blasted and coated with various PCPs (a weldable control, a waterborne zinc PCP, and two solvent-borne PCPs). The tanks were fabricated and allowed to weather 60 days. Various topcoats were applied after secondary surface preparation (SSPC-SP 1, SP 3, and SP 11 of welds). Two control tank compartments were included in the study; the control tanks had the original PCP blasted off to SSPC-SP 10 and, in one, the NAVSEA high-solids system was applied. The other control tank had MIL-P-24441 type IV applied.

Based on the overall performance of the coating systems tested throughout the four-year cycle, the author concluded, "The use of preconstruction primer in conjunction with standard tank lining systems did not degrade the overall performance of the lining system."[6]

In 2005, Hyundai Industrial Research Institute reported on the performance of two mock-up blocks using Korean shipbuilding procedures.[7] After fabrication, a one-month weathering period was observed. One mock-up was sweep blasted, and the other was fully blasted. Both assemblies were coated with standard ballast tank epoxy topcoats. Tensile adhesion tests on both tanks met NORSOK requirements. This data, along with cathodic disbondment testing per ASTM G8,[8] was used to conclude that retention of PCP is a viable option for process improvement and cost associated with shipbuilding and bridge building.

the PSPC. These photographs may also serve as a reference when applying the Performance Standard to void spaces as well as cargo oil tanks developed or to be developed by the IMO.

ISO 8501-1:1998/Suppl:1994 provides photographic examples of grades Sa 2½ and St 3 surface preparation, but only for rusted flat steel surfaces without a shop primer. It does not provide photographic examples of typical areas after block assembly or at the erection stage. Several coatings manufacturers have their own process standards for preparing aged PCP before coating application.

Between priming and fabricating steel, the PCP is likely to be contaminated or damaged from handling, outdoor storage, and/or welding. While the PCP does not have to be removed, a surface preparation step must be accomplished before applying the final coating system. This step, often called "secondary surface preparation," may consist of the methods, or a combination of the methods, discussed below.

Pre-construction primer application plate line Courtesy of General Dynamics NASSCO

Solvent Cleaning

SSPC-SP 1, Solvent Cleaning, describes a method for removal of oil, grease, dirt, soil, salts, and contaminants by cleaning with solvent, vapor, alkali, emulsion, or steam. This procedure is commonly performed on a spot or as-needed basis, though it can be applied to an entire surface regardless of initial condition. It can be used as a stand-alone cleaning method, but it is also recommended *before* performing any of the following surface preparation techniques.

Power Tool Cleaning

Welds and damaged primer should be mechanically cleaned to remove surface oxides and restore a profile before applying the main coating system. In many cases, power tool cleaning is the most cost-effective way to prepare these sections. There are several specifications for power tool cleaning including the following.

- *SSPC-SP 3, Power Tool Cleaning*, covers removal of loose rust, mill scale, and paint to the degree specified by power tool chipping, descaling, sanding, wire brushing, and grinding.
- *SSPC-SP 11, Power Tool Cleaning to Bare Metal,* covers complete removal of all rust, scale, and paint by power tools, with resultant surface profile.
- *SSPC-SP 15, Industrial Grade Power Tool Cleaning,* is the specification between SP 3 and SP 11 and calls for removing all rust and paint but allows for staining; requires a minimum 1 mil (25 μm) profile.

Pressure Washing

Pressure washing of a surface that has a PCP is an economical way to address the entire surface. By pressure washing the entire surface, non-visible contaminants should be removed. *SSPC-SP 12/NACE No. 5, Surface Preparation and Cleaning of Metals by Waterjetting Prior to Coating,* defines four degrees of cleaning for visible contaminants (similar to SP 5, 6, 7, and 10) and three levels of flash rust. SSPC-SP 12/NACE No. 5 also describes three levels of non-visible surface cleanliness for non-visible soluble salt contamination. For preparation of surfaces that have PCPs, low-pressure water cleaning should be used to achieve a WJ-4 condition (Light Cleaning). This involves using water at pressures less than 34 MPa (5,000 psig) to create a surface finish that, when viewed without magnification, is free of all visible oil, grease, dirt, dust, loose mill scale, loose rust, and loose coating. After a surface is pressure washed, welds and damaged primer will require power tool cleaning or abrasive blasting. The mechanical surface preparation would remove any rusting (or flash rusting) that might occur. A level of acceptable soluble salt contamination should be specified.

Abrasive Blasting

Abrasive blasting can be used to sweep blast intact primer, as well as prepare welds and damaged areas. Sweep blasting is performed in accordance with *SSPC-SP 7/NACE No. 4, Brush-Off Blast Cleaning*. The standard requires blast cleaning of the entire surface, except tightly adhering residues of mill scale, rust, and coatings, while uniformly roughening the surface. All pre-construction primed surfaces may be sweep blasted. Sweep blasting of PCPs can be challenging because the primer color is similar to that of abrasive blasted steel. It can be difficult for blasters who are used to near-white metal blast to adjust to the lesser level of surface preparation. However, once workers are trained to sweep blast, they can roughly double the production rate and reduce the amount of abrasive consumed compared to a near-white metal blast.

Welds and damaged areas require a higher degree of surface preparation to

Continued

remove any oxides and create a surface profile. These areas should be prepared to one of the following specifications.

- *SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning,* describes blast cleaning until at least two-thirds of the surface is free of all visible residues, with staining only permitted on the remainder.
- *SSPC-SP 10/NACE No. 2, Near-White Blast Cleaning,* describes blast cleaning to near-white metal cleanliness, until at least 95% of the surface is free of all visible residues, with staining only permitted on the remainder.

Inspection and Acceptance of Prepared PCP

Once the secondary surface preparation is complete, the prepared surface should be inspected before applying the final coating system. Because the prepared surface will contain intact primer, the measurement of surface profile is appropriate only on areas that have been cleaned to bare metal. Key considerations are visual cleanliness and non-visible salt contamination.

There are several visual standards for prepared PCP. This section will discuss the visual standards published by two coating manufacturers and JSTRA. These visual standards include photographs and descriptions for comparing the prepared surfaces but do not contain physical test procedures. Most manufacturers refer to washing and blowing down in addition to mechanical methods for preparing PCP. However, the visual standards predominantly address the extent and condition of intact paint remaining after mechanical surface preparation techniques. The inspection standards describe levels of surface preparation but do not provide guidance on acceptance criteria prior to overcoating (i.e., what level of cleanliness is required). Such guidance is commonly contained in the product data sheet for the main coating system.

Proprietary Abrasive Sweep Standards for Shop-Primed Steel

A major coating manufacturer has published a visual standard that provides nine photographs representing three levels of surface preparation for three different shop primers.[9] The shop primers are differentiated by color—red oxide, green, and gray. For each of the shop primers, three levels of preparation are illustrated.

Standards for the Preparation of Steel Substrates for PSPC

The JSTRA published a visual standard in 2008 that contains 84 reference photographs representing a variety of conditions prior to surface treatment and after various surface treatments. The surface preparation levels include those that would comply with PSPC requirements of Sa 2½ or St 3, as well as a higher grade (designated Sa 2½+ or St 3+ in the standard).

For damaged areas, the standards provide representative surfaces cleaned using abrasive blasting (Sa 2½) or power tools (St 3). A reference condition and preparation to Sa 2½, St 3, Sa 2½+, or St 3+ is shown for damage from spot rust, light pitting, burned, manual weld, semi-automatic CO_2 fillet weld, semi-automatic CO_2 butt weld, automatic butt weld, collar plate weld, and corner weld.

For undamaged shop primer with surface contamination, the visual standards show cleaning to recommended conditions using abrasive blasting (Sa 2½ or Sa 2½+) for light fume by steel cutting, heavy fume by steel cutting, zinc salt, slightly heated, and fume by welding.

The visual standards show cleaning to recommended conditions using power tools (St 3, St 3+) for zinc salt, fume by welding, surface overdue for overcoating. For oil contamination, a photograph of "other cleaning" to rec-

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ommended condition is shown. The other cleaning appears to be some sort of solvent wipe.

Proprietary Secondary Surface Preparation Visual Standards

A major coating manufacturer produced a visual standard for secondary surface preparation.[10] The standard contains 30 photographs representing five levels of surface preparation for each of six surface types.

Conclusions

Past studies and the present work conclusively demonstrate that certain PCPs can be retained without impacting coating performance.

There are various PCP materials. Their compatibility with the permanent system should be confirmed by proper testing.

Secondary surface preparation requirements and acceptance criteria must be developed and agreed upon to effectively retain PCP for service.

Acknowledgements

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first and second coats. The finish coat of the permanent system is rarely applied before the module stage.

Zinc content of PCPs is typically in the 28–48% range. Zinc content is chosen based on a tradeoff between welding issues (favors lower zinc content) and corrosion protection during storage (favors higher zinc content). Other factors, such as cost and usability, will also contribute to the final formulation. A common solution in the lower cost versions is to replace some of the zinc with inhibitors like zinc phosphate, molybdates, chromates, etc. One of the first of the inorganic PCPs recommended for immersion service of more than 15 years without sweep blasting had zinc oxide, vitreous silica, and kaolin in its formula.

PCP selection is driven by welding as well as coating issues. The primer can have an effect on welding speeds and quality. The composition of the primer can have health and safety implications for the welding process. A 1973 National Shipbuilding Research Program (NSRP) report discussed these issues.[1]

Shipyards in the Far East and Europe often use weldable zinc silicate PCPs in the block construction. Undamaged primers, after block erection, are not removed but given a secondary surface preparation designed to permit good adhesion of the full protective system. Areas of damage, through welding or erection, are either blasted to Sa 2½ during block construction or power tool cleaned to St 3 after erection of the blocks, followed by the full coating system.

This article highlights some of the research work that has been carried out to support this practice and describes some "standards" in use around the world.

Global PCP Standards

Material Standards

A significant challenge in the industry is that there is no standard for PCP material. A variety of coating materials have been marketed as PCPs. In the absence of a global standard, classification societies such as ABS, DNV, Lloyds, etc., issue type approval certificates for PCPs. These certificates indicate that the materials meet the class society's requirements for PCPs but do not establish a standard or meet a global standard. Competition among the societies for dominance in a particular market creates the potential for less stringent standards.

The nearest thing to a standard is the International Maritime Organization

LITERATURE REVIEW

The debate over whether to retain PCPs is not new. NSRP has sponsored a number of studies over the past 30 years that have looked at the issue. Several commercial shipyards outside the U.S. have recently performed testing in support of the IMO PSPC regulations. The following is a brief review of selected studies.

A 1985 NSRP report assessed what was then called the "Japanese methodology" to see if it could provide adequate corrosion protection to their ships, given a 20-year life cycle of a ship.[2] A key consideration of this methodology was never removing the PCP to bare metal. The investigators visited four different ships, all at a different period in their life cycles. The ships included a container ship at one-year service life, a large tanker at six years into its life, a car carrier at eight years of service life, and a bulk cargo ship with 14 years of service. At each inspection, assessments were made (whenever accessible) of coating condition on the freeboard, deckhouse, underwater hull, internal tanks, and engine room coatings. Finally, chief chemists of two large Japanese coating manufacturers were interviewed. The general message from this report was that the Japanese coating systems are standard, simple, and designed for maintainability at predictable intervals with shipyard production in mind. As such, they are "good enough" to get a ship 20 years with "adequate" corrosion protection. Other salient points of the report include:

- Assembly blocks are completely outfitted before attachment; therefore, dust must be kept at a bare minimum. Open blasting is virtually eliminated in construction; heavy emphasis is placed on secondary surface preparation, typically disc sanding.
- The Japanese shipyards utilized standard coating systems (for very specific reasons), unlike in the U.S., where several coating types of varying sophistication are employed. For example, PCPs consist of low-film build (0.6 mils' DFT typically), alkali silicate primers with zinc dust, allowing for fast cutting and weld-thru times. Higher build, zinc-free PCPs (1.5–2.0 mils' DFT) can lead to slower cutting and welding, unacceptable fumes, and weld porosity. The standard ballast tank coating is coal tar epoxy. The standard exterior hull coating above the boot-top (freeboard) consists of chlorinated rubber, which is recoated very easily every four years. The standard underwater hull system is coal tar epoxy, followed by a vinyl tar tie coat to an ablative anti-fouling layer.
- The four ships all exhibited varying signs of coating breakdown and wear, based on the age and service area of the coating. The coatings selected and the quick turn-around maintenance (never removing the PCP to bare metal) provided "adequate" corrosion protection for the ships' design life of 20 years.
- Other specific points are that the thin film PCPs used above the waterline did not provide adequate corrosion protection from undercutting, as evidenced after one year. There was a heavy dependence on secondary surface preparation, followed by touch-up with organic zinc coatings.

NSRP sponsored two laboratory test programs during the same time as the aforementioned visit to the Japanese shipyard. One study involved topcoating a number of inorganic zinc primers with

(IMO) Resolution (MSC215(82)), Performance Standard for Protective Coatings for Dedicated Seawater Ballast Tanks in all Types of Ships And Double-side Skin Spaces of Bulk Carriers (PSPC). This resolution, which became mandatory through an amendment of the SOLAS convention, applies to ships contracted on or after July 1, 2008. It specifies inhibitor-free zinc silicate shop primer or equivalent. (At least one zinc-free shop primer has been approved.) Equivalence is not defined; therefore, the determination of equivalence must be proved by the manufacturer of the PCP and submitted to the classification society, which will issue a Type Approval Certificate. However, it should be noted that this is only recognized by the Class issuing the certificate; it is not universally approved. This Resolution is based on specifications and requirements intended to provide a target useful for a coating life of 15 years for the entire coating system. The actual useful life will vary, depending on variables including actual service conditions.

The specific requirements of the IMO PSPC Resolution relating to PCPs include:

- Shop-primer is defined as "the prefabrication primer coating applied to steel plates, often in automatic plants (and before the first coat of a coating system)."
- "The shop primer shall be zinc containing, inhibitor free zinc silicate based, or equivalent."
- "Shop primer compatibility with main coating system shall be confirmed by independent testing of the complete system carried out for the coating manufacturer."
- The complete coating system comprising epoxy based main coating and shop primer shall have passed a pre-qualification certified by test procedures in annex 1. The annex describes a 180-day test of panels installed in a simulated ballast tank with wave movement.
- If the complete coating system, including PCP, has been approved, "the retained shop primer shall be cleaned by sweep blasting, high-pressure water washing, or equivalent method."

Process Standards

The Japan Ship Technology Research Association (JSTRA) published its Standard for the Preparation of Steel Substrates for PSPC-2008 (SPSS for PSPC). This photographic collection of surface preparation examples is intended as a reference when implementing

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various epoxy topcoats and subjecting them to various immersion performance tests to see if delamination and blistering occurred.[3] In a second study, four performance tests were carried out on six coating systems (coal tar epoxy, polyamide epoxy, inorganic zinc, chlorinated rubber, vinyl, and bleached tar) applied to retained and removed PCP.[4] The tests included: (a) six-month, 150 F salt water immersion; (b) three 17-day cycles each consisting of 14 days' immersion at 80 psi and three days of atmospheric exposure; (c) two-month alternating cycles of UV, heat, and immersion; and (d) 2000-hour cyclic salt fog testing per ASTM B-117. The laboratory testing did not lead to any conclusive position on the retention of PCP, but both studies contained detailed observations on the effect of various topcoats and zinc loadings in the primer.

NSRP also sponsored two tests of PCP retention in simulated ballast tanks. A study completed in 1982 included retained PCP as part of a project looking at various coating systems with and without cathodic protection.[5] After one year, no depletion of the inorganic zinc PCP was observed, along with minimal loss of zinc anode. The author concluded that this system, based on the mock-up test, probably could last 20 years without replacement of the zinc anodes. The other systems had diminished performance with the soft coatings performing so poorly that they were removed from the testing phase a few months into the test.

Another project involved a series of four simulated ballast tank assemblies, which were fabricated at NASSCO (San Diego, CA) in November 1998. Each tank was blasted and coated with various PCPs (a weldable control, a waterborne zinc PCP, and two solvent-borne PCPs). The tanks were fabricated and allowed to weather 60 days. Various topcoats were applied after secondary surface preparation (SSPC-SP 1, SP 3, and SP 11 of welds). Two control tank compartments were included in the study; the control tanks had the original PCP blasted off to SSPC-SP 10 and, in one, the NAVSEA high-solids system was applied. The other control tank had MIL-P-24441 type IV applied.

Based on the overall performance of the coating systems tested throughout the four-year cycle, the author concluded, "The use of preconstruction primer in conjunction with standard tank lining systems did not degrade the overall performance of the lining system."[6]

In 2005, Hyundai Industrial Research Institute reported on the performance of two mock-up blocks using Korean shipbuilding procedures.[7] After fabrication, a one-month weathering period was observed. One mock-up was sweep blasted, and the other was fully blasted. Both assemblies were coated with standard ballast tank epoxy topcoats. Tensile adhesion tests on both tanks met NORSOK requirements. This data, along with cathodic disbondment testing per ASTM G8,[8] was used to conclude that retention of PCP is a viable option for process improvement and cost associated with shipbuilding and bridge building.

Keeping Workers Safe During Abrasive Blasting

This article reviews the use of personal protective equipment, regulations, & standards affecting safe abrasive blasting.

By Thomas E. Enger, MS, CSP, CHMM,
Clemco Industries Corp.

Employers understand that safety is one of the most important ingredients to a successful business. However, providing a safe workplace and ensuring a safe and environmentally-sound environment is complex. Navigating the course to fool-proof safety can be mind-boggling.

Since 1970, the primary references for determining the minimum safety and environmental standards in the workplace have been the Occupational Safety & Health Administration (OSHA) and the Environmental Protection Agency (EPA) mandated by Titles 29 and 40 of the Code of Federal Regulations. These regulations incorporate thousands of standards from hundreds of agencies and organizations.

The purpose of this article is to attempt to provide the reader a basic understanding of the minimum standard to provide safe work conditions for their employees when using open air abrasive blasting equipment. (The phrase "open air abrasive blasting" in this article refers to unrestricted abrasive blasting, as opposed to enclosed abrasive blasting that is done in blast booths or permit-required confined spaces, where additional safety regulations would apply and are beyond the scope of this article.) This article addresses many federal worker safety regulations from 29 CFR as well as from other agencies or organizations, but does not purport to be comprehensive or a substitute for reading and complying with any regulation. Moreover, this article does not address in any detail the federal regulations (40 CFR) or other regulations and standards for protecting the environment (ground, air, water, and the public) during and after abrasive blasting, such as allowable emissions or contaiment of abrasive blasting debris.

Editor's Note: This article, from Clemco's publication, "The Use of Personal Protective Equipment and Regulations & Standards Affecting Safe Abrasive Blasting," appears here with the permission of Clemco (www.clemcoindustries.com).

Worker Protection Standards Associated with Abrasive Blasting

There are three primary industries that perform abrasive blasting: General Industry (29 CFR 1910), Maritime (29 CFR 1915), and Construction (29 CFR 1926). OSHA has developed regulations for these industries. The most basic elements of these standards include the sections shown in Table 1 (p. 22) and can be found on OSHA's website, www.osha.gov.

There are more than 40 references in 29 CFR that address the basic hazards associated with open air abrasive blasting. The regulations governing these three industries address the requirement for Job Hazard Analysis (JHA) when the operator wears Personal Protective Equipment. Because a JHA is required by all the OSHA-covered industries, I will use a JHA to identify not only the proper PPE but also to identify other hazards and relevant regulations as they apply to open air abrasive blasting. Table 2 (pp. 29–33) contains a Job Hazard Analysis. This Job Hazard Analysis is modeled after OSHA publication #3071 and can be downloaded from www.osha.gov/Publications/osha3071.pdf.

In Tables 1 and 2, we have identified all the basic regulatory references that address the process for safely blasting a surface that is not in a permit-required confined space or blast room. Figure 1 better illustrates these basic regulatory requirements and standards by component.

Basic Elements of Abrasive Blasting and Their Hazards

It should be emphasized that this article reviews only the basic safety regulations and standards that directly affect how abrasive blasting is performed in an ambient environment. The analysis does not delve into the multitude of referenced standards incorporated by the basic regulations and standards that this article lists; but it has established that there are standards to support the following layman discussion on what an operator must have to safely work and be fully compliant when operating abrasive blast equipment. There are three basic elements of abrasive blasting: the abrasive, the personal protection equipment the operator uses, and the abrasive-delivery system. Each could pose safety hazards and call for protective measures.

The Abrasive

The first element, the abrasive, brings into consideration the surface being cleaned or prepared for coating operations. There are a multitude of abrasives the operators may use, and they must be aware of the hazards (and other regulations) associated with not only the abrasive but also the surface they are blasting. The most common abrasives used in open air blasting include, but are not limited to, sand and slags.

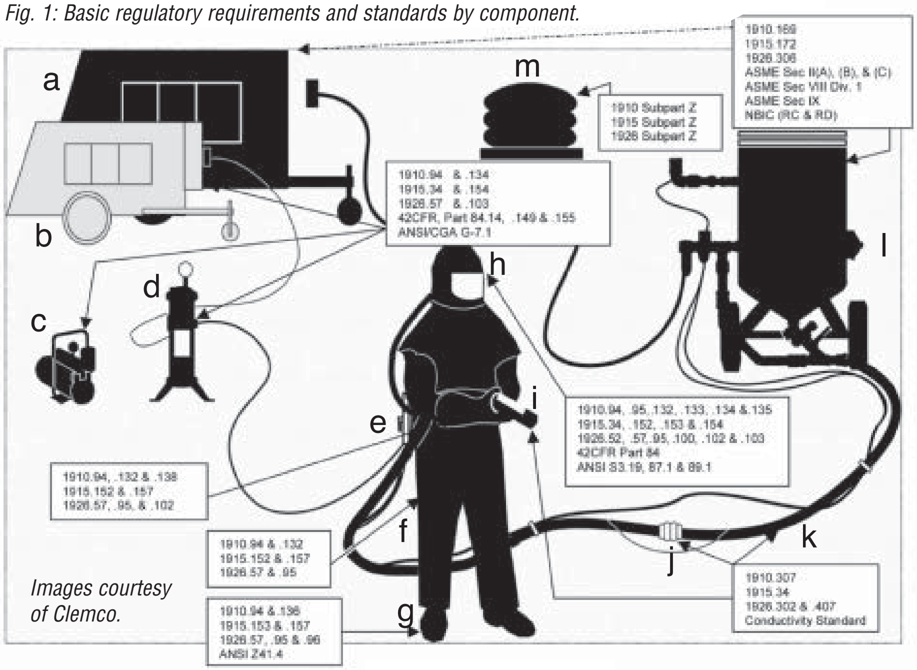
There are numerous hazards associated with these and other abrasives and the surface contamination that is being removed. The government is aware of these hazards and has placed the responsibility of protecting and educating the worker squarely on the shoulders of the employer. Most employers specialize in very specific surface preparation and coating operations. The best way to determine the hazards generated by these abrasives and coatings is to have a local Certified Safety Professional or Certified Industrial Hygienist perform a workplace environmental audit and determine the appropriate worker protection. Safety professionals and industrial hygienists are listed in local directories available to employers on these web sites:

- Safety Professionals: http://www.asse.org; and
- Industrial Hygienists: http://www.aiha.org.

Personal Protective Equipment

The second element of abrasive blasting is personal protective equipment. Once the professional performs the environmental audit, the employer can determine the proper protection for the operator. In the vast majority of applications, the personal protective equipment shown in Figs. 2, 3, 4, and 5 (pp. 24–25) will be required when performing abrasive blasting.

Fig. 1: Basic regulatory requirements and standards by component.



a. air compressor
b. breathing air compressor
c. ambient air pump
d. breathing air filter
e. leather/canvas gloves
f. blast suit
g. safety shoes
h. NIOSH-approved type CE respirator
i. blast nozzle
j. coupling
k. blast hose
l. ASME-code blast machine
m. abrasive

Leather gloves and steel-toed boots are commonly acknowledged to be necessary and are commercially available from safety supply stores (Fig. 2). There are several different types of fall protection available. The most common type for scaffolding is handrails and toe boards. When handrails and toe boards are not used or available, the most common fall protection involves a harness and a shock-absorbing lanyard (Fig. 3).

Blast suits are not normally provided by safety supply houses but are readily available through an abrasive blasting equipment distributor. The two basic types of blast suits are "lightweight" and "leather" (Fig. 4). Because they seal out the abrasive material from entering the operator's clothing and irritating the skin, blast suits are preferable over heavy jeans and a shirt. The use of blast suits also provides the operator outer clothing that can be removed and cleaned.

The most common respirator used in the surface preparation operation is the Supplied Air Respirator (SAR). This respirator is the most complex piece of Personal Protection Equipment the operator uses and is also the most controlled by federal safety regulations. Every major manufacturer of supplied air respirators provides an owner's manual with every respirator. These manuals provide all the operation, maintenance, and cleaning instructions required for the use of the respirator. OSHA requires every respirator user to understand not only the hazards the respirator protects him or her from, but also how to maintain the respirator. Conscientious manufacturers have web sites where owners can download these manuals if the originals get lost. Three examples of these web sites and brands or series include the following.

- http://clemcoindustries.com (Apollo Respirators)
- http://www.bullard.com (88VX Series)
- http://www.3m.com (Helmet Systems Headgear W-Series)

OSHA's respiratory standard requires more than just reading these manuals. The manual should be the cornerstone of an effective respiratory safety program.

A common mistake made by employers in the surface preparation industry is issuing a SAR only to the operator of the blast equipment. The use of SARs should be based on the industrial environmental survey the safety professional performs.

Table 1: Basic OSHA Regulations for Abrasive Blasting

General Industry		Maritime		Construction	
Reference	**Title**	**Reference**	**Title**	**Reference**	**Title**
29 CFR 1910.6	Incorporation By Reference	29 CFR 1915.5	Incorporation By Reference	29 CFR 1926.28	Personal Protective Equipment (PPE)
29 CFR 1910.94(A)	Ventilation–Abrasive Blasting	29 CFR 1915 Subpart C	Surface Preparation & Preservation	29 CFR 1926.52	Occupational Noise Exposure
29 CFR 1910.95	Occupational Noise Exposure	29 CFR 1915.34	Mechanical Paint Removers	29 CFR 1926.57(F)	Ventilation–Abrasive Blasting
29 CFR 1910 Subpart I	Personal Protective Equipment (PPE)	29 CFR 1915 Subpart I	Personal Protective Equipment	29 CFR 1926.59	Hazard Communication
29 CFR 1910.132	PPE–General Requirements	29 CFR 1915.152	PPE–General Requirements	29 CFR 1926 Subpart E	Criteria For Personal Protective Equipment
29 CFR 1910.133	PPE–Eye & Face Protection	29 CFR 1915.153	PPE–Eye & Face Protection	29 CFR 1926.96	PPE–Occupational Foot Protection
29 CFR 1910.134	PPE–Respiratory Protection	29 CFR 1915.154	PPE–Respiratory Protection	29 CFR 1926.100	PPE–Head Protection
29 CFR 1910.135	PPE–Head Protection	29 CFR 1915.155	PPE–Head Protection	29 CFR 1926.101	PPE–Hearing Protection
29 CFR 1910.136	PPE–Occupational Foot Protection	29 CFR 1915.157	PPE–Hand & Body Protection	29 CFR 1926.102	PPE–Eye & Face Protection
29 CFR 1910.138	PPE–Hand Protection	29 CFR 1915 Subpart K	Portable, Unfired Pressure Vessels, Drums & Containers, Other Than Ship's Equipment	29 CFR 1926.103	Respiratory Protection
29 CFR Subpart M	Compressed Gas & Compressed Air Equipment	29 CFR 1915.172	Portable Air Receivers & Other Unfired Pressure Vessels	29 CFR 1926.306	Air Receivers
29 CFR 1910.169	Air Receivers	29 CFR 1915 Subpart Z	Toxic And Hazardous Substances	29 CFR 1926 Subpart Z	Toxic And Hazardous Substances
29 CFR 1910.307	Hazardous (Classified) Locations	29 CFR 1915.1200	Hazard Communication		
29 CFR 1910 Subpart Z	Toxic And Hazardous Substances				
29 CFR 1910.1200	Hazard Communication				

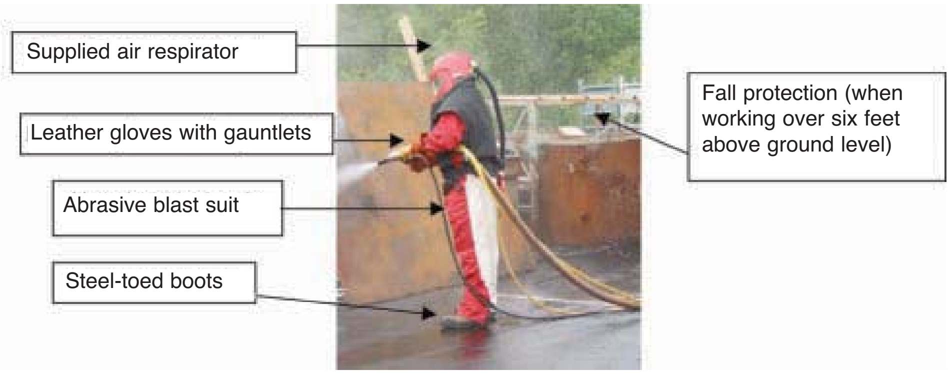


Fig. 2: Personal protective equipment required when abrasive blasting.

Another common mistake operators and employers make is using non-original replacement parts for these respirators. All manufacturers must get their respirators approved by the National Institute of Occupational Safety and Health (NIOSH). NIOSH approval is valid only when all the manufacturer's parts are used. There is no acceptable or approved non-original aftermarket replacement part, PERIOD! Everything that comes in the original respirator box must be replaced by the same item from the original manufacturer.

Fig. 3: Harness and shock-absorbing lanyard.

- helmet,
- removable knitted collar,
- breathing air hose,
- air control valve,
- cape,
- air supply line, and
- helmet lenses.

The only acceptable replacement parts for any of these items are those made by the original manufacturer.

This SAR must be supplied by what is termed as Grade D breathing air, as well as having oil, mist, and odors removed (Fig. 5). The sorbent bed filter shown in Fig. 5 removes oil, mist, and odors, but does not create Grade D air. The air entering this filter already must be Grade D.

Most compressors can provide Grade D air; however, several precautions must be taken. The air must be monitored for carbon monoxide. There are exceptions to the requirement for using CO monitors; but they are few, and the alternative is restrictive. The alternative is that all breathing systems include a CO monitor. The air coming from most compressors is also extremely hot. OSHA requires a high-temperature alarm or switch on the compressor.

It is recommended the employer supply the user with an air-temperature control valve as shown in Fig. 5. There are air control valves, which do not provide cooling; however, for a minimal investment, the employer can provide an air supply that makes this very demanding operation comfortable. Every SAR requires a defined airflow. This airflow is mandated by NIOSH and is controlled by the regulator. Lastly, the manufacturer of the respirator must supply the airline from the sorbent bed to the air control valve. These air lines are commonly color-coded for easy recognition.

While there are low-pressure SARs available for use with an ambient air pump, the vast majority of SARs are high-pressure respirators, which use air compressors for the air supply. There are air compressors that are oil-less and do not present a carbon monoxide hazard; however, the majority of compressors employers use are oil-lubricated and require a carbon monoxide alarm as well as a high-temperature alarm.

It is also common for employers to use the same compressor for providing breathing air as they use for operating the blast machine. It is important to remember to place the intake of the compressor away from sources of carbon monoxide, e.g., cars and trucks.

Figure 5 shows one of the most commonly used SARs. It is composed of a

This type of SAR has an Assigned Protection Factor (APF) of 25. This NIOSH rating means that the operator can work in an environment with contaminants defined by OSHA that are present at 25 times the permissible exposure limit. The safety professional who performs the original environmental audit will determine the concentration of OSHA-defined contaminants. All three manufacturers listed on p. 22 also obtained an OSHA exception to NIOSH's APF of 25 rating for lead. The OSHA exception rates these respirators as having an APF of 1000 for lead.

The Abrasive Delivery System

The third element, the abrasive delivery system, is the surface preparation equipment itself. The most common piece of equipment is the six-cubic foot capacity blast machine, commonly called a "six-sack pot." This slang is used to describe the number of bags of abrasive material loaded into the pot at one time. Figure 6 shows a six-cubic foot capacity blast

Fig. 4: Lightweight blast suit for hot environments (left); leather blast suit for cooler environments (right).

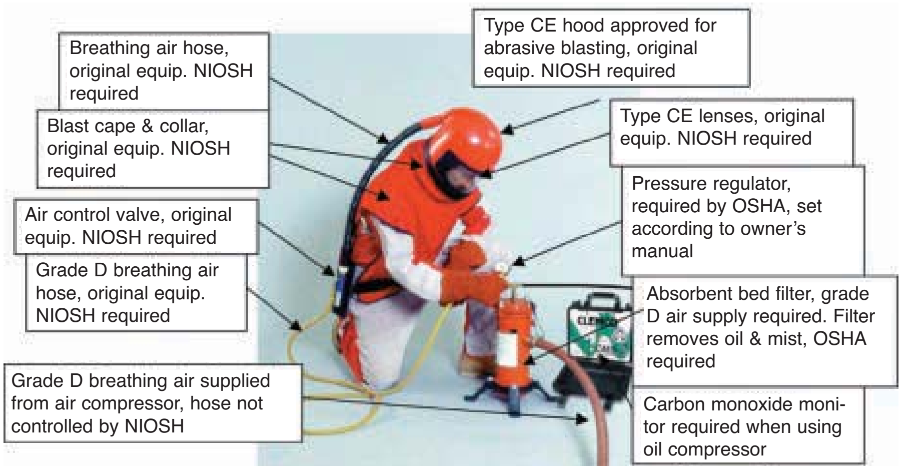


Fig. 5: One of the most commonly used supplied air respirator (SAR) setups.

machine and related equipment for abrasive blasting.

Misuse and abuse of surface preparation equipment is the major cause of all acute injuries when performing surface preparation. The following are common causes of injury.

- Moving machine while loaded with abrasive
- Placing fully loaded machine on scaffolding not rated for heavy loads
- Operator remote being bypassed, taped, or tied down
- Hose or nozzle being worn out and rupturing while under high pressure
- Coupling not being fully engaged and screwed tightly onto conductive hose causing a break in the conductive hose system and static discharge
- Coupling screws missing or not fully screwed into the hose
- Deflated tires

Abrasive blasting remains the predominant method to efficiently prepare a surface for coatings. However, abrasive blasting poses specific hazards, which must be addressed before beginning operation. The Federal or State Occupational Safety & Health Administration mandates all the above minimal monitoring and training requirements. The very best way to assure a safe and compliant workplace is to implement a Safety Audit and Training program developed by a Certified Safety Professional that is tailored to a specific operation.

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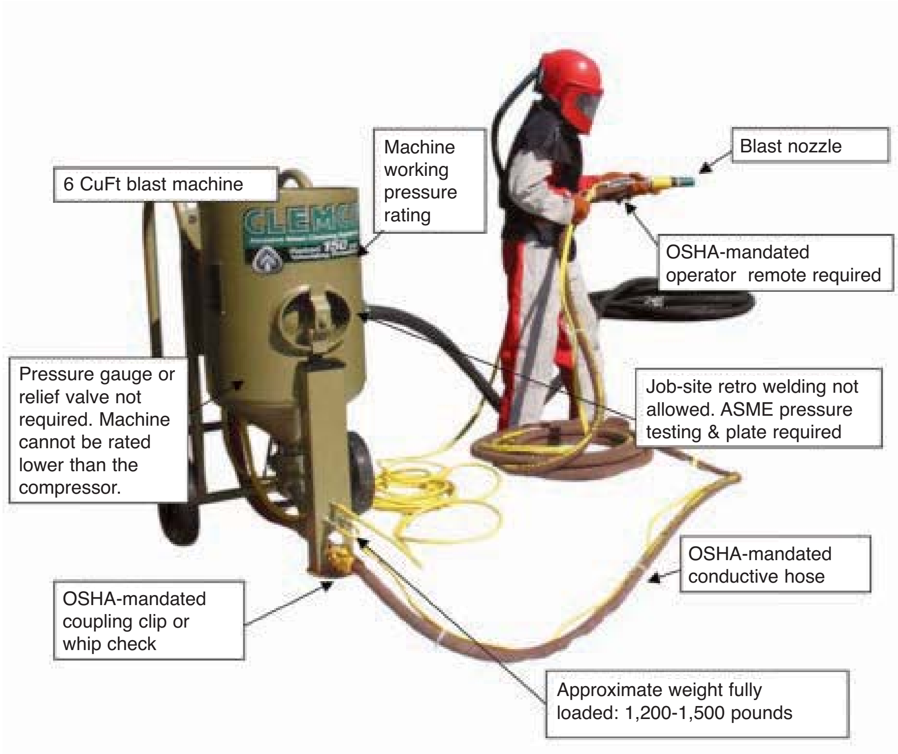

Fig. 6: Six cubic foot capacity blast machine and related equipment for abrasive blasting.

Safety Compliance Is Not the End of the Story

As noted earlier, several environmental standards also apply to air abrasive blasting. These standards are predominantly promulgated by Title 40 of the Code of Federal Regulations. These regulations can be found on the web site, http://www.epa.gov/epahome/cfr40.htm.

These federal regulations for environmental protection are based primarily on the Clean Air Act. They normally control the dust (PM10, or PM5) generated by open air blasting. The degree of dust abatement is predominantly controlled by a local governmental authority, which may be the State, County, or Air Pollution Control District. The Clean Water Act, and the Resource Conservation and Recovery Act, as well as related state and local enviromental laws, also figure prominently in

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the environmental regulations to protect water bodies, soil, groundwater, and the general public from contamination and exposure to hazardous materials.

It is the contractor's responsibility to obtain the proper environmental permits, such as a dust abatement permit, and comply with their standards. The primary document the surface preparation industry uses to comply with these regulations is the SSPC Guide #6, titled "Guide for Containing Debris Generated During Paint Removal Operations" (Publication No. 97-21, ISBN #1-889060-22-4). This document can be purchased and downloaded from the Internet by going to http://www.sspc.org/standards/guidescopes.html#g6.

This article quickly touches on the environmental requirements for using dust containment systems while preparing a surface to be painted; however, what controls containment more often is owner-mandated protection of the area surrounding the surface preparation work. Always take the time to investigate the surrounding area and the customer requirements for protection of non-work-site property.

Summary

Surface preparation, using open air abrasive blasting, is a very effective and economical way to provide high-quality surfaces ready to receive state-of-the-art coatings. Costs associated with employee accidents, regulatory actions, or damage to surrounding property add unnecessary expenses to a job. A well-planned job, which provides a safe environment for both the contractor's employees and the nearby public, always pays off in large cost savings and customer satisfaction.

Continued on p. 29

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Table 2: Job Hazard Analysis Model

Job Description: Blasting Setup	**Analyst:** Tom Enger		**Date:** April 1, 2009
Task/Activity	**Hazard Description**	**Hazard Control**	**Regulation-Standard**
Move pot to work area Tilt pot onto back wheels and push to work area. Upright pot	Pot tips, crush hand/fingers & toes; back injury; collateral damage	Move pot empty, use mule, inspect wheels prior to moving, inspect work surface for tipping hazards. Use gloves & steel-toe shoes	General Duty Clause, Section 5(a)(1) OSH Act 29CFR1910.136 & .138 29CFR1926.96 & Subpart E 29CFR1915.152 & .157
	Back injury, sprain/strain (pot weight ≥ 600 lbs, abrasive weight ≥ 600 lbs)	Move pot empty, remove all abrasive prior to moving. Inspect wheels, inspect work surface	General Duty Clause, Section 5(a)(1) OSH Act NIOSH "Work Practices Guide for Manual Lifting" PB94-176930LJM
	Floor/scaffold failure under load	Assure scaffold/floor is designed to handle load of pot & abrasive @ ≥ 1,200 lbs	29CFR1926 Subpart L - Scaffold Specifications 29CFR1910.28 - Safety Requirements for Scaffolding 29CFR1915.71 - Scaffolds or Staging ANSI/ASSE-A10.8-2001 Scaffolding Safety Requirements
Set up pot	Hand injury from sharp/rough equipment edges	Heavy cotton/leather gloves	29CFR1910.138 29CFR1915.157 29CFR1926 Subpart E
Add abrasive	Inhalation hazard, when adding abrasive	Type CE abrasive-blast respirator. Industrial environmental audit to determine PELs	29CFR1910.94(a) 29CFR1910.134 29CFR1915.154 29CFR1926.103 29CFR1910 Subpart Z 29CFR1915 Subpart Z 29CFR1926 Subpart Z 42CFR Part 84
Hook up blast hose & nozzle	Regulatory violation ESD, explosion/fire (Hazards associated with these violations occur during operation of equipment)	ESD/Conductive blast hose, metal couplings, conductive washers/blast hose system	29CFR1910.307(b)(2)(i) 29CFR1915.34(c)(1)(i) 29CFR1915.34(c)(1)(ii) 29CFR1915.34(c)(1)(iii) 29CFR1926.407(b)(2)(i)
	Regulatory violation (Hazards associated with these violations occur during operation of equipment)	Inspection/quality of hose, coupling, deadman, whip check/clips, nozzle & nozzle support is a regulatory requirement	29CFR1915.34(c)(2) 29CFR1915.34(c)(1)(iii) 29CFR1915.34(c)(1)(iv) 29CFR1926.302(b)(1) 29CFR1926.302(b)(5) 29CFR1926.302(b)(7) 29CFR1926.302(b)(10)
Hook up air supply hose to pot	Regulatory violation (Hazards associated with these violations occur during operation of equipment)	Inspection/quality of hose, coupling, whip checks/clips pressure reducing valve on air supply line	29CFR1915.34(c)(2) 29CFR1915.34(c)(1)(iii) 29CFR1915.34(c)(1)(iv) 29CFR1926.302(b)(1) 29CFR1926.302(b)(5) 29CFR1926.302(b)(7) conductivity standard

Abrasive Blasting Safety

Job Description: Blasting Setup	Analyst: Tom Enger		Date: April 1, 2009
Task/Activity	**Hazard Description**	**Hazard Control**	**Regulation-Standard**
Inspect pot for damage	Regulatory violation (Hazards associated with these violations occur during operation of equipment)	Inspect compressor to assure relief valve is operable & compressor does not exceed pot rating. Inspect for nonapproved ASME welds/modification	29CFR1910.169(b)(3) 29CFR1915.172(c) 29CFR1926.306(b)(3) ASME-VIII, Div.1,UG-125(g)(1) ASME-VIII, Div. 1, Sec. 9
Inspect pot piping	Possible failure when pressure is turned on	Inspect piping, especially piping in abrasive stream for wear and excessive rust	General Duty Clause, Section 5(a)(1) OSH Act
Set up respirator & put on respirator			
Select respirator	Unapproved respirator, regulatory violation (Hazards associated with these violations occur during operation of equipment)	Assure you have NIOSH respirator approved for abrasive blasting & toxins associated with surface and abrasive	29CFR1910.94(a)(5) 29CFR1915.34(c)(3) 29CFR1926.57(f)(5) 42CFR Part 84 OSHA 3142 – Lead In Construction NIOSH - Respirator User Notice: All Users of Type CE, Abrasive-Blast Supplied-Air Respirators NIOSH Respirator Selection Logic 2004
Inspect respirator	Unapproved respirator assemblies, damaged parts (Hazards associated with these violations occur during operation of equipment)	Inspect breathing hose, helmet, air hose, air control valve, & cape. All parts should be from same manufacturer. Check for cleanliness	29CFR1910.94(a)(5) 29CFR1915.34(c)(3) 29CFR1926.57(f)(5) 29 CFR1910.134(h)(3) 42CFR Part 84
Inspect absorbent bed filter	Regulatory violation (Hazards associated with these violations occur during operation of equipment)	Absorbent bed filter is normally cartridge type & is replaceable. Check housing & regulator for damage	29CFR1910.134(I)(5)(iii)&(iv) 29CFR1915.154 29CFR1926.103 29CFR1910.94(a)(6)
Inspect gage/regulator at respirator connection	Regulatory violation (Hazards associated with these violations occur during operation of equipment)	29 CFR 1910.134(I)(5) requires respirator to meet 42 CFR Part 84. This reg. requires use of gage/regulator	42CFR Part 84.82 (Gages) 42CFR Part 84.148 & .149 42CFR Part 84.155
Connect breathing air	Regulatory violation, improper fittings or tanks (Hazards associated with these violations occur during operation of equipment)	Ensure breathing air couplings are incompatible with outlets for nonrespirable worksite air. Ensure breathing gas containers are marked for breathing	29CFR1910.134(I)(8) 29CFR1910.134(I)(9)
	Regulatory violation, noncompliant breathing air from compressor (Hazards associated with these violations occur during operation of equipment)	Use, calibrate high temperature & carbon monoxide alarm. Place compressor intake away from contaminated air (car exhaust)	29CFR1910.94(a)(6) 29CFR1910.134(I) ANSI/CGA G-7.1
Put on blast suit	Regulatory violation, blast suit mandated by OSHA (Hazards associated with these violations occur during operation of equipment)	Put on “blast suit” coveralls or appropriate alternative	29CFR1910.94(a)(5)(v) 29CFR1910.132 29CFR1915.152 29CFR1915.157 29CFR1926.57(f)(5)(v) 29CFR1926.95

Abrasive Blasting Safety

Job Description: Blasting Setup	Analyst: Tom Enger		Date: April 1, 2009
Task/Activity	**Hazard Description**	**Hazard Control**	**Regulation-Standard**
Put on safety shoes	Regulatory violation, safety shoes mandated by OSHA (Hazards associated with these violations occur during operation of equipment)	Put on safety shoes	29CFR1910.94(a)(5)(v)&(v)(a) 29CFR1910.136 29CFR1915.153 29CFR1915.157 29CFR1926.57(f)(5)(v)& (v)(a) 29CFR1926.95 29CFR1926.96 ANSI Z41.1
Put on proper hearing protection	Regulatory violation, hearing protection mandated by OSHA (Hazards associated with these violations occur during operation of equipment)	Properly use hearing protection based on noise survey	29CFR1910.95 29CFR1910.95 App B 29CFR1910.132 29CFR1926.52 29CFR1926.101 ANSI S3.19 for NRR
Put on face protection	Regulatory violation, face protection mandated by OSHA (Hazards associated with these violations occur during operation of equipment)	Inspect inner respirator lens for ANSI Z87.1 stamp or put on safety glasses/shield compliant with ANSI Z87.1	29CFR1910.94(a)(5)(v)(b) 29CFR1910.133 29CFR1915.152 29CFR1915.153 29CFR1926.57(f)(5)(v)(b) 29CFR1926.95 29CFR1926.102 ANSI Z87.1
Put on head protection	Regulatory violation, head protection mandated by OSHA (Hazards associated with these violations occur during operation of equipment)	Inspect inner respirator for ANSI Z89.1 stamp/label or put on protection compliant with standards	29CFR1910.133 29CFR1910.135 29CFR1915.152 29CFR1926.57(f)(1)(ii) 29CFR1926.95 29CFR1926.100 ANSI Z89.1
Put on leather/canvas gloves	Regulatory violation, hand protection mandated by OSHA (Hazards associated with these violations occur during operation of equipment)	Put on gloves that have adequate coverage and durability to resist abrasive rebound and misdirected blast stream (i.e., leather/canvas gloves with gauntlets)	29CFR1910.94(a)(5)(v) 29CFR1910.132 29CFR1910.138 29CFR1915.152 29CFR1915.157 29CFR1926.57(f)(5)(v)(b) 29CFR1926.95 29CFR1926.102
Turn on breathing air line	Operator receives toxic or degraded air	Assure compressor, monitors, absorbent bed, gages/regulators and alarms are all working properly	29CFR1910.94(a)(5) 29CFR1915.34(c)(3) 29CFR1926.57(f)(5) 29 CFR1910.134(h)(3) 29CFR1910.134(I)(5)(iii)&(iv) 29CFR1915.154 29CFR1926.103 29CFR1910.94(a)(6) 29CFR1910.134(I)(8) 29CFR1910.134(I)(9) 29CFR1910.94(a)(6) 29CFR1910.134(I) 42CFR Part 84 42CFR Part 84.82 (Gages) 42CFR Part 84.148 & .149 42CFR Part 84.155 ANSI/CGA G-7.1
	Operator is not physically fit and suffers harm by the use of respirator	Assure each operator has annual pulmonary fitness test	29CFR1910.94(a)(5)(iv) 29CFR1910.134(e) 29CFR1915.134 29CFR1926.103

Abrasive Blasting Safety

Job Description: Blasting Setup	Analyst: Tom Enger		Date: April 1, 2009
Task/Activity	**Hazard Description**	**Hazard Control**	**Regulation-Standard**
Turn on blast air	Inadvertent operation of blast nozzle, damaged surrounding equipment, injury of operator/ bystanders Pot failure, piping failure, air & blast hose failure	Inspect operator's remote to assure proper operation and condition Inspect pot for wear and non-ASME approved welding. Inspect fittings & hoses for wear. Check to make sure pressure on compressor does not exceed blast equipment ratings	29CFR1915.34(c)(1)(iv) 29CFR1926.302(b)(10) 29CFR1910.169(b)(3) 29CFR1915.34(c)(2) 29CFR1915.172(c)(2) 29CFR1926.306(b)(3) ASME-VIII, Div.1,UG-125(g)(1) ASME-VIII, Div. 1, Sec. 9 ASME Standards
	Blast & air hoses disconnect at couplings	Inspect and install whip checks and safety clips onto couplings	29CFR1915.34(c)(1)(iii) 29CFR1926.302(b)(1) 29CFR1926.302(b)(2)
Actuate blast machine	Initial pressure pushes operator off platform–injury	Install handrails or require fall protection use Proper blast hose grip and operator position for blasting	29CFR 1926 Subpart L - Scaffold Specifications 29CFR 1910.28 - Safety Requirements for Scaffolding 29CFR 1915.34(c)(3)(v) 29CFR 1926.500 29CFR 1915.71 - Scaffolds or Staging A10.8-2001-ANSI/ASSE Scaffolding Safety Requirements
Blast surface	Body/bystander injury from rebound	Wear proper PPE: helmet/respirator, shoes, gloves, clothing, face/eye protection	Blast Suit: 29CFR1910.94(a)(5)(v) 29CFR1910.132 29CFR1915.152 29CFR1915.157 29CFR1926.57(f)(5)(v) 29CFR1926.95 Safety Shoes: 29CFR1910.94(a)(5)(v)&(v)(a) 29CFR1910.136 29CFR1915.153 29CFR1915.157 29CFR1926.57(f)(5)(v)& (v)(a) 29CFR1926.95 29CFR1926.96 ANSI Z41.1 Face/Eye Protection: 29CFR1910.94(a)(5)(v)(b) 29CFR1910.133 29CFR1915.152 29CFR1915.153 29CFR1926.57(f)(5)(v)(b) 29CFR1926.95 29CFR1926.102 ANSI Z87.1 Head Protection: 29CFR1910.133 29CFR1910.135 29CFR1915.152 29CFR1926.57(f)(1)(ii) 29CFR1926.95 29CFR1926.100 ANSI Z89.1 Leather/Canvas Gloves: 29CFR1910.94(a)(5)(v) 29CFR1910.132 29CFR1910.138 29CFR1915.152 29CFR1915.157 29CFR1926.57(f)(5)(v)(b) 29CFR1926.95 29CFR1926.102

Abrasive Blasting Safety

Job Description: Blasting Setup	Analyst: Tom Enger		Date: April 1, 2009
Task/Activity	**Hazard Description**	**Hazard Control**	**Regulation-Standard**
	Noise level exceeds 85 TWA & 130 dBA OSHA Max. Hearing damage	Wear proper hearing protection using Hearing Conservation Program and NIOSH recommendations	29CFR1910.95 29CFR1910.95 App B 29CFR1910.132 29CFR1926.52 29CFR1926.101 ANSI S3.19 for NRR Compendium of Hearing Protection Devices - Online Version NIOSH Publication No. 98-126 NIOSH Publication No. 96-110
	Inhalation hazards from abrasive and blasted surface	Perform industrial environmental audit to determine toxins generated by blasting operations	29CFR1910.94(a)(2)(ii) 29CFR1910.94(a)(5)(ii)(c) 29CFR1910.94(a)(5)(iv) 29CFR1910.94(a)(6) 29CFR1910.132(d)(1) 29CFR1910.134(a)(2) 29CFR1910.134(d)(1)(ii) 29CFR1910.134(d)(1)(iii) 29CFR1910.134(d)(3)(I) 29CFR1910.134(I)(1)(ii) thru (j) 29CFR1910 Subpart Z 29CFR1915.34(a)(4) 29CFR1915.34(c)(3)(I) thru (iii) 29CFR1915.152(b) 29CFR1915.154 29CFR1915 Subpart Z 29CFR1926.55(a) 29CFR1926.57(d)(2) 29CFR1926.57(f)(1)(vi) 29CFR1926.57(f)(2)(I)thru(iii) 29CFR1926.57(f)(5)(I)thru(iv) 29CFR1926.57(f)(6) 29CFR1926.103 29CFR1926 Subpart Z
		Proper respirator selection & use	29CFR1910.94(a)(1)(ii) 29CFR1910.94(a)(5) 29CFR1910.94(a)(6) 29CFR1910.134 29CFR1915.154 29CFR1926.57(f)(5)&(6) 29CFR1926.103 NIOSH Pub. #2005-100
	Tripping hazards	Maintain clean work area, remove spent abrasive	29CFR1910.22 29CFR1915.77 29CFR1926.25 29CFR1926.57(f)(7)
	ESD – Explosion, shock	Use conductive blasting system, i.e., hoses & couplings	29CFR1910.307(b)(2)(i) 29CFR1915.13(b)(11) 29CFR1915.34(c)(1)(i) 29CFR1915.34(c)(1)(ii) 29CFR1915.34(c)(1)(iii) 29CFR1926.407(b)(2)(i)
Stop blasting operation	Inadvertent operation of nozzle	Hang nozzle on appropriate hook, assure safety latch operates properly	29CFR1915.34(c)(1)(iii) 29CFR1926.302(b)(10)

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Photos courtesy of KTA-Tator

Time Is Money: Improving Shop & Field Painting Throughput by Reducing Finish Coat Handling Time

By Benjamin Fultz, Bechtel Corporation; William D. Corbett, KTA-Tator, Inc.; and Kurt Best, Bayer MaterialScience

Shop-field throughput—which includes handling and transporting finish-coated steel from the fabrication shop to the project site—is affected by the time it takes the finish coat to dry. Reducing the dry time required before handling (without compromising performance), as well as minimizing damage from handling, can reduce project costs. The authors believe that it may be possible to save at least one or two full days of throughput time by using a two-coat system (organic zinc or inorganic zinc silicate primer with a fast-dry finish coat) compared to a two-coat or three-coat system with a slower drying finish coat. Additionally, faster dry times reduce the risk of dust, abrasive, and other airborne contaminants from becoming embedded into the finished product. This article reports on a study that compared the handling time of three generic types of high-performance finish coats applied as two- and three-coat systems, and cured under normal and cold/damp conditions, to evaluate handling performance under adverse curing conditions. The study used traditional standardized test procedures for coated steel as well as novel testing procedures designed to simulate

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actual handling and environmental conditions in the shop or field. The reasons for the novel testing procedures are also described.

Coating Systems

Six coating systems (supplied by three coating manufacturers) were included in the study (Table 1). The polysiloxane, polyaspartate, and polyurethane coatings each came from different manufacturers.

Table 1: Coating Systems Tested

Code	Generic Coating System
A	Organic (epoxy) Zinc Primer/Polysiloxane Finish
B	Organic (epoxy) Zinc Primer/Polyaspartate Finish
C	Organic (moisture-cure urethane) Zinc Primer/Polyaspartate Finish
D	Inorganic Zinc Primer/Epoxy Mid Coat/Acrylic Polyurethane Finish
E	Inorganic Zinc Primer/Polysiloxane Finish
F	Inorganic Zinc Primer/Polyaspartate Finish

Test Panel Preparation

The study included a variety of substrate sizes, test panels types, surface preparation methods, and tests. Test panel preparation data is presented in the original paper.

All coatings were mixed, thinned, and applied in accordance with the respective manufacturer's instructions. The coatings were applied by conventional (air) spray. Dry film thickness measurements were acquired after the application of each coat using an electronic coating thickness gage. Coating thickness data was collected for two sets of panels: one set at ambient cure of the finish coat (Set 1) and one set at a colder temperature/higher humidity cure (Set 2). The range was reported for each; the average was also recorded. The "cure-to-test" time (and/or film deformation caused by testing) for the finish coats prevented the acquisition of dry film thickness measurements on certain panels.

The organic zinc-rich primers were cured for 24 hours before the finish coats were applied, while the inorganic zinc primers were cured for 48 to 96 hours before the mid- and finish coats were applied. The epoxy mid-coat for the three-coat system was cured for 24 hours before the finish coat was applied.

The finish coats were cured at two different conditions: 72 F and 50% relative humidity; and 50 F and 75% relative humidity. All curing was accomplished in an environmentally-controlled chamber. As shown in Table 2, the cure time between finish coat application and testing ranged from 2 hours to 35 days, depending on the testing protocol (indicated by "√").

Testing Procedures

Standard ASTM testing procedures were performed, including dry-to-handle testing of the finish coats only (ASTM D1640, Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature). Also performed were impact resistance (ASTM D2794, Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact)), Taber abrasion (ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser), and tensile (pull-off) adhesion (ASTM D4541, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers).

There are no standardized tests to simulate some of the handling challenges commonly encountered in the shop and field. Therefore, non-traditional testing procedures were designed to represent several common handling practices and problems associated with extended cure times. The novel procedures included resistance to abrasive/dust pick-up, compression/tensile pull, and contact point. Each of the standard ASTM test methods and non-standard test procedures is described below.

Impact Resistance

The impact resistance was determined in accordance with ASTM D2794. Steel Q-panels (0.032 in. x 4 in. x 6 in.), prepared to SSPC-SP 7 (brush blast) and coated, were used. The testing was performed in direct (coating upward) orientation of the panels. A four-pound

Table 2: Cure Times before Testing

Test	2 Hours	6 Hours	12 Hours	24 Hours	48 Hours	35 Days
Impact Resistance	√	√	√	√		√
Taber Abrasion		√	√	√		√
Abrasive/Dust Pick-up	√	√				√
Compression/Tensile Pull	√	√	√	√		√
Contact Point		√	√	√	√	√
Tensile Adhesion			√	√		√

Fig. 1: Removal of abrasive/dust blend after one hour of dwell time.

Fig. 2: Aligning mating surfaces for compression load

weight was dropped from various heights along the guide tube of the apparatus on a tap directly onto the coated surface. The maximum height at which the coating exhibited no cracking was considered to be the impact resistance of the coating.

Taber Abrasion

Taber abrasion resistance was determined in accordance with ASTM D4060. Duplicate 4-inch x 4-inch steel Taber panels, prepared to SSPC-SP 1 (solvent clean) and coated, were weighed and then subjected to 1000 cycles using a 1000g load and CS-17 abrasion wheels. Post weights were acquired and the weight loss (in mg) was reported.

Tensile Adhesion

Tensile adhesion (pull-off strength) was measured in accordance with ASTM D4541, Annex A4, Self-Aligning Adhesion Tester Type IV. Steel test panels (4 in. x 6 in.), prepared to SSPC-SP 5 (White Metal) and coated, were used. The testing surfaces were wiped clean and abraded gently using fine sandpaper. Loading fixtures with an abraded test surface were attached to the coating using a two-component epoxy adhesive, which was allowed to cure at ambient laboratory conditions. The fixtures were then detached using a self-aligning pneumatic adhesion tester. The force (in psi) required to remove each loading fixture was recorded along with the location of the break and approximate percentage of each. The location of break was defined as adhesive (a split between layers), cohesive (within a layer), or glue failure (coating strength exceeds glue strength).

Resistance to Abrasive/Dust Pick-Up

Since airborne dust and stray abrasive are not uncommon in the shop and field, a novel test was designed to evaluate each respective finish coat's resistance to dust/abrasive debris pick-up. Steel Q-panels, solvent cleaned to SSPC-SP 1 and coated, were used. To evaluate debris pick-up, approximately 50 grams of an abrasive/dust blend (G50 steel grit and silica dust; approximately 25 grams of each) was poured onto the finish coated panels (positioned horizontally) after the designated curing times (see Table 2) and allowed a one-hour dwell time. The panel was then inverted, and any abrasive/dust that did not adhere to the coating was poured off (Fig. 1). The panel was then carefully blown off with clean, dry compressed air at a distance that would remove any loosely adhering debris but not dislodge debris trapped in the coating film. The finish-coated surface was then evaluated visually for residual debris (none, very minor, moderate, or severe). In addition, post-test gloss values (at 65 F and 85 F) were acquired in general accordance with ASTM D523, Specular Gloss, and compared to the gloss values on the 35-day cure panels (considered baseline, because no debris would adhere after a 35-day cure) to assess whether dust or debris lodged in the film reduced the gloss of the finish coat. The gloss values and percent gloss retention are reported.

Compression/Tensile Pull

Duplicate ⅝ in. x 3 in. x 4 in. carbon steel test panels were prepared to SSPC-SP 5 (White Metal) and coated on one surface. After the curing times shown in Table 2, the coated surfaces were mated and placed under a predetermined compression load (260 lbs-force to simulate stacking of coated members) using a load cell of a Universal Testing apparatus (Figs. 2 and 3). The lbs-force was selected based on the weight of one linear foot of I-beam with a 36-in. web with 16.5 in. wide x 1.440 in. thick flanges. If the mating surfaces attached to one another, bolts were threaded into pre-drilled and tapped holes in the non-coated faces, then the assembly was mounted in the Universal Testing apparatus and the force (in pounds) to separate the mating surfaces was quantified (Figs. 4 and 5). Any damage to the coating on the mating surfaces (once separated) was visually assessed (none, very minor, moderate, or severe).

Contact Point

Duplicate ⅝ in. x 4 in. x 12 in. carbon steel test panels were prepared to SSPC-SP 5 and coated on one surface. After the cure times listed in Table 2, the coated surface of the steel panels was placed onto the apex of two pieces of angle iron (simulating dunnage placed beams during transit, or resting points for pipe sections during coating). A load (260 pounds) was applied to the plate for 24 hours (Figs. 6 and 7). Damage to the coating after the dwell time was rated on a relative scale of 5 (none) to severe (1).

Fig. 3: Application of 260 lbs of force to mating surfaces

Test Results

Other than the dry time testing, the standardized ASTM procedures used in the testing program yielded little useful data because these tests are primarily designed to be performed on fully cured films. For example, the impact resistance was relatively high during the early curing stages of the finish coats, but diminished as the film cured and became harder. After 35 days' ambient cure, all six coating systems exhibited an impact resistance of 10–15 inch-lbs. Abrasion resistance varied widely, and at colder temperatures and higher humidity, the coating was too wet to test for two of the four systems (polyurethane and polysiloxane finish coats), even after 24 hours' curing. Tensile (pull-off) adhesion values were all relatively low at 12 hours' cure time (note that the loading fixtures were attached to the coating film a minimum of 8 hours' prior to testing, so the epoxy adhesive may have affected the properties of the uncured finish coat). The adhesion values increased substantially after 24 hours' cure time (ambient cure) but remained relatively low after 24 hours' cure at 50 F/75% RH curing conditions.

Fig. 4: Threading pulling rods to back sides of compression panels

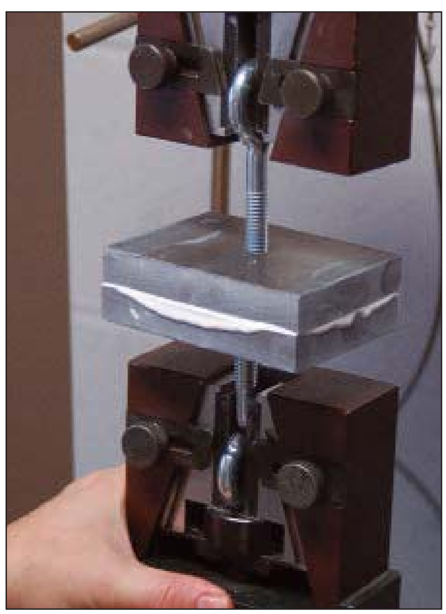

Fig. 5: Application of tensile force to separate compression panels

Conversely, the non-traditional testing procedures (gloss retention after abrasive/dust pick-up, compression/tensile pull and contact point) appeared to produce data that showed relative differences in performance under both finish coat curing conditions.

The data for the dry-to-handle times for each of the three finish coats (ASTM D1640) and for the non-traditional tests are summarized in Tables 3–7. The results are the average of duplicate tests when testing was performed using replicate samples.

Analysis Of Test Results

A relative rating system was created in order to compare the performance of

Table 3: Dry-to-Handle Times of Finish Coats (ASTM D1640)

Product	Dry-to-Handle Time (@ 23±2°C & 50±5%RH)
Polyaspartate	50 minutes
Polysiloxane	4 hours, 25 minutes
Acrylic Polyurethane	5 hours, 15 minutes

Table 4: Results of Gloss Retention After Abrasive/Dust Pick-Up Test (60° Angle)

Coating System	Ambient Cure (72°F/50% RH)		Cold/Damp Cure (50°F/75% RH)	
	2 Hours	6 Hours	2 Hours	6 Hours
OZ/Polysiloxane (A)	1.6%	17.2%	NA	NA
OZ/Polyaspartate (B)	80.5%	89.3%	NA	NA
MCUZ/Polyaspartate (C)	157.3%*	152.7%*	159.1%*	156.3%*
IOZ/EP/Polyurethane (D)	7.6%	17.9%	6.5%	8.5%
IOZ/Polysiloxane (E)	4.5%	15.9%	2.5%	5.3%
IOZ/Polyaspartate (F)	97.8%	111.3%*	113.8%*	126.4%*

**Gloss values increased from baseline. May be due to differences in application*

the various coating systems. In addition, a weighting factor was assigned to each test, which was based on the relative importance of the characteristic. The rating scale and weightings are shown in Table 8. The dry-to-handle times determined according to ASTM D1640 were not included and weighted in the analysis because the procedure is not a performance test and was only conducted on the finish coats under prescribed conditions of temperature and humidity. Also, results from ASTM D2794, D4060, and D4541 were not weighted because most data from them was not useful.

Gloss Retention after Abrasive/Dust Pick-up (72 F/50% RH; 50 F/75% RH)

After two and six hours' cure, the three coating systems containing the polyaspartate finish coat displayed the highest gloss retention (>81% of the baseline gloss), resulting in a weighted rating of (6.50) for each system. The polysiloxane and polyurethane systems displayed gloss retentions less than 20% of baseline and received weighted ratings of 1.30.

Resistance to 260 Pounds-Force Compression (72 F/50% RH)

All six coating systems displayed severe damage after two hours' cure when subjected to 260 pounds-force compression for one hour. However after six hours' cure, two systems (organic zinc/polyaspartate and moisture-cure urethane zinc/polyaspartate) did not reveal any damage to the finish coat, even though tensile force had to be applied to the panel sets to pull them apart. The organic zinc/polysiloxane system exhibited very minor damage after six hours' cure. The remaining three systems exhibited severe damage resulting from compression testing after six hours' cure. Only one system (inorganic zinc/epoxy/polyurethane) exhibited severe damage resulting from compression testing after 12 hours' cure. None of the six systems displayed damage of the film resulting from compression testing after 24 hours' cure. The

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Table 5: Results of Gloss Retention After Abrasive/Dust Pick-Up Test (85° Angle)

Coating System	Ambient Cure (72°F/50% RH)		Cold/Damp Cure (50°F/75% RH)	
	2 Hours	6 Hours	2 Hours	6 Hours
OZ/Polysiloxane (A)	0.2%	1.1%	NA	NA
OZ/Polyaspartate (B)	138.9%*	157.6%*	NA	NA
MCUZ/Polyaspartate (C)	86.3%	88.7%	98.4%	98.7%
IOZ/EP/Polyurethane (D)	1.3%	2.0%	1%	1%
IOZ/Polysiloxane (E)	0.8%	1.8%	0.4%	1.3%
IOZ/Polyaspartate (F)	99.8%	126.4%*	147.1%*	151%*

**Gloss values increased from baseline. May be due to differences in application*

Table 6: Damage After Compression/Tensile Pull Test

Coating System	Ambient Cure (72°F/50% RH)				
	35 Days (control)	2 Hours	6 Hours	12 Hours	24 Hours
OZ/Polysiloxane (A)	None	Severe	Very Minor	None	None
OZ/Polyaspartate (B)	None	Severe	None	None	None
MCUZ/Polyaspartate (C)	None	Severe	None	None	None
IOZ/EP/Polyurethane (D)	None	Severe	Severe	Mod.-Severe	None
IOZ/Polysiloxane (E)	None	Severe	Severe	None	None
IOZ/Polyaspartate (F)	None	Severe	Severe	None	None

Coating System	Cold/Damp Cure (50°F/75% RH)			
	2 Hours	6 Hours	12 Hours	24 Hours
MCUZ/Polyaspartate (C1)	Severe	Severe	Severe	Moderate
IOZ/EP/Polyurethane (D1)	Severe	Severe	Severe	Minor-Moderate
IOZ/Polysiloxane (E1)	Severe	Severe	Mod.-Severe	Very Minor-Minor
IOZ/Polyaspartate (F1)	Severe	Severe	Moderate	Minor

overall weighted ratings for resistance to compression (72 F/50%) for each of the six systems follow.

- Organic zinc/polyaspartate (5.40)
- Moisture-cure urethane zinc/polyaspartate (5.40)
- Inorganic zinc/polyaspartate (4.05)
- Inorganic zinc/polysiloxane (4.05)
- Organic zinc/polysiloxane (4.05)
- Inorganic zinc/epoxy/polyurethane (2.70)

Resistance to 260 Pounds-Force Compression (50 F/75% RH)

All six coating systems displayed severe damage after two hours' and six hours' cure when subjected to 260 pounds-force compression for one hour. One system (moisture-cure urethane zinc/polyaspartate) did not reveal any damage to the finish coat when cured for 12 hours before testing, even though tensile force had to be applied to the panel set to pull them apart. Two systems (organic zinc/polyaspartate and moisture-cure urethane zinc/polyaspartate) did not reveal any damage to the finish coat after compression testing at 24 hours cure. The overall weighted ratings for each of the four systems follow.

- Moisture-cure urethane zinc/polyaspartate (4.05)
- Inorganic zinc/polyaspartate (2.70)
- Inorganic zinc/polysiloxane (1.35)
- Inorganic zinc/epoxy/polyurethane (1.35)

Fig. 6: Positioning of panel on apex of 1-inch angle iron (coated side down) for contact point test

Fig. 7: Application and positioning of weight onto coated panel for contact point test

Table 7: Damage after 24-Hour 260# Contact Point Test

Coating System	Ambient Cure (72°F/50% RH)				
	35 Days (control)	6 Hours	12 Hours	24 Hours	48 Hours
OZ/Polysiloxane (A)	None	Moderate	V. Minor	None-V. Minor	V. Minor
OZ/Polyaspartate (B)	Very Minor	Moderate	Minor	Very Minor	Minor
MCUZ/ Polyaspartate (C)	Very Minor	Severe	Severe	Mod.-Severe	Moderate
IOZ/EP/Polyurethane (D)	None	Severe	Severe	Minor-Mod.	Minor
IOZ/Polysiloxane (E)	None	Severe	Severe	Very Minor	V. Minor
IOZ/Polyaspartate (F)	Very Minor	Severe	Severe	Minor-Mod.	Minor-Mod.

Coating System	Cold/Damp Cure (50°F/75% RH)			
	6 Hours	12 Hours	24 Hours	48 Hours
MCUZ/Polyaspartate (C1)	Severe	Severe	Severe	Moderate
IOZ/EP/Polyurethane (D1)	Severe	Severe	Severe	Minor-Mod.
IOZ/Polysiloxane (E1)	Severe	Severe	Mod.-Severe	V. Minor-Minor
IOZ/Polyaspartate (F1)	Severe	Severe	Moderate	Minor

Resistance to 24-hour 260# Contact Point Load (72 F/50% RH)

After six hours' cure, the systems were subjected to 24-hour 260# contact point load. Three of the six systems containing the polyaspartate finish coats displayed moderate damage to the film (weighted rating of 2.70) after 24 hours' contact point loading; the remaining three systems displayed severe damage (weighted rating of 1.35). After 12 hours' cure, one system (organic zinc/polysiloxane) showed very minor damage (weighted rating of 5.40), while the remaining systems showed moderate damage (weighted rating of 2.70) to severe damage (weighted rating of 1.35) to the film. After 24 hours' cure, one system (moisture-cure urethane zinc/polyaspartate) showed moderate damage to the film (weighted rating of 2.70), while the remaining five systems revealed minor damage (weighted rating of 4.05). After 48 hours' cure, two systems (organic zinc/polysiloxane and inorganic zinc/epoxy/polyurethane) displayed very minor damage (weighted rating of 5.40), while the remaining four systems all displayed minor damage (weighted rating of 4.05).

Resistance to 24-hour 260# Contact Point Load (50 F/75% RH)

After 12 hours' cure, the systems were subjected to 24-hour 260# contact point load. One of the four systems (inorganic zinc/polyaspartate) displayed minor damage to the film (weighted rating of 4.05) after 24 hours' contact point loading; the remaining three systems displayed severe damage (weighted rating of 1.35). After 24 hours' cure, one system

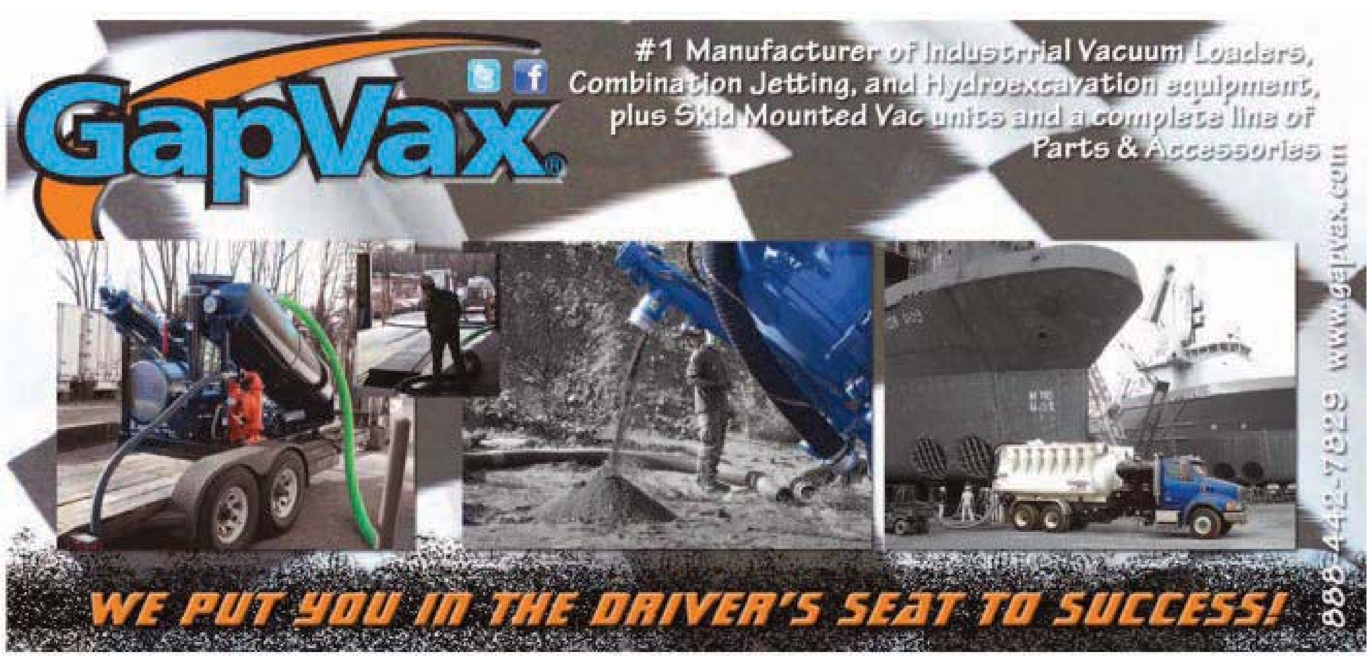

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Table 8: Rating Scale and Weighting Factors

Test	Result Range	Point Value	Weight Factor
ASTM D523, Gloss Retention after Abrasive/Dust Pick-up (60° and 85° incidence angle)	>81% gloss retention	5	30%
	61–80% gloss retention	4	
	41–60% gloss retention	3	
	21–40% gloss retention	2	
	< 20% gloss retention	1	
Resistance to Compression No Damage	<2 hours	5	35%
	2–6 hours	4	
	>6–12 hours	3	
	>12–24 hours	2	
	>24 hours	1	
Contact Point Damage	None	5	35%
	Very minor	4	
	Minor	3	
	Moderate	2	
	Severe	1	

(inorganic zinc/polyaspartate) showed minor damage (weighted rating of 4.05) and one system (moisture-cure urethane zinc/polyaspartate) showed moderate damage (weighted rating of 2.70; the remaining systems showed severe damage to the film (weighted rating of 1.35). After 48 hours' cure, one system (inorganic zinc/polyaspartate) displayed very minor damage (weighted rating of 5.40). The moisture-cure urethane zinc/polyaspartate system and the three-coat inorganic zinc/epoxy/polyurethane system displayed minor damage (weighted rating of 4.05). The inorganic zinc/polysiloxane system showed moderate damage (weighted rating of 2.70).

Summary of Results

Based on the testing performed in this study, the polyaspartate finish coat performed equivalent to or slightly better than the polysiloxane finish coat when cured under normal conditions of temperature and humidity (72 F and 50% relative humidity). The polyaspartate finish coat performed comparatively better when tested for resistance to abrasive/dust pick-up and compression damage, while the polysiloxane appeared to have better performance in the contact point testing under the same curing conditions. Both finish coats outperformed the acrylic polyurethane finish.

The polyaspartate finish coats outperformed the polysiloxane and polyurethane finish coats when cured under cold/damp conditions (50 F and 75% relative humidity) in all three of the tests designed to simulate product handling (abrasive/dust pick-up, compression damage, and contact point damage).

It does not appear that the generic type of primer used with the polyaspartate finish coat affected the performance of the finish coat (cured at 72 F/50% RH). The type of primer used with the polysiloxane finish coat may have affected the performance of the finish coat, because there was a decrease in performance when an inorganic zinc was employed (versus an epoxy zinc primer). Since the polyurethane was only used in a single system, it is unknown whether the primer (or primer/mid-coat) affected the performance of the finish coat.

Conversely, there appeared to be some effect of the primer on the finish coat performance when the polyaspartate finish coat was cured under cold/damp conditions (50 F/75% RH), because there was a reduction in performance when a moisture-cure urethane zinc primer was employed, compared to an inorganic zinc primer. Because the polysiloxane and polyurethane finish coats were used only in a single system (both over inorganic zinc primers), it is unknown whether the primer (or primer/mid-coat) affected the performance of the finish coat.

Conclusions

Based on the data generated by this study, it appears that the use of polyaspartate and polysiloxane finish coats in steel fabrication shops (or "blast & paint" shops), when cured under "normal" conditions of 72 F air temperature and 50% relative humidity can reduce throughput time and minimize or eliminate damage caused by stray abrasive or airborne dust in the cured film and compression (stacking), when compared to the performance of two-component acrylic polyurethane finish coats.

When shop conditions are cooler and the relative humidity is escalated (e.g., 50 F air temperature and 75% relative humidity), the use of a polyaspartate finish coat can reduce shop-to-field throughput by producing a hardened film that resists handling damage (abrasive/dust pick-up, compression and contact point damage), even at the lower temperature and higher humidity. Neither the polysiloxane nor the two-component acrylic polyurethane finish coats can be applied under these conditions without extended cure times before handling.

This study was not exhaustive and raises a couple of issues that may need further research. These include:

Are the data representative of the performance of polyaspartates, polysiloxanes, and acrylic polyurethanes as product classes, or can differences in performance be expected between various manufacturers of these generic classes?

Since the testing procedures that appeared to produce the most meaningful data were novel and non-standardized, is there a need to develop consensus-driven industry standards (complete with precision and bias statements) in order to evaluate shop throughput attributes of finish coats uniformly? The data generated by this testing program was used to make relative comparisons of finish coat performance under controlled procedures by a single laboratory. The testing was performed using replicates, and the data are considered reliable. However, the repeatability and reproducibility of the non-traditional test methods used in this study are unknown, because these methods are not standardized by ASTM International, ISO, or other industry organizations.

Ben Fultz works for Bechtel Corporation, where he is Chief, Materials Engineering Technology Bechtel Fellow. He has more than 44 years of experience in technical and production management of protective coatings uses and applications. His predominant work has been in marine, chemical processing, and nuclear applications, but he also has knowledge of other corrosion control techniques. He was recently elected Vice President of the SSPC Board of Governors and will become president of the organization in 2013. (See p. 6.) In addition to being active in SSPC for many years, he is a member of ASTM, NACE, and ASM. Fultz was recently named one of 24 *JPCL* Top Thinkers: The Clive Hare Honors, in recognition of his leadership in the coatings industry. He was a contributing editor to *JPCL* and has written frequently for *JPCL*. He won SSPC's Outstanding Paper Award (1991) as well as two *JPCL* Editors' Awards (1996 and 1999). He holds a B.S. in chemistry from Spring Hill College.

Bill Corbett is the Professional Services Business Unit Manager for KTA-Tator, Inc., where he has been employed for 32 years. He is an SSPC-approved instructor for three SSPC courses, and he holds SSPC certifications as a Protective Coatings Specialist, Protective Coatings Inspector, and Bridge Coatings Inspector. He is also a NACE Level 3-certified Coatings Inspector. He was the co-recipient of the SSPC 1992 Outstanding Publication Award, co-recipient of the 2001 *JPCL* Editors' Award, recipient of SSPC's 2006 Coatings Education Award, and recipient of SSPC 2011 John D. Keane Award of Merit. He holds an A.D. in business administration from Robert Morris University.

Kurt Best is a Principal Scientist with Bayer MaterialScience LLC in Pittsburgh, PA. With Bayer for over 24 years, Best started his career in the Inorganic Pigments Division, which led him to polyurethane coatings in 1989. He currently leads development and technical support efforts for Bayer in the areas of corrosion protection and heavy-duty maintenance, commercial and military aviation, military ground equipment, and naval and commercial marine arenas, as well as in light architectural applications. He is a co-winner of the Green Chemistry Award in 2000, sponsored by the USA Environmental Protection Agency. He is a member of SSPC, the past Committee Chair for ASTM D-1.33 and an active member of D-1.46. He holds a B.S. in chemistry from Thiel College and an M.S. in chemistry from Duquesne University.

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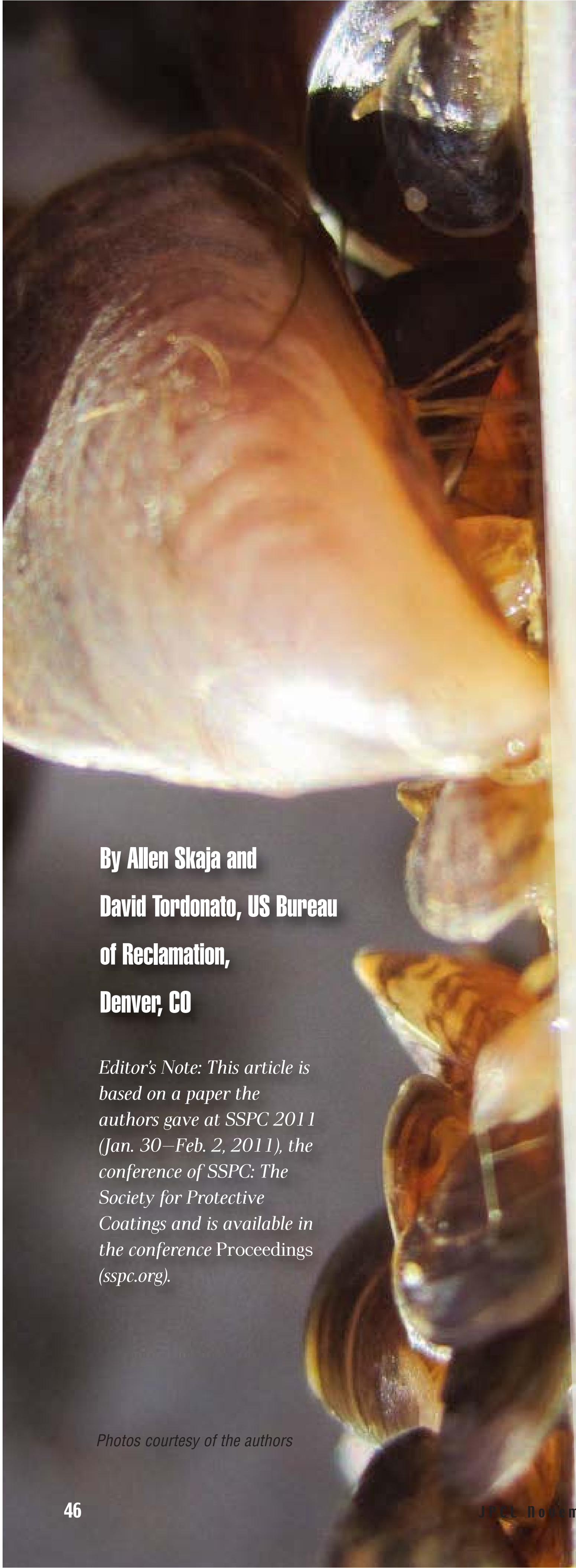

Evaluating Coatings to Control Zebra Mussel Fouling

By Allen Skaja and David Tordonato, US Bureau of Reclamation, Denver, CO

Editor's Note: This article is based on a paper the authors gave at SSPC 2011 (Jan. 30–Feb. 2, 2011), the conference of SSPC: The Society for Protective Coatings and is available in the conference Proceedings *(sspc.org).*

Photos courtesy of the authors

The US Bureau of Reclamation is part of the U.S. Department of Interior. The main function of the Bureau of Reclamation is to deliver water and hydropower in the 17 western United States. The Bureau of Reclamation produces 17% of the nation's hydropower; supplies irrigation water for 10 million acres of farmland (25% of fruits and 60% of vegetables produced in the U.S.); and serves 31 million people for municipal, residential, and industrial water use.[1] The Bureau of Reclamation's infrastructure consists of dams, power plants, pumping plants, canals, pipelines, storage tanks, fish hatcheries, desalination plants, and water treatment plants, and as such, has a complex infrastructure that is highly susceptible to zebra/quagga mussel infestations, which interfere with the water and hydropower operations.

Quagga mussels were first found in western waters during January 2007 in Lake Mead (Hoover Dam). Since then, the mussels have spread downstream and into the Colorado aqueduct to Los Angeles and the Central Arizona Project to Phoenix. There has also been confirmed detection of zebra and quagga mussels in a few other reservoirs in the western United States. Due to the warm climate of the southwest, the mussels are able to reproduce at greater rates than in the Great Lakes and Upper Mississippi River.

Zebra and quagga mussels are freshwater fouling mussels that attach themselves using byssal threads. The zebra mussel is named for the distinct striped pattern of its shell. The quagga mussel is slightly larger, about the size of a thunb nail; is also striped; but fades away towards the hinge.

Currently, the greatest risks from mussel infestations are in blockages of small diameter piping (such as cooling water, HVAC, and domestic water piping); fish screens; and intake structures. Because of the potential impact mussels will have on Reclamation infrastructure, a research program to minimize their effects was started.

In other studies, investigators have tested the efficacy of antifouling and foul-release coatings by suspending coated plates in static water. However, mussel attachment and coating service life are likely to depend on water velocity, with foul release-coatings relying on hydrodynamic drag forces for mussel removal, and antifouling coatings exhibiting biocide depletion rates that are directly dependent on velocity. The Bureau of Reclamation study addresses this by testing coatings in flowing water as well as static conditions.

The first round of testing began in May 2008 at the Parker Dam on the Colorado River. A variety of different coatings and materials was investigated, which included but was not limited to, zinc metal coatings, copper metal alloys, copper-based antifouling coatings, biocide release coatings, and foul-release coatings. The first year results of this study were published previously. Three coatings were still performing after one year of exposure: two foul-release coatings and an antifouling coating containing copper.[1,2]

This article describes The Bureau of Reclamation's second year of testing, which focused on non-toxic foul-release coatings, because of the end use of the water for irrigation, municipal uses, and recreation.

Test Program

Foul-release coatings were appealing mainly because of their lower toxicity and promising results from the previous year. Therefore, non-toxic foul-release coatings will be the primary focus throughout the remainder of the testing, unless proof of the environmental fate of the biocides can be provided for fresh water and even more importantly for irrigation canals.

A secondary focus was to find more durable foul-release coatings for use on trash racks and intakes where high impact and abrasion is seen. One interest was fluorinated powder coatings due to their low surface energies and greater durability. There was no data showing whether or not fluorinated powder coatings would work at preventing mussel attachment. Another interest was fluorinated polyurethanes and silicone epoxy foul-release coatings, which are also characterized by low surface energy and greater durability.

Modifications to the initial study this year consisted of securing stainless steel control substrates to each sample, quantifying the extent of fouling, measuring the force to remove mussels from the surface, changing the depth of immersion to avoid contact with the concrete cross members, recording the environmental factors, and measuring the velocities at each bay with varying turbine units in operation.

Extent of Fouling

The percent of flow blockage for the grates was measured for all the coatings evaluated in the year 2009. To obtain this information, the photos were evaluated using the graphics program IMAGEJ. A cropped image of each grate was selected for the analysis. A series of 20 randomized measurements were taken over the middle third of the image. A pixel count was then taken horizontally to measure the inner and outer spacing of the grate as shown in Fig. 1.

The percent blockage was calculated according to the following equation.

$$\%\ Blockage = \frac{L_1 - L_2}{L_1 + L_2}$$

Fig. 1: Schematic for percent blockage calculation.

The 20 data points were averaged, and the blockage figure was corrected for the metal and coating thickness to allow for a direct comparison between substrates. Two methods were used to correct for the metal and coating thickness. For one method, photos were taken before exposure. In another method, a clean portion of the grate was used to subtract out the coating and steel thickness. At least three measurements were taken and then averaged to get the final correction factor. For the final percent of blockage, the 20 data points were averaged and then the correction factor was subtracted out.

To quantify the mussel coverage on the static water plates, IMAGEJ and GIMP (GNU Image Manipulation Program) were used to process the data in the following manner.

- Images were cropped to include as much coated surface as possible.
- Images were converted to grayscale.
- A black and white Threshold was applied to differentiate between mussels and coated surface.
- When there was insufficient contrast for differentiation, the mussels were manually colored, and the threshold was applied.
- An area was selected such that the rope and plate holes were excluded from the analysis.
- A percent coverage of the threshold area was calculated using IMAGEJ.

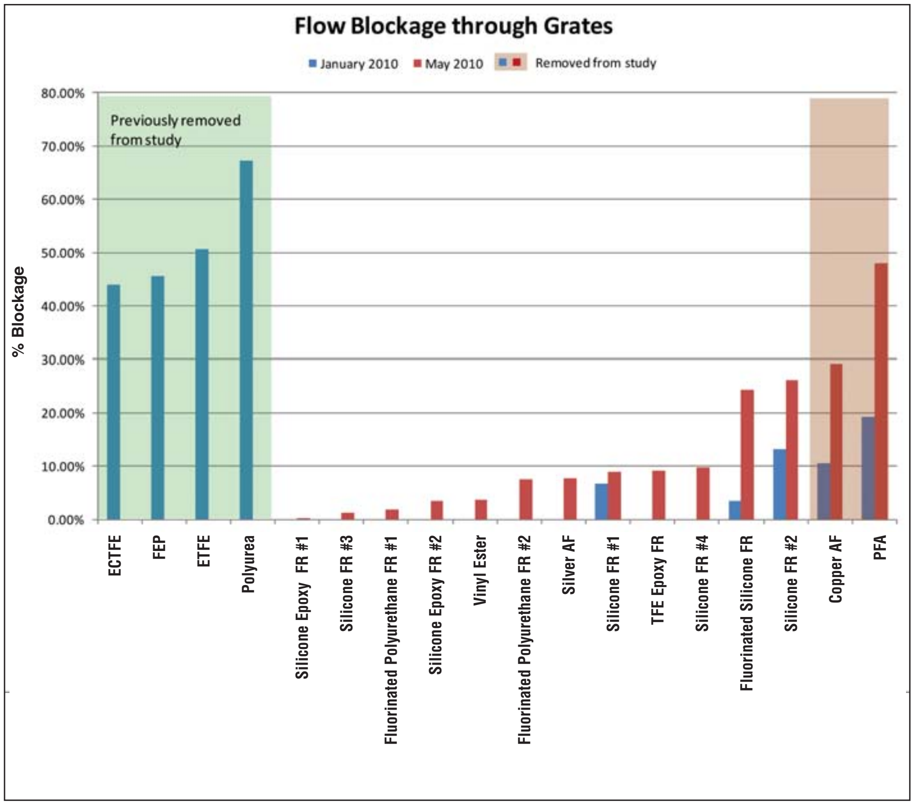

Fig. 2. Blockage observed on coated test grates in flowing water conditions. Values were calculated using image analysis and corrected for material thickness.

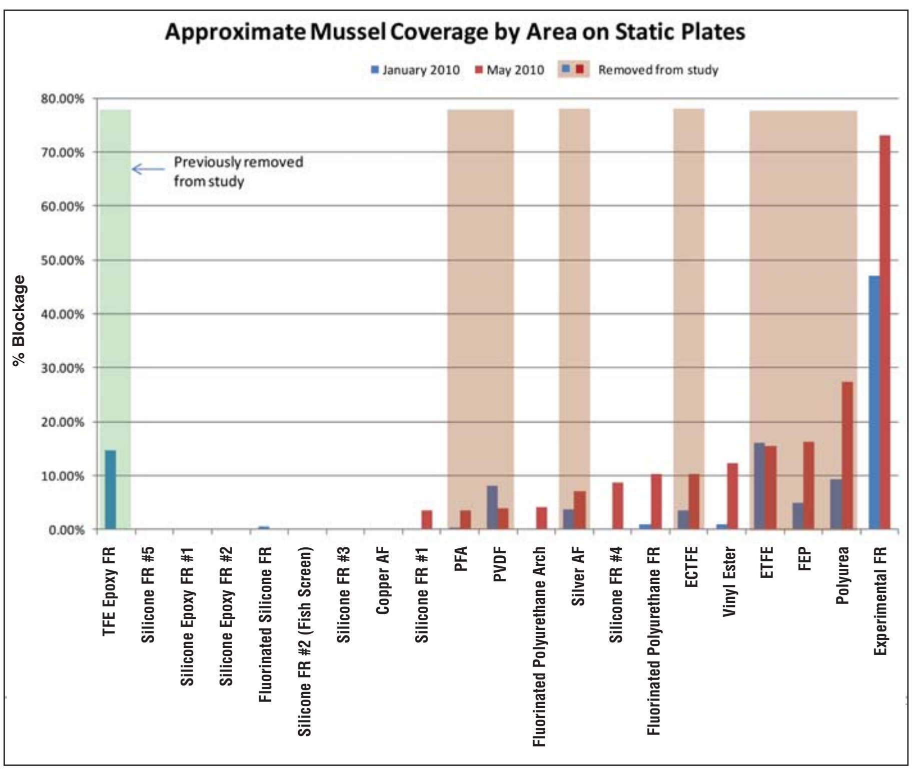

Fig. 3: Mussel colonization on coated test plate in still water. Values were calculated using image analysis.

Attached Mussels

Bond Strength Measurement

Mussel attachment strength was determined using a handheld force gage (Shimpo Model FGV-5XY, maximum capacity of 5 lb). The procedure is modeled after ASTM D5618-94, which is used to determine the attachment strength of barnacles.[3] The major exception was that no attempt was made to measure the attachment area because of the difficulties in performing such a measurement with quagga mussels.

In areas where mussel colonization had reached a point of saturation, a "plow" test was used to determine the approximate force that would be required if the substrate was to require cleaning while in service. This test involved pushing the force gauge probe through the area of saturation at a constant speed of approximately 1 in./sec and parallel to the substrate. The data is fairly scattered at this time; therefore, more data collection is required. As one would expect, it takes more force to remove colonized areas than individual mussels.

Results with Coatings Retained after Year 1

Extent of Fouling

Figure 2 shows the blockage due to macrofouling in flowing water conditions observed on the coated grates evaluated, and Figure 3 shows the results of the image analysis of the static plates. The quantified measurements are taken from the 2nd year only (2009).

Mussel Bond Strengths

Figure 4 shows the maximum force to remove a single mussel from the coated plates. Mussels build on top of one another and can grow into a large mass. It is difficult to obtain any reproducibility in measuring force to remove a cluster of mussels. Also, the force needed to remove a cluster is much greater than that needed to remove one mussel. To get a more reproducible result in measuring force, researchers targeted single mussels between $\frac{3}{8}$- and $\frac{5}{8}$-inch long. It was also observed that single mussels were more abundant on the static plates. Mussels tended to build up on the grates and usually did not allow a single mussel for force measurements. However, the occasional single mussel was found on the grates and was measured for a comparison to the measurements on the plates. There were significant differences in the attachment force between the plates and grates; generally, the force to remove a single mussel was greater on the grates. At this time, there is not enough data to determine the approximate increase in mussel adhesion strength.

Coating Suitability

For determining which coatings are going to provide suitable mussel control, the percent coverage needs to be compared to the force to remove the mussels.

The goal is to have less than 25% coverage and a removal force of less than 0.25 pounds of force.

Discussion

Between the first and second years, the foul-release coatings began allowing mussel attachment, or the growth of algae, to which the mussels would attach. There were significantly greater numbers of mussels in flowing water vs. non-flowing water. One possible explanation is that mussels prefer to be in flowing water where the nutrients and food are continuously delivered. Fig. 5 shows a silicone foul-release coating #2. Fig. 6 was silicone FRC #1 that has been exposed for 2 years. Notice that some algae and a few mussels are in the photo. This coating is performing well, and it is easily cleaned by hand or brush.

Effects of Color

This same product was applied in a black color, labeled silicone FR #2, and incorporated into the study in May 2009. Even though the black coating was only exposed for one year (Fig. 5), greater biofouling was present compared to the white silicone FR #1 (Fig. 6). One possible explanation is that mussels preferentially settle on darker surfaces to blend into the background.[4, 5] The references claim that significantly more *Ulva* sporelings and *spirorbis* attach to darker surfaces than lighter surfaces. It was observed that the algae were directly attached to the coating, and the mussels were attached to the algae. Therefore, greater fouling occurred on the black coating rather than the white. Again, minimal force is required (0.05 lb or less) to remove mussels and algae from the surface. Even though the black coating is approximately 25–30% blocked, it was easy to clean by hand or brush; therefore, it remains in the study.

Figure 7 shows the second retained coating system at 2

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SALTS
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FLASH RUST
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GREASE

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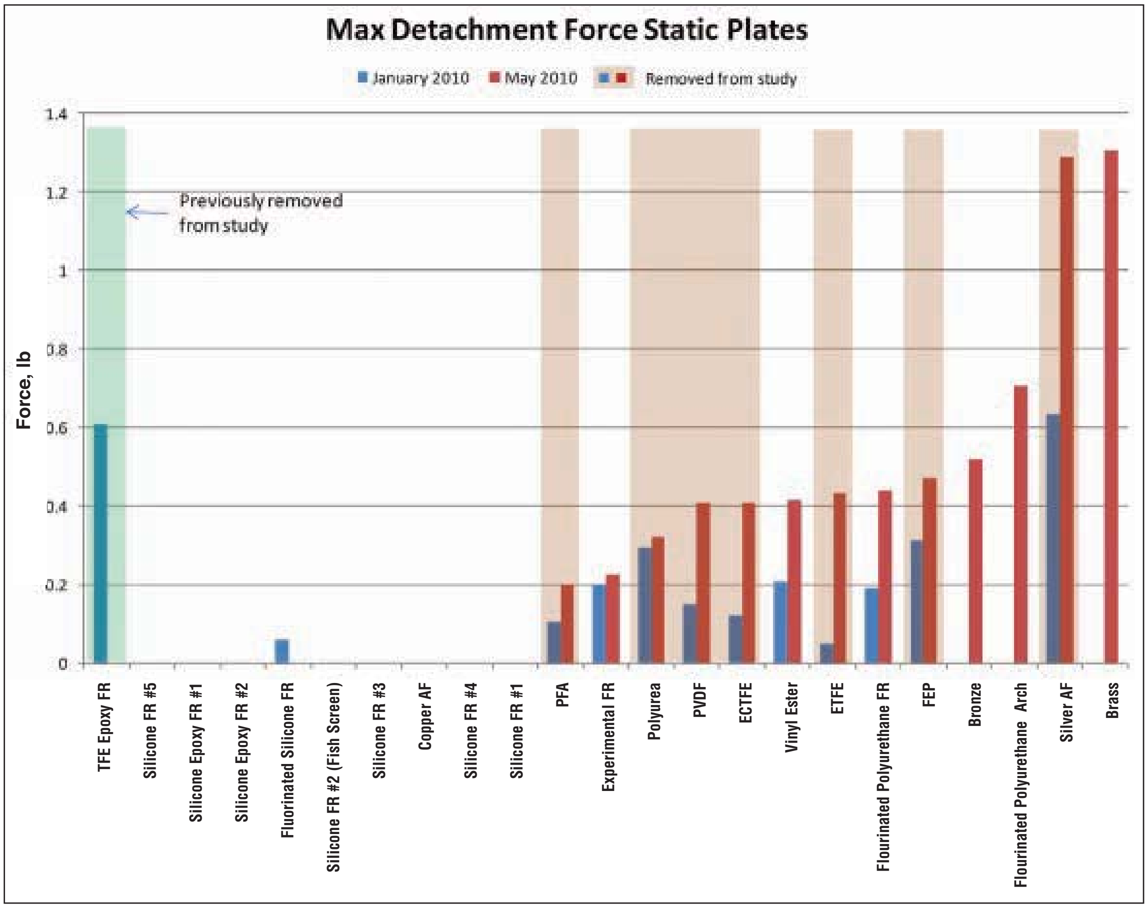

Fig. 4: Maximum attachment force on coated test plates suspended in static water.

years' exposure, a fluorinated silicone foul-release coating. This system has algae and mussels attached to the surface, but the attachment force is under 0.05 lb. Even though there was approximately 15–20% blocked, it was easy to clean by hand or brush, and it remains in the study.

The third system that has been exposed for two years is a polyester filled with copper metal pigment, shown in Fig. 8. The copper in this system has been significantly depleted because of leaching. Therefore, the copper is not providing a high enough

Fig. 5: Silicone foul-release coating #2 black color exposed for 1 year.

Fig. 6: Silicone foul-release coating #1 exposed for 2 years.

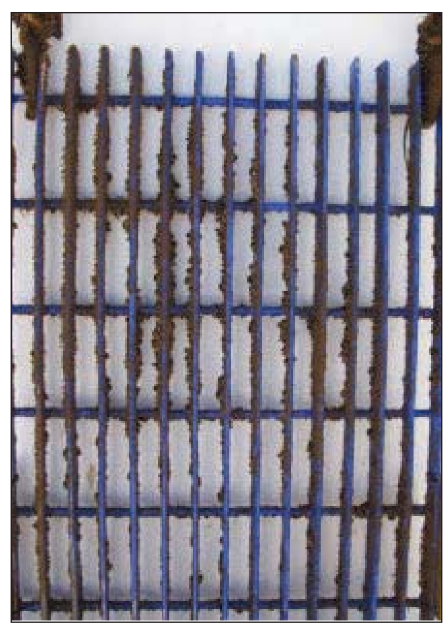

Fig. 7: Fluorinated silicone foul-release coating exposed for 2 years.

Fig. 8: Polyester filled with copper metal pigments.

copper ion concentration at the coating/water interface to prevent mussel attachment. However, the sample that was placed in static conditions is still showing no mussel attachment because of the difference (lower) in leach rate of the copper. Sufficient copper is still available in the static plates to deter mussel attachment. The mussels attach to the grate with significant force; it takes over 1 lb of force to remove a single mussel. The binder is insoluble in water and does not erode, but the copper leaches out of the coating matrix, leaving behind a honeycomb surface that is conducive to a high-strength bond between the substrate and the byssal threads of the mussel. A blockage of greater than 25% coupled with the high adhesion values observed resulted in removal of this coating from the study.

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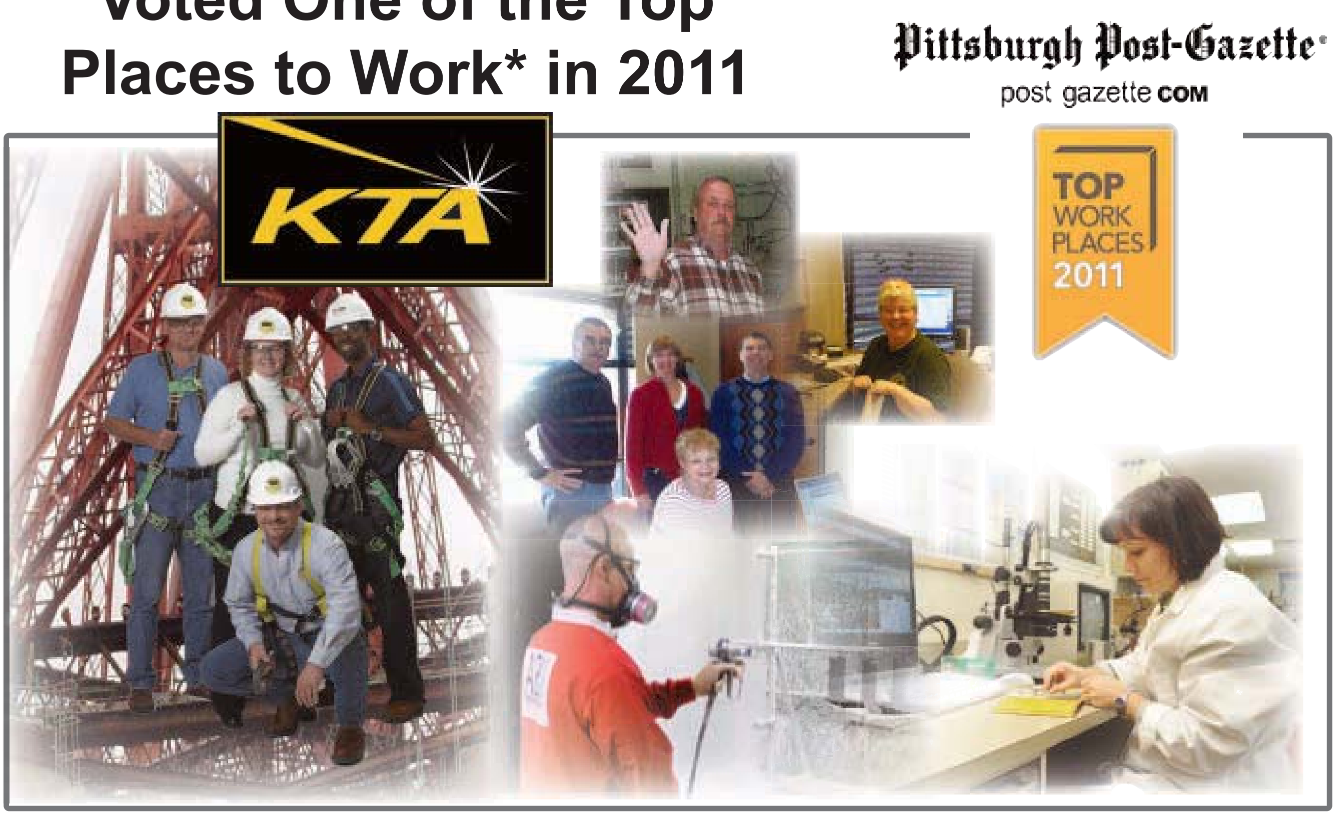

*As reported in the *Pittsburgh Post Gazette*, October 6, 2011

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Coatings Tested in the Second Year

The results of the testing of these coatings are also shown in Figs. 2–4 (pp. 48 and 50).

Fluorinated Powder Coatings

Five fluorinated powder coatings were added to the study in May 2009. These coatings were evaluated every three months and were withdrawn at different times, depending on the fouling rate and the difficulty of cleaning the surface. Eventually, all five fluorinated powder coatings fouled within one year of exposure. Polyvinylidene fluoride (PVDF) coating was the first fluorinated powder coating to be withdrawn, at 6 months' exposure. The PVDF had 40% blockage and required 0.4 lb of force to remove a mussel. Ethylene tetrafluoro ethylene (ETFE), ethylene chloro trifluoro ethylene (ECTFE), and fluorinated ethylene propylene copolymer (FEP) were withdrawn at 9 months of exposure when they became over 40% blocked. It took at least 0.4 lb of force to remove the mussels. The perfluoro alkoxy (PFA) coating lasted one year before being withdrawn from the study at 40% blockage. Surprisingly, it took a maximum of just 0.2 lb of force to remove a mussel.

Out of all of these fluorinated powder coatings, the PFA was the most interesting for potential use for mussel control. PFA is the only fluorinated powder coating that has an ether linkage between the polymer backbone and the trifluoromethyl group, possibly making it more flexible resulting in easier shear of the mussels off the surface. The PFA has a very low surface energy, and the contact angle is about 105 degrees. Limitations of this powder are the cost, application that requires baking the coating to 500 F, and the coating thickness of only 1–2 mils DFT.

Additional Silicone Foul-Release Coatings

Two additional silicone foul-release coatings were added to the study in October 2009 to be compared directly with the other foul-release coatings. Since May 2010, both products have less than 10% blockage. One coating system is white (silicone FR #3), and the other is black (silicone FR #4). As with the silicone coatings previously discussed, the mussels are exhibiting a preference for the black coating. And as with the silicone coatings that were discussed previously, the mussels were easily removed with minimal force.

Durable, Low Coefficient of Friction Coatings

A PTFE-filled epoxy, vinyl ester, and a fluorinated polyurethane architectural coating system were identified as potential low friction alternatives to conventional epoxies and polyurethane coatings. All three systems were added to the test in October 2009. These products currently have less than 10% blockage. Of the three coatings, the vinyl ester showed the lowest attachment force of 0.4 lb. The PTFE-filled epoxy had an attachment force of 0.6 lb. The fluorinated polyurethane had an attachment force of 0.7 lb. Currently, these systems remain in the study.

Elastomeric Coatings

Polyurea was evaluated for its elastomeric properties to see if the mussels could be easily cleaned. This product fouled quickly as expected; however, attachment forces were limited to 0.3 lb on the static plates. The force to remove a mussel was considerably higher in flowing water, 1.4 lb of force.

Durable Foul-Release Coatings

Silicone epoxy coatings claim to have foul-release capability and increased durability over conventional silicone foul-release coatings. A solvent-borne silicone epoxy coating was added to the study in October 2009. This coating also meets the 100 g/l VOC regulation in the South Coast Air Quality Management District (SCAQMD). The coating is being tested with two epoxy primer systems, one that the coating manufacturer recommended and the other that meets the 100 g/l VOC in SCAQMD (i.e., silicone epoxy FR #1 and FR #2). To date, both coating systems remain completely free of mussels, and no attachment force can be recorded.

Because of its increased durability, a fluorinated polyurethane foul-release coating (fluorinated polyurethane FR #1) was also added to the study in October 2009. The main difference between this coating and the other fluorinated polyurethane tested was that the chemistry of this coating was designed as a foul-release system. The initial results show that after six months' exposure, blockage was less than 10%, and the force to remove a mussel was 0.4 lb.

Discussion

The expectation is that foul-release coatings will foul with algae and mussels to some degree; however, they should be cleaned by hand, brush, or underwater waterjetting/cleaning with minimal effort. Some may question this decision because corrosion protective coatings could be allowed to foul and then be cleaned off periodically. The time frame between cleanings should be as long as possible. Currently, at some reservoirs, cleaning is required twice a year with the existing coatings. Foul-release coatings could be expected to extend the interval between cleanings up to two years or more, potentially minimizing downtime and maintenance costs. Most cleaning methods would require the use of divers to do the work. It is well known that any underwater procedure costs more than the same task when it is performed on the ground. Another problem is that many of the

Bureau of Reclamation dams are a few hundred feet tall, making the dives quite challenging and dangerous. The greater the depth, the less work time per diver. Therefore, ease of cleaning is very important to increase the productivity of the divers to keep the maintenance costs as low as possible.

Summary

The decision was made to allow coatings to foul and perform periodic cleaning. To minimize the maintenance, it is desired to wait as long as possible between required cleaning.

The coatings that had been exposed for two years began to foul with mussels and algae. All coatings were evaluated for the percentage of fouling and the force to remove mussels off the coated surface. Foul-release coatings are easier to clean than antifouling coatings; however, the durability of silicone foul-release coatings may be the limiting factor in the overall service life of these coatings on the Bureau of Reclamation's infrastructure.

Durable foul-release coatings, fluorinated powder coatings, and low coefficient of friction coatings were evaluated for mussel control. Initial results are showing several coating systems that, with periodic cleaning, may work for mussel control.

During the summer of 2010, the Bureau of Reclamation learned about two new foul-release coating systems that claim to be durable. These products are in the process of being applied to substrates by the coating manufacturers. These systems were added into the study in November 2010, and results are currently pending.

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Allen Skaja joined the Bureau of Reclamation as a Coatings Specialist. His experience is in evaluating coatings for corrosion protection and testing coatings to deter the attachment of zebra/quagga mussels. He has a BS in Chemistry and a Ph.D. in Coatings and Polymeric Materials.

David Tordonato is a Materials Engineer with the US Bureau of Reclamation and works in the Technical Service Center's Materials Engineering and Research Laboratory. He holds BS and MS degrees in Mechanical Engineering and a Ph.D. in Materials and Metallurgical Engineering. He is a SPRAT-certified engineer and frequently performs engineering assessments and other work on the inaccessible features of Reclamation Dams and equipment using Rope Access methods.

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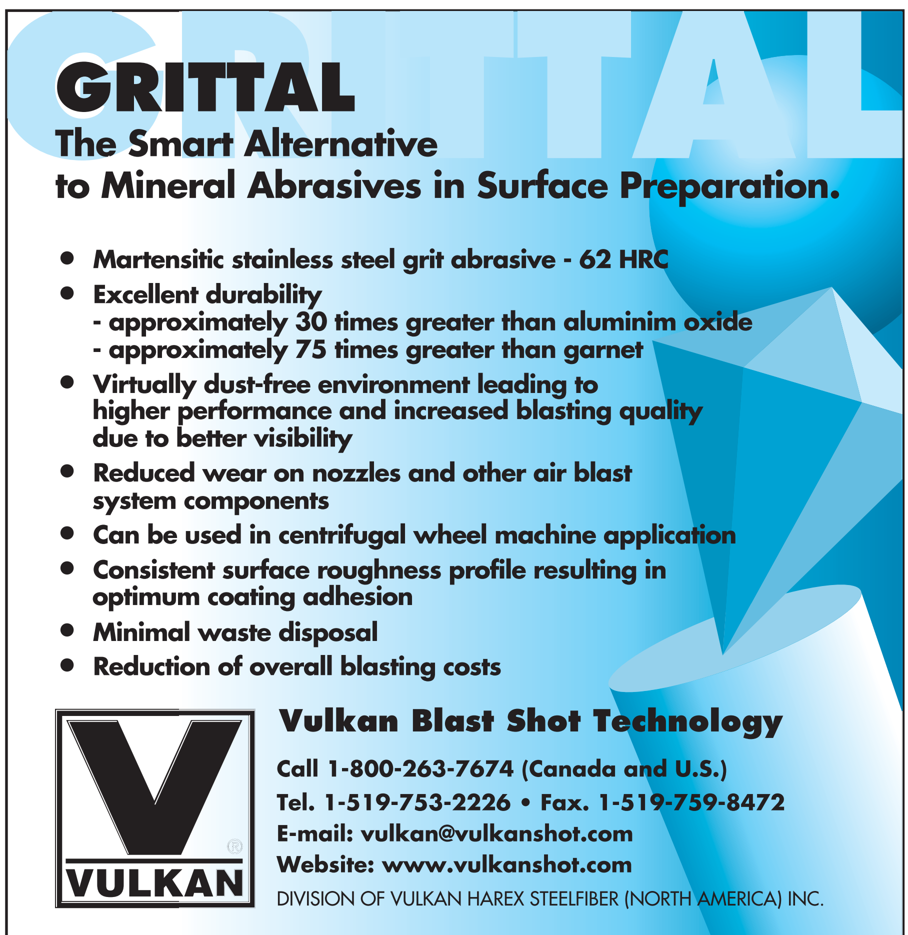

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SSPC Technical Program Spans Four Days, 19 Tracks

Photo courtesy of Tampa Bay & Company, www.visittampabay.com.

SSPC 2012 featuring GreenCOAT will take place in Tampa, FL, on Jan. 30 to Feb. 2, 2012. The technical program runs for four days, with 19 different tracks covering a wide range of topics in the industrial, marine, and commercial coatings industries. Over 75 papers were scheduled as of press time. The following pages provide the dates, times, titles, presenters, and company affiliations as well as a brief abstract of each paper. All information is current as of press time; visit www.sspc2012.com for updates and more information.

Monday, January 30

Track: Improve a Business with Strategic Planning

• 1:30-2:30 p.m., "Industrial Marketing & Sales in a Digital Age," by Nicole Eisenhauer, Eisenhauer Creative Group

The presenter will discuss easily employed digital marketing tools and the role of social networking tools for marketing in an industrial forum. The integration of print, digital, and three-dimensional marketing tools will also be covered, as well as the definition of "permission-based" marketing.

• 2:30-3:00 p.m., "Succession Planning," by Robert Ziegler, BBZ Contracting

The presentation will cover succession plans including selling the company, customer relations, and competitive reactions.

• 3:00-3:30 p.m., "Everyone Wins: Driving Value and Profitability for the Painting Contractor and the Owner," by Dee McNeill, The Sherwin-Williams Company

This paper will show how improving shop throughput and field painting operations can save time and money and increase the profitability of the painting contractor while also saving taxpayers money.

• 3:30-4:00 p.m., "Writing a Good Process Control Procedure," by Rick Smith, PCS, Wheelblast, Inc.

The presentation will cover key items to use when preparing a process control procedure (PCP), including material handling, environmental conditions, surface preparation, mixing oversight, and coating application.

Track: Nanotech—Enhanced Performance of Coatings

• 1:30-2:30 p.m., "Nano-Structured Particles to Enhance Primer Performance Properties," by Maria Nargiello, Evonik Degussa Corporation

This paper will address how modified nano-structured particles based on SiO_2 are differentiated and modified to create specially tailored solutions to enhance the performance of both solvent-borne and waterborne primers.

• 2:30-3:00 p.m., "Corrosion Resistant Nanocomposite Pretreatment Coating for Marine Structures," by Robert Iezzi, Ph.D., NEI Corporation

The presenter will discuss the laboratory test results of the pretreatment, scale-up of the pretreatment with a major shipbuilder, and outdoor test results in a severe marine environment.

• 3:00-3:30 p.m., "Nanotechnology for Enhanced Coating Performance," by Mark Morrison, The Sherwin-Williams Company

The presentation will provide insight into the advancing role of nanomaterials and nanotechnology for coatings. Discussion will include the simultaneous global technology developments, the limitations of these developments, and a view of the future growth of nanotechnology in coating materials.

• 3:30-4:00 p.m., "Multi-Walled Carbon Nanotubes for Polymeric Coatings and Composites," by Serkan Unal, Bayer MaterialScience

The paper will review the industrial scale production and applications of multi-walled carbon nanotubes, including those containing waterborne and UV-curable anti-static coatings, in light of current concerns of the EPA for safe use and handling of nanomaterials.

Tuesday, January 31

Track: Women in the Industry

• 10:00-10:30 a.m., "Women in Coatings: The Present State and a Glimpse of Our Future," Cynthia O'Malley, PCS, KTA-Tator

During the inaugural "Women in Coatings" session held at SSPC 2011, a survey was developed and distributed to conference participants to determine the present state of the role of women in the coatings industry. This presentation sum-

SSPC 2012 Exhibitors

The following is the most recent list of companies currently planning on exhibiting at SSPC 2012 featuring GreenCOAT. All information is accurate as of press time. The December *JPCL* will provide brief descriptions, contact information, and booth numbers for known exhibitors.

- Abrasives, Inc.
- Advanced Recycling Systems, Inc.
- Aggreko LLC
- Air Systems International
- Arid Dry by CDIMS
- Atlantic Design
- Axxiom Manufacturing Inc./Schmidt
- Carboline Company
- CESCO/Aqua Miser
- Chlor*Rid international Inc.
- Church & Dwight (ArmaKleen)
- Clemco Industries Corp.
- Clothes Cleaning Systems
- *Coatings Pro* Magazine
- The Comex Group
- Croda
- CSI Services, Inc.
- Cytec Industries
- Defelsko Corporation
- Dehumidification Technologies, Inc.
- DESCO Manufacturing Co., Inc.
- Detroit Tarp Inc.
- Doosan Portable Power
- DRYCO, LLC
- DUSTNET by EMI
- E.D. Bullard
- Eagle Industries
- EcoQuip Inc.
- Elcometer Instruments Ltd.
- EnTech
- Ervin Industries
- Evonik Degussa Corporation
- Farrow Systems
- Fischer Technology Inc.
- Forecast Sales Inc./Pirate Brand
- Glidden Professional
- GMA Garnet (USA) Corp.
- Graco Inc.
- Granite Mountain Quarries
- Green Diamond Sand Products
- Greenman-Pedersen, Inc.
- Guzzler Manufacturing, Inc.
- Hanes Supply Inc.
- Harsco Minerals
- Hi-Temp Coatings Technology
- HippWrap Containment
- HoldTight Solutions Inc.
- Hydrex Underwater Technology
- Indian Valley Industries
- Industrial Info Resources
- Industrial Vacuum Equipment Corp.
- International Paint LLC
- ITW Industrial Finishing
- JAD Equipment Co.
- Kennametal Inc.
- KTA-Tator, Inc.
- Longhai Duoling Saw Blade Co., Ltd.
- LVH Industries Inc.
- Marco
- Mascoat
- Midwest Rake
- MMLJ (Sanstorm)
- Mohawk Garnet, Inc.
- Monarflex by Siplast
- Montipower, Inc.
- NACE
- National Equipment
- Nelson Industrial Svcs (BlastProMfg)
- NexTec, Inc./Pretox
- Novatek Corp.
- Novetas Solutions
- Olimag Sand
- OPTA Minerals, Inc.
- Painters & Allied Trades
- Paul N. Gardner Co.
- Pinnacle Central Company
- Pinovo AS
- Polygon
- PPG Protective & Marine Coatings
- Ring Power Corporation
- SAFE Systems
- SAFWAY Services
- Sauereisen
- The Sherwin-Williams Company
- Spider
- Sponge-Jet Inc.
- Sulzer Mixpac USA
- Surface Prep Supply
- Tarps Manufacturing, Inc.
- Technology Publishing/PaintSquare
- Tesla Nanocoatings Ltd.
- TFT-Pneumatic LLC
- Thomas Industrial Coatings
- Tnemec Company
- Tomoric Technology Inc.
- Tractel Inc. Griphoist Division
- Trimaco LLC
- TSE-Okulen Americas, LLC
- TWRS (The Warehouse Rentals & Supply)
- Van Air Systems
- VRSim
- Western Technology
- WIWA LP
- Wooster Brush

marizes the data obtained from the survey responses, which attendees will then use to define the present state of women in the industry.

• 10:30-11:00 a.m., "Success Factors for Women's Career Advancement in Chemical Industry," by Sharon Feng, Bayer MaterialScience

This presentation is based on a three-year study of more than 1,700 women scientists working in the chemical industry. The study will be used to provide insight into what women can do to achieve success and level the playing field in historically male-dominated industries.

• 11:00-11:30 a.m., "How Do You Balance Work and Family?" by Sarah Olthof, Corrosion Control Consultants & Labs, Inc.

• Noon-12:30 p.m., "The Gender Gap: Impact on Innovation," by Elizabeth Haslbeck, NAVSEA

Track: Coatings in Marine Environments

• 10:00-10:30 a.m., "NSRP Surface Preparation and Coatings Panel, Update," by Steve Cogswell, BAE Systems Southeast Shipyards

• 10:30-11:00 a.m., "Epoxy/Silicone: Ecological Evolution in High Performance Marine Coatings," by Duane Palmateer; Ian Germain; and John Kilger, Ph.D., Greenfield Manufacturing, Inc.

The presenters will discuss a novel epoxy/silicone chemistry that polymerizes an organic epoxy polymer with a silicone polymerization to form a network containing hard epoxy domains and low surface energy silicone domains, resulting in a coating that presents a low energy surface on the exterior and an aggressive bonding surface toward the coated substrates. Emphasis will be placed on the chemical and physical performance properties of the coating. Data will be presented that correlates the physical properties of the coating with performance data collected in field application testing.

• 11:00-11:30 a.m., "Zinc Rich Primers for Corrosion Protection," by J. Peter Ault, PE, PCS, Elzly Technology Corp.

The lecture will review the various types of zinc-rich coatings available for corrosion protection. The challenges associated with the proper specification and application of zinc-rich coatings will be discussed, as well as data from various studies that quantifies the corrosion protection benefits of various types of zinc-rich coatings.

• 11:30 a.m.-Noon, "Ship Hull Performance in the Post TBT Era," by Boud van Rompay, Hydrex Underwater Technology

This presentation will discuss specially formulated glassflake vinyl ester surface treated composite (STC) as today's best available technology for protecting a ship's underwater hull. The speaker will cover the problems that exist with conventional coatings and show why glassflake vinyl ester STC is the future of ship hull protection as more restrictions are placed on conventional systems.

Track: Advancing Green Technology

• 10:00-10:30 a.m., "New Solvent-Free Waterborne Epoxy Resin Dispersion for Low VOC 2-Pack Protective Coatings," by Ming Tsang, Cytec

The presenter will discuss the development of solvent-free, waterborne epoxy resin dispersion and how it can meet the needs of the protective coatings market. The resin will be compared to existing solvent-borne coatings and waterborne epoxy dispersions with significant amounts of solvents.

• 10:30-11:00 a.m., "Green Blasting Technology with Focus on HSE and Quality," by Kjetil Roksvag, Pinovo AS

The presenter will explain a technology that his company developed for vacuum blasting pipes to an SA 3 surface with zero emissions. The technology also focuses on operator safety and health as well as reducing the overall carbon footprint compared to alternative methods.

• 11:00-11:30 a.m., "Green—Just Another Color in Mechanical Surface Preparation?" by Kumar Balan, Wheelabrator Group

In this discussion, attendees will learn the definition of green manufacturing in relation to surface preparation in addition to its practicality and benefits. Part of the presentation will revolve around how green manufacturing is more than just a social cause for the mechanical surface preparation technique.

• 11:30 a.m.-Noon, "Cartridge Technology for Spray Applied Coatings—Low Cost, Reliable, Portable, and Green," by Peter Kuzyk, Plas-Pak Industries

This presentation will focus on HSS (high solids spray) system as a new, low cost, portable, disposable meter-mix-dispense and spray system for use with a wide variety of fast-cure formulations, including coatings, liners, foams, and sprayable adhesives and sealants.

• Noon-12:30 p.m., "Access Solutions for Wind Turbines," by Clint Ramberg, Spider

The discussion will focus on new suspended platform configurations and methods that have been designed for the wind tower and blade access market to improve the safety, quality, productivity, and profitability for the maintenance coordinator.

Track: *Durability + Design* Commercial Coating and Flooring Symposium

• 10:00-10:30 a.m., "An Architect's Call for Paint Standards," by Walter Scarborough, HKS Architects

The presentation will describe the frustrations and problems architects experience because of insufficient or non-existent standards governing architectural coating materials and practices. Real-world examples will be given, and areas where standards need to be written or

upgraded will be named and discussed.
• 10:30-11:00 a.m., "Extending the Life Cycle of Coatings Applied to Commercial Buildings," by Barry Law, Master Painters Institute

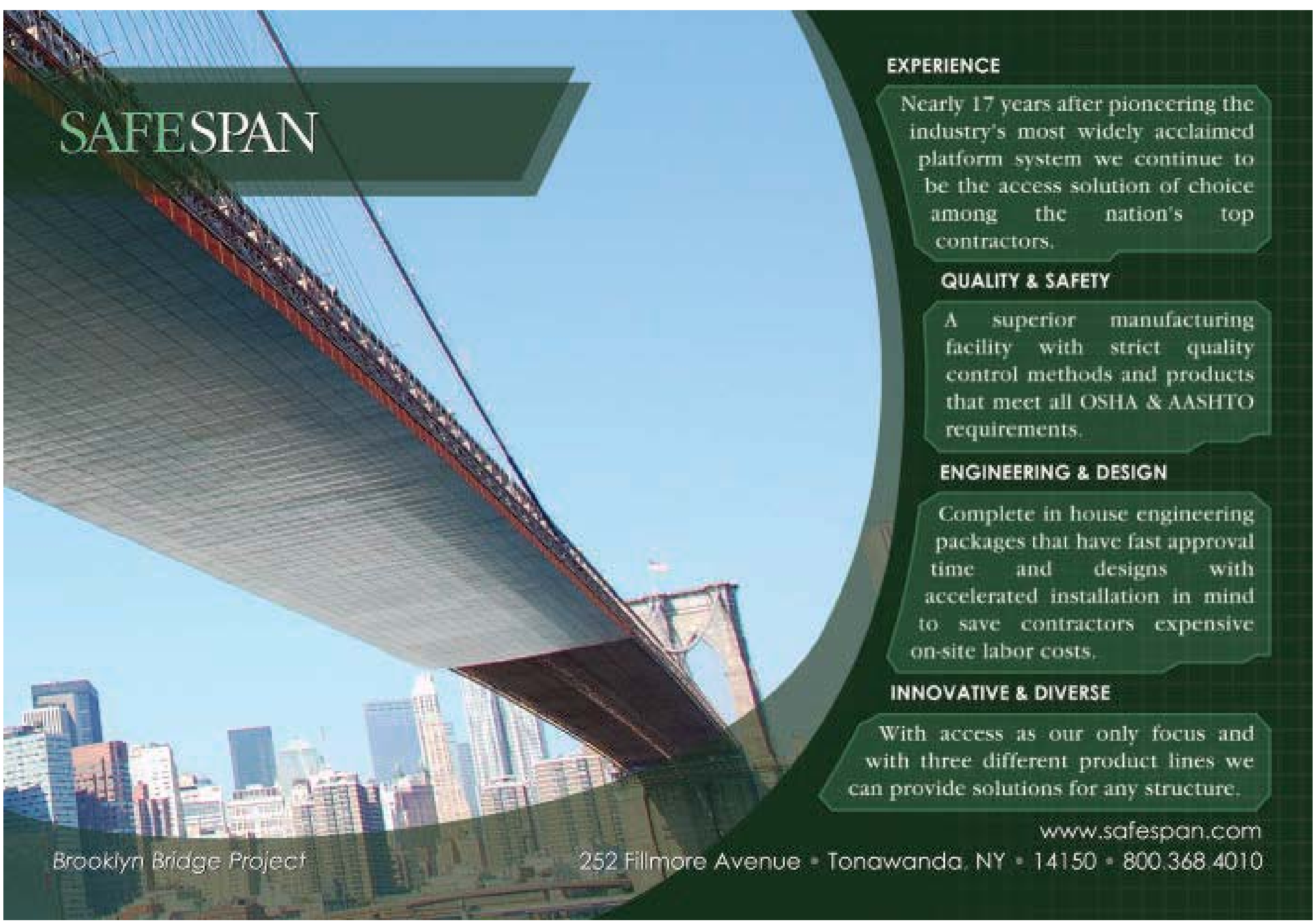
The presenter will provide methods for extending the life of coating systems through the development of sound cleaning and painting specifications, contractor quality control, and owner quality assurance oversight.
• 11:00-11:30 a.m., "Fundamentals of Making Good Decisions in Coating Selection," by Allen Zielnik, Atlas Material Testing Technology

This presentation will focus on interpreting accelerated weathering test standards, warranty claims, and marketing jargon to understand what really matters—choosing the right product for the right climate.
• 11:30 a.m.-Noon, "New Architectural Wall Coatings Technology Targeted at Stricter Hospital Infection Protocols," by Steven Reinstadtler, Bayer MaterialScience

New developments in architectural coating technologies for targeted hospital environments that require a higher frequency of cleaning with harsher disinfectants offer improved durability and resistance without sacrificing appearance. This discussion will cover some of the requirements, chemicals involved, testing, and case history related to this topic.
• 1:30-2:00 p.m., "Moisture Vapor Emission Rates of Concrete Floors—Can Moisture Meters be Used Instead of Anhydrous Calcium Chloride?" by George Holz, American Institute of Architects, and Kevin Brown, KTA-Tator

This paper presents data obtained from field studies that compared anhydrous calcium chloride test results with three different types of moisture meters.
• 2:30-3:00 p.m., "The Impact on the Painting Industry by New Building Codes and Standards for Air/Vapor Barriers," by Kevin Knight, Architectural Testing Canada Inc.

The presenter will address the challenges that are facing the painting industry with the changes to building codes and standards. Current state-of-the-art commercial buildings will be reviewed together with common ongoing failures. Examples will be used to address different issues with paint/coating failures, lack of functional thermal barriers, and poor water management. Infield and laboratory test programs and possible solutions will be examined.
• 3:00-3:30 p.m., "Air Barrier Testing of Concrete Masonry Assemblies and the Effect of Surface Coatings on Air Performance," by Jason Thompson and



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Nicholas Lang, National Concrete Masonry Association

The presenters will discuss specific procedures that were developed to better test concrete masonry assemblies for compliance with new energy efficiency requirements. These procedures are used to evaluate the effectiveness of integral water repellents, surface water repellents, and various other surface coatings on the air permeance of concrete masonry assemblies.

- 3:30-4:00 p.m., "Use of Atlas Test Cells to Assess the Performance of Coatings Over CMU with Varied Permeance," by Chuck Duffin, Sto Corporation; Cynthia O'Malley, PCS, KTA-Tator; and Steve Revnew, The Sherwin-Williams Company

This paper describes the results of a study to determine if the Atlas Cell Test (NACE TM0174) can be modified to evaluate the performance of individual coating systems based on permeance. The goal of the test program is to establish a protocol that can eventually be used to determine the number of times that a given system can be repainted before the reduction in permeance causes concerns with blistering or peeling.

Track: Real World Coatings in Action

- 1:30-2:30 p.m., "Experiences with Coating Systems Selection for the World Trade Center Transportation Hub," by John Bullard, PCS, The Port Authority of NY & NJ

The presenter will discuss the history, background, and selection of several coating systems and combinations systems used for the structural steel and architectural elements of the WTC Transportation Hub.

- 2:30-3:00 p.m., "Cross-Linking Performance to Mechanism," by Andrew Recker, International Paint LLC

The main focus of this paper is the mechanism of cure of the different polymer binds. Data will be presented that shows the rate of differences of post-cure of the peroxide radical/vinyl esters when compared to the epoxy systems.

- 3:00-3:30 p.m., "Colored Pigments for Coatings—Chemistry & Performance," by Romesh Kumar, Clariant Corporation

This discussion will focus on the basic chemistry, the physical and chemical properties, and a comprehensive guide to the selection of organic pigments.

- 3:30-4:00 p.m., "Ultraviolet Curable Coatings from Highly Functional Acrylated Biobased Resins," by Adlina Paramarta, Dean Webster, and Xiao Pan, North Dakota State University

The presenters will discuss their research in decreasing dependency toward petroleum-based products in the polymer field. In their research, the unsaturation of sucrose soyate was modified into acrylate functionality by means of epoxidation and acrylation process.

- 4:00-4:30 p.m., "Portable Plural Component Equipment Utilizing Synergistic Chemistry," by Chas Weatherford, Specialty Products, Inc.

Track: Protecting the Military

- 1:30-2:30 p.m., "Leadership in Corrosion Prevention and Mitigation," by Daniel Dunmire, DoD Corrosion Policy and Oversight, Office of Under Secretary of Defense

The presenter will outline the Department of Defense Corrosion Prevention and Control (CPC) Program vision, policies, and strategies, and discuss results of the CPC program leadership in areas of education, training, communication, outreach, and overall cultural change in the broad corrosion prevention and control community.

- 2:30-3:00 p.m., "The Importance of Coatings to the Department of the Navy," by Stephen Spadafora, U.S. Navy

This presentation will cover the impact of corrosion on Navy assets, the role of protective coatings in combating corrosion, changes impacting the effectiveness of coatings, and the future of coatings in the Navy.

- 3:00-3:30 p.m., "Coatings Technical Warrant Holder Update," by Mark Ingle, NAVSEA
- 3:30-4:30 p.m., "With Great Power Comes Great Responsibility," by Roger Hamerlinck, U.S. Army

The presenter will discuss where the authority for the corrosion executive comes from, who is responsible for the outcomes of the program, the five pillars upon which the Army's program is built, what actions they have taken to fully implement the statute, and what challenges and successes the program has experienced.

- 4:30-5:00 p.m., "United States Marine Corps Corrosion Prevention and Control Office (CPAC) Program Overview," by Andrew Sheetz, Naval Surface Warfare Center—Carderock Division

The CPAC program was established to specifically address the corrosion issues within the Marine Corps land weapon systems. The program has improved the readiness of Marine Corps equipment, significantly reduced the cost of corrosion, and is recognized as a model DoD corrosion program.

Wednesday, February 1

Track: Extending the Life of a Bridge

- 10:00-10:30 a.m., "Next Generation Polyaspartate Topcoat: Matching Throughput with Performance," by Jim McCarthy, PPG Protective and Marine Coatings

This paper will cover the features and benefits of next-generation polyaspartate topcoats that have been developed to overcome limitations of first generation finishes, such as diminished recoatability and shortened pot life. The presenter will compare properties of the two products as well as traditional polyurethanes.

- 10:30-11:30 a.m., "A KYTC Study of the Effects of Chlorides on Bridge Coatings Performance," by Bobby Meade, Kentucky Transportation Cabinet

The presenter will discuss a study conducted by the Kentucky Transportation Center to assess the impact of chloride on the coating performance of KYTC bridges. The study had field and laboratory components.

• 11:30 a.m.-Noon, "QC for the VTB: Overcoating the East Tower," by William Hansel, PCS, California Department of Transportation

This paper presents the difference between QC and QA, QC for new construction, QC for overcoating, and QC's role in pre-job planning. The painting of the Vincent Thomas Bridge's east tower will be used to highlight QC issues encountered during a spot prime, full overcoat paint project.

• 11:30 a.m.-Noon, "Next Generation Polyaspartate Topcoat: Matching Throughput with Performance," by Jim McCarthy, PPG Protective and Marine Coatings

This paper will cover the features and benefits of next-generation polyaspartate topcoats that have been developed to overcome limitations of first-generation finishes, such as diminished recoatability and shortened pot life. The presenter will compare certain properties of the two products as well as traditional polyurethanes.

Track: Coatings for Concrete

• 10:00-10:30 a.m., "Waiting for the Concrete to Dry at Johnstown Memorial Medical Building in Arlington, VA," by David Simkins, Polygon

Attendees will learn about determining the environmental conditions that can affect a project at a given time of year, evaluate loads on a structure or containment, and design a system to meet those loads. The presenter will discuss the challenges of designing and holding low moisture levels in containments in the middle of August.

• 10:30-11:00 a.m., "With Novel 2K Water Based Polyurethane Systems, You Can Walk Where Traditional Systems Cannot Tread," by Leo Meilus, NAVCOR, Inc.

The author will discuss case histories where waterborne polyurethanes have been successfully used.

• 11:00-11:30 a.m., "Case History: Primary Care Physician's Office Refurbished with Sustainable Self Leveling Coating and a UV Curable Topcoat," by Bob Seman, Seman Flooring, Inc.

This presentation will cover the challenges faced in the preparation of a slab-on-grade subfloor, removal of a defunct gypsum layer, and the successful application of a decorative and green flooring option.

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• 11:30 a.m.-Noon, "The History of Sealers and Coatings in Decorative Concrete," by Chris Sullivan, ChemSystems Inc.

The presenter will discuss the history of coatings and sealers within the decorative concrete market place. Topics include the progression of solvent and waterborne coatings, how they have changed to meet the increasing durability and environmental demands, and the next generation of green coatings currently being introduced in the market.

Track: Waterborne Performance

• 10:00-10:30 a.m., "Performance Comparison of Waterborne and Solventborne Epoxy Primers," by Tim Miller and Yong Zhang, Dow Chemical Co.

Performance of commercial and experimental waterborne 2K primers will be compared with commercial solventborne 2K primers. The effects on primer performance of curing agents, PVC, and amine-epoxy ratio will also be discussed.

• 10:30-11:00 a.m., "Factors Influencing the Stay-Clean Properties and Service Life of New Fluoropolymer Coatings," by Kurt Wood, Arkema, Inc.

This presentation will review the factors contributing to stay-clean properties and exterior durability of fluoropolymer coatings. The presenter will also examine their role in affecting the properties of coatings based on the new waterborne fluoropolymer-acrylic hybrid technology.

• 11:00-11:30 a.m., "Enova™ Aerogel Additives for Next Generation Waterborne Insulative Coatings," by Dhaval Doshi

The presentation will cover current technologies used to create different classes of insulative coatings and how silica aerogel products can be used to create the next generation of these coatings. Attendees will gain an understanding of the formulation principles and test methods, as well as the benefits of insulative coatings in various scenarios.

Track: Keeping it Clean—Coatings for Wastewater

• 3:00-3:30 p.m., "Wastewater Treatment Plants—Bring Your 'A' Game," by Eric Brackman, RFI Consultants LLC

The discussion will look at concrete substrates and the things associated with improving its long-term protection.

• 3:30-4:00 p.m., "Manhole Rehabilitation—The Role Played by Linings," by Kevin Morris, The Sherwin-Williams Company

The paper will be a discussion of the various generic lining products available in the marketplace today, required application methods, and potential issues associated with each. Additional discussion will take place around ancillary work required to achieve successful long-term installation.

• 4:00-4:30 p.m., "Design Considerations for Lining Concrete Sludge Mixing and Storage Tanks in Wastewater Treatment Plants: Issues That Do Not Meet the Eye," by R.A. Nixon, Corrosion Probe, Inc.

This paper will present a number of important design considerations based on lessons learned that can avert lining performance problems and appropriate lining material selection. Specific examples from a number of sludge tank lining projects will be used to illustrate these design considerations.

• 4:30-5:00 p.m., "A Practical Approach to the Rehabilitation of a Wastewater Treatment Facility: Utilizing Case Histories to Demonstrate Real-Life Applications," by Lake Barrett Jr., Pete Jansen, and Tony Oswald, Sauereisen

The presenters provide an overview of the steps necessary to restore and protect dilapidated concrete structures from the effects of biogenic corrosion and years of neglect within the wastewater treatment system.

Track: Environmental Health & Safety

• 3:00-3:30 p.m., "Regulatory Update: Current and Emerging Trends in Occupational and Environmental Health," by Alison Kaelin, KTA-Tator

This annual paper summarizes and tracks environmental, health, and safety issues that may impact painting contractors and facility owners. The paper summarizes regulatory and enforcement developments in the current year and reviews expected rulemaking for the upcoming year.

• 4:00-5:00 p.m., "Identifying Potential Inhalation and Other Hazards Associated with Abrasive Blasting Operations," by Thomas Enger, MS, CSP, CHMM, Clemco Industries Corp.

The presenter will cover inhalation hazards common to the abrasive blasting employee; OSHA enforcement of inhalation hazards, including carbon monoxide from compressed air lines; NIOSH's requirements for approved respirators; and calculating noise reduction rating using a supplied air respirator as secondary hearing protection.

Track: Big Bridges, Big Solutions

• 3:00-3:30 p.m., "Overcoating—Texas DOT Perspective," by Johnnie Miller, Texas DOT

The presenter will discuss the four Texas DOT coating systems, maintenance painting practices, reasons to overcoat, performance of system to date, cost/limitations, the future of overcoating, and more.

• 3:30-4:00 p.m., "Suspended Scaffold for Bridge Access," by Clint Ramberg, Spider

This paper will review case studies from several bridge access projects where suspended scaffolding was used to provide safe, economical access for crews performing inspection, structural repair, demolition, blasting, and coating work. Special attention will be paid to advanced project planning, worker safety requirements, unique platform configurations, and productivity-improving tips.

• 4:00-5:00 p.m., "Two-Component Polyurethane Topcoats—Formulating Variables Affecting Performance in the

Heavy Duty Corrosion Protections Market," by Edward Squiller and Kurt Best, Bayer MaterialScience

This is the final paper in a series that discusses weathering performance of two-component polyurethane topcoats used in corrosion protection applications with emphasis on the key formulating variables affecting performance. Commercial topcoats, along with some laboratory formulas, are used to illustrate the raw material choices and how weathering performance plays out in both QUV-A and natural Florida exposure scenarios.

Thursday, February 2

Track: Field & Laboratory Testing

• 10:00-10:30 a.m., "Slip Coefficient and Tension Creep Testing of Coatings Used in Slip-Critical Bolted Connections," by William Corbett, PCS, KTA-Tator

The presenter will list the variables affecting slip-coefficient values, describe the process associated with test panel preparation and coating, identify the testing procedures for slip coefficient and tension creep, and describe the importance of verifying conformance to testing variables during shop/field application. Data from various generic coating types previously tested will be presented.

• 10:30-11:00 a.m., "Easy Inspection Form Creation for Dry Film Thickness and Related Test Measurement Requirements," by Paul Lomax, Fischer Technology, Inc.

This presentation will cover solutions that will help assist coatings professionals with taking readings specified in standards as well as provide solutions on how to simplify recording and documentating of results.

• 11:00 a.m.-Noon, "When Undercover Agents Can't Stand the Heat: The CIA and the Netherworld of Corrosion Under Insulation (CUI)," by Dr. Mike O'Donoghue, International Paint LLC

This paper describes a suite of accelerated laboratory tests undertaken to evaluate some of the claims made for engineered coatings touted to possess simultaneous anticorrosive and high-temperature resistance to CUI.

Track: Sink or Swim—Protecting Marine Structures

• 10:00-10:30 a.m., "Coatings for Zebra/Quagga Mussel Control, 3rd Year Evaluation," by Allen Skaja, PCS, and Dr. David Tordonato, U.S. Bureau of Reclamation

In this update, results from the third year of research are presented. The current study includes long-term test data from silicone-based coatings, as well as new foul-release coatings technologies.

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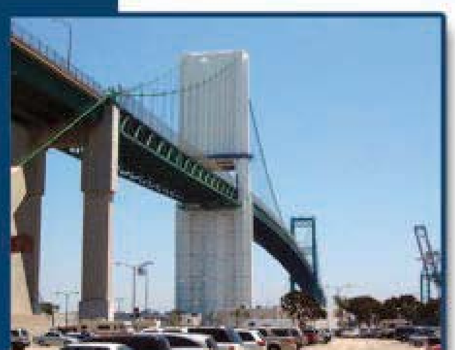

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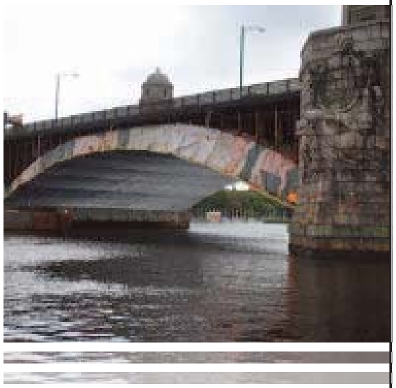

Learn PCCP's QC Requirements

If you are a painting contractor who wants to acquire SSPC certification, you'll want to register for this December's webinar: **"Basic Steps in Creating a Contractor Quality Program: Comparison of Documentation, Hold Point, and Quality Control Training Requirements in Various SSPC Contractor QP Standards."**

Presented by KTA-Tator's Alison Kaelin, the webinar focuses on setting up contractor quality programs that will meet SSPC certification requirements.

After providing a general overview of SSPC's QP standards that are used in the Painting Contractor Certification Program (PCCP), Kaelin will describe the scope and content of QP 1, QP 3, QP 6, and QP 8. She will then explain training requirements, hold point observations, and QC documentation.

Free registration for the webinar is currently available online at www.paintsquare.com/education.

Sponsored By:

SSPC The Society For Protective Coatings

Date:
December 14, 2011
11:00 a.m.-Noon, EST

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Force measurements were also conducted to determine the force to remove mussels from various coated surfaces. Laboratory tests were conducted to predict real-world, foul-release performance.

- 10:30-11:00 a.m., "Durability Assessment of Foul Release Coatings," by Allen Skaja, PCS, and Dr. David Tordonato, U.S. Bureau of Reclamation

The Bureau of Reclamation has developed testing protocols to evaluate the durability of foul-release coatings with respect to abrasion and erosion resistance. This paper details each testing methodology and presents results.

- 11:00-11:30 a.m., "Non-Toxic Novel Silicone Foul Release Marine Coatings," by Rob Thomaier, Nusil Technology

The presenter will discuss a study that evaluated modified silicone materials as foul-release coatings. Coatings were evaluated with in-situ samples placed in test racks in Morro Bay, CA. Concrete samples were coated with foul-releasing coatings and submerged off the dock so that marine growth could be monitored at monthly intervals.

- 11:30 a.m.-Noon, "Copper Antifouling Coatings—Greener than the Headlines—The Latest Regulatory Happenings and How They Can Affect You," by Neal Blossom, American Chemet Corporation

The presenter will discuss the continuing use of copper-based antifouling coatings, along with the latest scientific findings and regulatory happenings in the U.S. and worldwide. Attendees will learn how to manage the use of antifouling products, including their relationship to state storm and process water permits.

Track: Maintenance Painting—Fountain of Youth

- 3:00-3:30 p.m., "Rehabilitation of National Water Storage Landmark," by Gregory Stein, PE, Tank Industry Consultants, Inc.

This presentation will take the audience through the unique repainting project of the Washington Suburban Sanitary Commission's Earthoid. Attendees will learn the perspective of the original design engineer and the engineers responsible for the periodic coating evaluations during the service life of the existing coatings and the design of the new coating system.

- 4:00-4:30 p.m., "Galvanize It," by Kevin Irving, AZZ Galvanizing

The purpose of this presentation is to inform and educate attendees about hot-dip galvanized steel and how it can address the growing corrosion problem throughout North America.

- 4:30-5:00 p.m., "Maintenance Painting of Galvanized Mast Arms: A Project Performed Despite Budget Constraints," by Gregory Richards and Richard Burgess, PCS, KTA-Tator

The presenters will discuss the development of a maintenance painting process developed to accommodate budget constraints and produce a satisfactory outcome.

Track: Corrosion Protection & Protective Coatings

- 3:00-3:30 p.m., "Life Expectancy of a Paint System," by Al Beitelman, PCS, U.S. Army Construction Engineering

This presentation will cover factors that impact coating performance for various coating systems on navigation structures.

- 3:30-4:00 p.m., "An Organometallic Ester Corrosion Inhibitor for Use in Direct-to-Metal Paints," by John Hughes, Croda Inc.

Traditionally, the light industrial/general maintenance paint systems involved a primer along with multiple coats of acrylic finish paint. New DTM acrylic paints are formulated to eliminate the primer; however, when used on mild steel substrates, these DTM paints show poor corrosion resistance and flash rust. A new organometallic ester (OME) corrosion inhibitor was developed to improve the corrosion resistance of the DTM acrylic paints when used over mild steel substrates.

• 4:00-4:30 p.m., "Coatings Used in Conjunction with Cathodic Protection," by Richard Norsworthy, Polyguard Products

This paper will discuss the differences between CP shielding coatings and non-shielding coatings and how CP works with these coatings.

• 4:30-5:00 p.m., "Chemical Oxidative Polymerization of Polypyrrole on the Inorganic Flake Surface for Corrosion Inhibition of Aluminum 2024-T3," by Victoria Gelling, North Dakota State University

This project incorporated different dophants on the backbone of the PPy chain in varying concentrations. The synthesized PPy-flake composite pigment was incorporated in the coating at varying pigment volume concentrations and was coated on aluminum 2024-T3. These coatings were subjected to prohesion tests and were monitored to see if the PPy helped prevent corrosion.

Track: Polyurea and Thick-Film Coatings

• 3:00-3:30 p.m., "Drinking Down Under: Great Idea, Second Thoughts, The Right Path," by Dudley Primeaux, PCS, Primeaux Associates LLC

The paper will discuss a recent major concrete potable water storage tank lining application in Australia, including the challenges faced and the solution that led to success.

• 3:30-4:00 p.m., "Polyurea Great Wall: Beijing-Shanghai High Speed Railway Polyurea Protection Project," by Weibo Huang, Qingdao Technological University

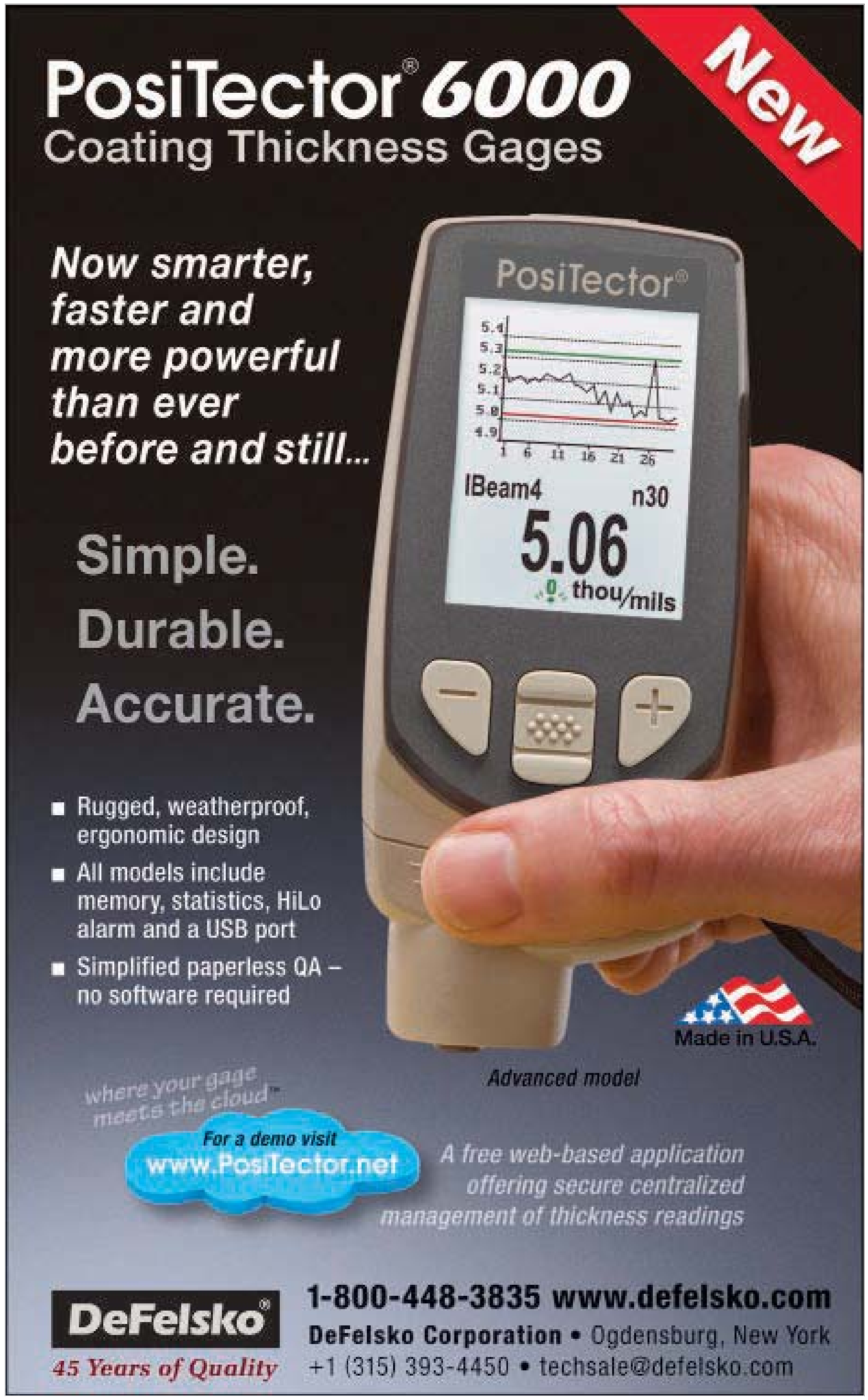
This presentation covers the protective coatings project that used polyurea on 12,000,000 square meters of concrete, and it discusses the difficulties encountered.

• 4:00-4:30 p.m., "Polyurea Applied Over 30 Gage Galvanized Flashing," by Ernst Toussaint, EIT, PCS, Sherwin-Williams Protective & Marine Coatings

Several coating systems and designs were chosen to protect a concrete chamber with sidewalls coated with a polyvinylidene fluoride (PVDF) material. This paper will discuss which coatings systems exhibited the best adhesion value per ASTM D4541.

• 4:30-5:00 p.m., "New Developments in Aliphatic Polyurea Coatings," by Paul Wiggins, Albemarle Corporation

The presenter will discuss key markets for polyurea thick-film coatings, fundamentals of curatives for polyurea thick-film coatings, a new aliphatic diamine, and formulations and performance of the new aliphatic diamine in polyurea thick-film coatings.



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SSPC, Embry-Riddle, and Honda Aircraft Recognize Certification for Aircraft Coatings Quality

SSPC, Embry-Riddle Aeronautical University, and Honda Aircraft recently created the first ever industry certification for Aerospace Coatings Applicators professionals by conferring this new credential upon four Honda Aircraft employees, who are the first people to complete the certification program.

SSPC and Embry-Riddle conducted the first professional training and certification of individuals involved in this aerospace coatings application. The first four recipients are Jason O'Neal, Michael Garza, Eliot Ewald, and Jeffrey Varner. They completed the certification in late August 2011.

The collaboration among Embry-Riddle, SSPC, and Honda Aircraft was driven by a common goal to lead the industry toward higher paint performance by establishing a level of quality in the preparation of an aircraft's surface and in the

Continued

SSPC on the Road in Hampton Roads

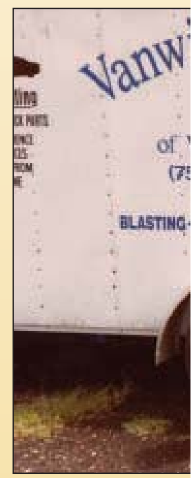
Jennifer Merck, SSPC Training and Technical Program Specialist, presented at the Hampton Roads Chapter on Sept. 20. The presentation covered "The Facts and Figures of SSPC Training."

The Hampton Roads Chapter is one of SSPC's most active chapters. It recently gave out scholarships of $1,000 each to seven individuals. The recipients were Cody Griffey, Joshua Rice, Jennifer Person, Taylor Stone, William Brackin, Michael Dreyer-Byrd, and Megan Waser. The chapter also made a donation of $2,000 to the Greenbrier YMCA and a donation of $5,000 to the Red Cross for the Haitian Relief fund.

The Hampton Roads Chapter had a total of five meetings in 2010 with a total attendance of 174 people. It also held its annual golf outing with 63 players. The chapter held 10 classes with 71 attendees in 2010.

Board members of the chapter include Robert Patrick, Chairman; Mark Wilde, Vice Chair; Gary Duschl, Treasurer; and Pam Winterling, Secretary.

SSPC Hampton Roads Chapter Meeting



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training of professionals to consistently achieve that level.

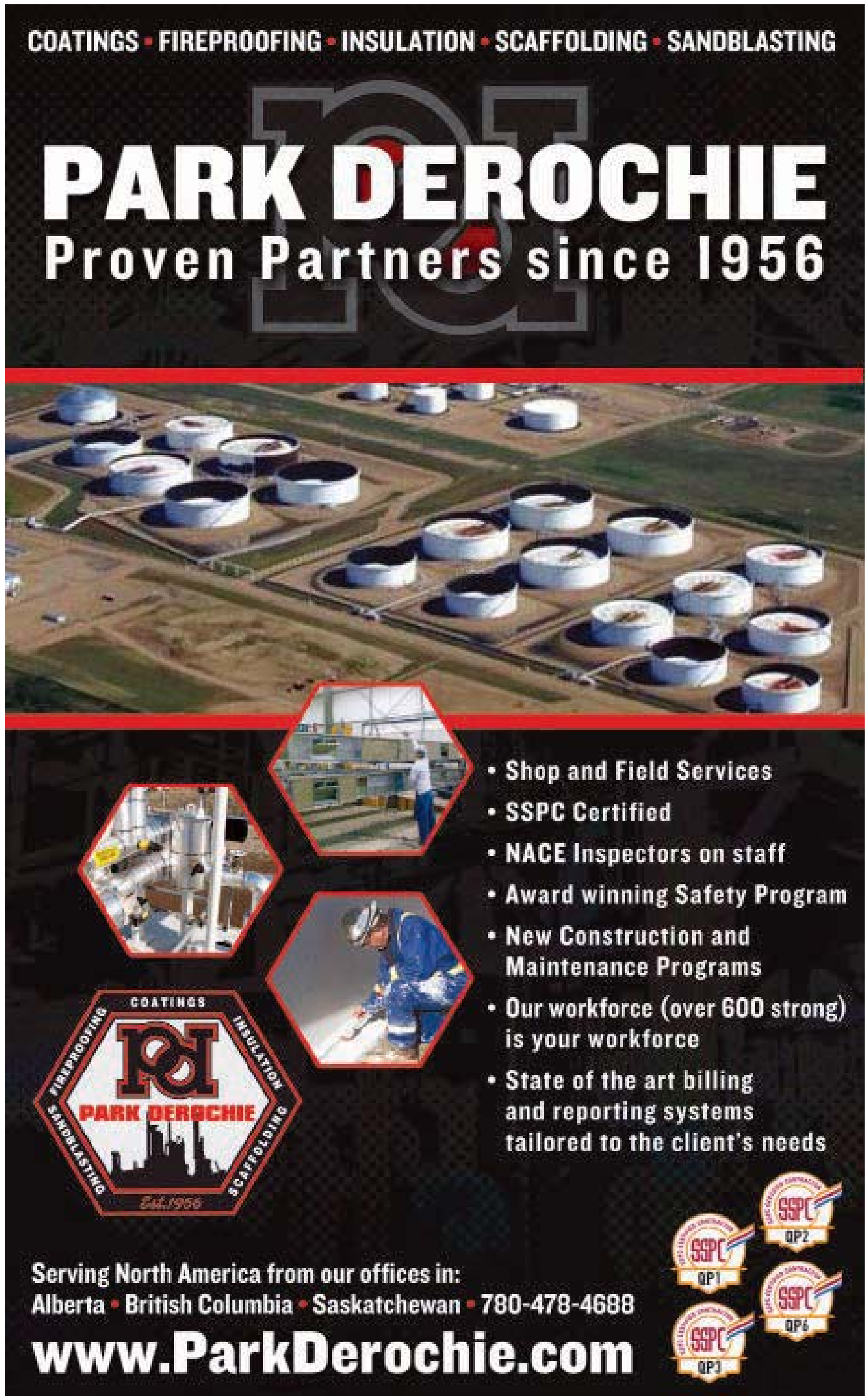
The three organizations worked together to create the requirements for the credential and the curriculum for the training program. The first graduation was marked with a brief ceremony at the National Business Aviation Association (NBAA) Convention, the world's largest business aviation annual event, held this year in Las Vegas.

"SSPC is honored that we were chosen by Embry-Riddle Aeronautical University and Honda Aircraft to be a partner in this first of its kind training and certification program dealing with aerospace coatings application," said Bill Shoup, SSPC Executive Director. "Aircraft coatings are extremely important in preventing corrosion and cracking, as can be documented by the structural failure that occurred in Hawaii in 1988 and the recent structural failure with a major airline. Coatings are the first line of defense in preventing such structural failures and certified applicators are the vanguards in such an effort."

Embry-Riddle will offer full online training to lead up to the new Aerospace Coatings Applicator certification program beginning in January 2012. For more information, visit the Professional Education web site at www.erau.edu/professionaleducation.

n (left), Vanwin Coatings of VA, and Jennifer Merck, SSPC


ck, SSPC, with Chaffin Brandon and Jimi Olson, Colonnas Shipyard, Inc.



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companies

WorkBoat Show Returns to New Orleans

The International WorkBoat Show, the annual commercial marine tradeshow, will take place in New Orleans on Nov. 30 to Dec. 2 at the Morial Convention Center.

Over 15 programs have been scheduled for the WorkBoat Professional Series, covering topics such as social media marketing, offshore support vessels, and clean water standards. The conference also includes the Fourth Annual WorkBoat Environmental Awards/Shipyard Day Awards.

The Professional Series kicks off with a keynote address on Nov. 30 at 11:30 a.m. This year's keynote speaker is David T. Matsuda, the Maritime Administrator for the U.S. Department of Transportation. Matsuda was appointed Deputy Maritime Administrator in July 2009 by President Obama and was sworn in as the Maritime Administrator in June 2010.

For more information about WorkBoat, visit www.workboatshow.com.

Exhibitors

The exhibition at WorkBoat will feature over 960 companies, many of which are involved in the manufacture, supply, and application of marine coatings. Below is a list of such companies known to *JPCL* as of press time.

• Blue Water Marine Paint offers boat building and repair supplies, and coatings. Booth 1437

• Carboline Company offers products for solving marine/offshore corrosion problems through protective coatings and linings. Booth 2813

• Custom Abrasives, LLC provides high-quality blasting abrasives, including coal slag, industrial sand, and garnet. Booth 3438

• Dalseide, Inc. (Rustibus) makes maintenance equipment and tools used in marine industries worldwide. Booth 2607

Photo courtesy of the New Orleans Convention & Visitors Bureau, neworleanscvb.com, and photographer Chris Granger.

• Damrich Coatings Inc. offers abrasives, blasting equipment, coatings, and contracting services. Booth 3262

• DRYCO provides temporary climate control equipment and service, focusing on industrial and commercial markets. Booth 3513

• Dumond Chemicals provides boat building and repair materials, as well as chemicals for surface preparation. Booth 3555

• Eagle Industries services the marine and corrosion industry with containment and ventilation solutions. Booth 128

• Fibergate Composite Structures manufactures fiberglass reinforced plastic products. Booth 169

• Hempel (USA) Inc. develops and produces high standard coatings. Booth 2530

• Hydrex Underwater Technology offers turnkey underwater repair and maintenance solutions. Booth 3409

• InduMar Products, Inc. manufactures a full line of leak repair and emergency response products for the maritime/industrial sector. Booth 1836

• International Paint LLC manufactures and supplies marine coatings and provides solutions for the industry's needs. Booth 1630

• ITW Polymer Technologies manufactures polymer-based chocking, coatings, repair compounds, and other products. Booth 1820

• Jotun Paints, Inc. supplies coatings products for foreign and domestic marine and shipping, offshore, HPI, and the military. Booth 2312

• KMT Aqua-Dyne Inc. manufactures waterblasting and surface preparation equipment including custom and standard units. Booth 2821

• Mascoat designs and manufactures thermal insulating and sound damping coatings. Booth 2167

• NACE International, The Corrosion Society, is a globally recognized association for corrosion control. Booth 254

• Opta Minerals Inc. distributes abrasives including garnet, steel, grit, and glass, and it processes coal and copper slag abrasives. Booth 2731

• PolySpec LP specializes in marine deck coating technologies to meet requirements of offshore living and work spaces. Booth 1824

• POR-15 Inc. offers deck coatings, paints, and surface preparation supplies. Booth 3226

• PPG Protective & Marine Coatings supplies high-performance coatings for marine, offshore, and architectural

Continued

applications worldwide. Booth 2241

- Schmidt/Axxiom Manufacturing, Inc. will exhibit its blast equipment and containment system. Booth 3508
- The Sherwin-Williams Company delivers asset protection with a broad line of high-performance coatings, comprehensive technical service, and a large distribution system. Booth 2749
- Sponge-Jet, Inc. manufactures clean, dry, low-dust, recyclable sponge abrasives and blasting systems. Booth 2636
- SSPC: The Society for Protective Coatings is the only non-profit association that focuses solely on the protection and preservation of steel, concrete, and other industrial and marine structures through the use of high-performance coatings. Booth 2735
- TEMP-COAT Brand Products offers a liquid ceramic insulating coating and other products to serve the maritime/industrial sectors. Booth 1800
- Tuflex Rubber Flooring offers high-performance, long-lasting floor covering solutions. Booth 1769
- Wheelabrator Group manufactures a full range of wheel-type shot blast machines and automated air blast solutions. Booth 2857
- Wooster Products, Inc. manufactures a complete line of safety stair treads, anti-slip safety coatings, and non-slip safety tape. Booth 258

products

Harsco Launches Copper Abrasive

Harsco Minerals has introduced a new surface preparation abrasive, made from recycled material, to the Southeastern U.S.

The new Iron Horse copper abrasive will be produced by the company's production facility in Tampa, FL. According to the company, the new product is processed from a recycled copper co-product, and the low free-silica, recyclable abrasive is available in extra-fine, fine, and medium grades.

For more information, visit www.ironhorseabrasives.com.

Jetstream Upgrades HP Gun Handles

Jetstream of Houston LLP has revamped the handles on its control guns used in industrial cleaning, surface preparation, and other applications. The new handles will fit control guns of earlier designs with no modifications.

The new design features a 4–6 pound trigger force, a narrower grip with tex-

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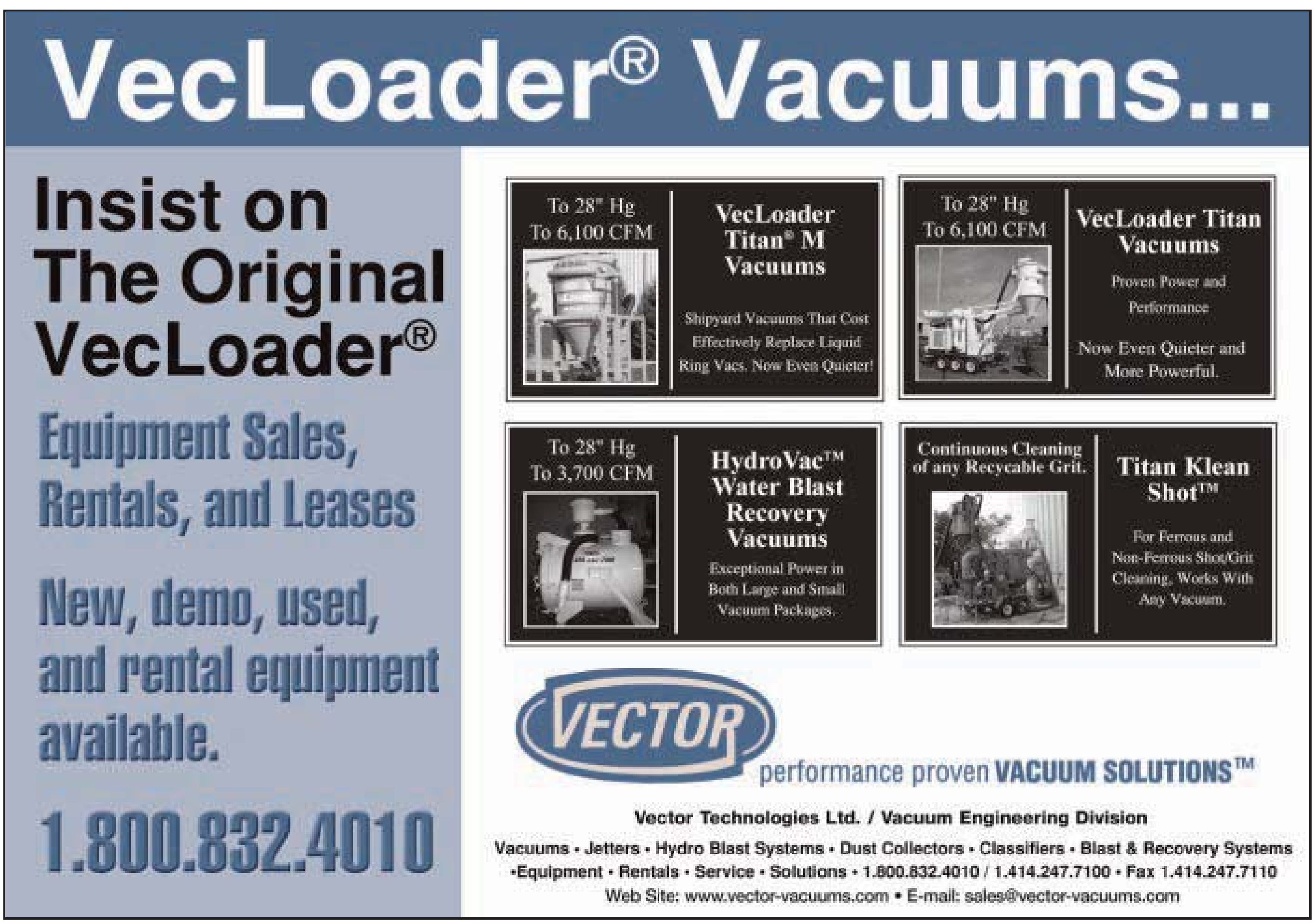

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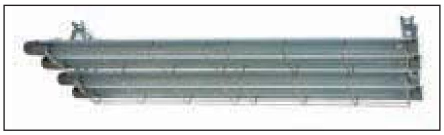
tured rear surface, and a long dump tube to prevent hot water from running inside the trigger, according to the company.

More information is available at www.waterblast.com.

Three New Lights Are Explosion-Proof

Larson Electronics has unveiled three new Magnalight explosion-proof lights.



The Magnalight EPL-48-4L-LED is a four-foot long light fixture with four

lamps designed to replace traditional fluorescent-equipped fixtures with more light and less power. The EPL-BS-161M-TP1-100 is a tripod-mounted LED light for hazardous locations where flammable vapors, gases, and dusts may be present. According to the company, it produces 10,000 lumens of light and draws only 150 watts. The EXPLED-

SOL12 is an LED light and solar panel combination with day/night and motion sensors. The light runs for 15 hours when fully charged, the company says.

For more information, visit www.paintsquare.com or www.magnalight.com.

Low-VOC, Anti-Graffiti Coating Launched

Sherwin-Williams Protective & Marine Coatings has introduced 2K Water-Based Urethane Anti-Graffiti, a low VOC, super hydrophobic polyurethane coating designed for graffiti resistance and simpler graffiti removal.

According to the company, it includes tintable gloss and satin versions and requires only a dry cloth or environmentally friendly citrus cleaner to remove most types of graffiti.

Visit www.protective.sherwin-williams.com for details.

Fire Retardant Forms Insulating Layer

Buckman now offers a new Flamebloc GS portfolio of specialized products designed to offer fire-retardant protection to a broad range of substrates.

The GS 500 coating has been designed to adhere to many surfaces and forms a thick layer of insulating material when exposed to fire or extreme heat, the company says. GS 503 is designed for use as a tie coat primer where required; and GS 602 is a flame-retardant powder additive for coatings.

More information: www.buckman.com.

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Liberty-Alpha Awarded Tobin Bridge Contract

By Charles Lange, Paint BidTracker

Liberty-Alpha III J.V., LLC (Campbell, OH) secured a $42,397,298.60 contract from the Massachusetts Department of Transportation to clean and recoat a section of the Maurice J. Tobin Memorial Bridge, an 11,906-foot-long x 36-foot-wide, double-deck cantilevered truss bridge over the Mystic River in Boston, MA. The structure, finished in 1950, is the largest bridge in New England.

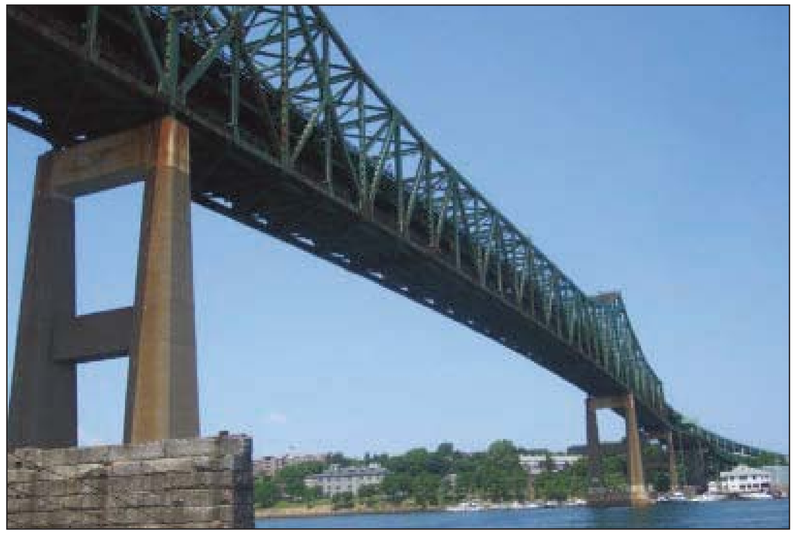

Photo courtesy of Emanouel Frangos

Liberty Maintenance and Alpha Painting, both SSPC-QP 1- and QP 2-certified, have teamed up for similar projects over the past four years, including coating the Benjamin Franklin Bridge in Philadelphia and the Thames River Bridge in Connecticut. “This is a difficult project, but it’s the kind of work we do,” said Tom Kousisis, president of Alpha.

The project includes performing structural steel repairs and graffiti abatement on concrete. The coatings work addresses roughly the middle third of the bridge, including a 12-span toll plaza. The project includes abrasive blast cleaning structural steel and rails to a Near-White condition (SSPC-SP 10) and recoating the steel with a three-coat organic zinc-epoxy-urethane system. The existing coatings are presumed to contain lead and will require containment according to SSPC-Guide 6 and waste disposal according to Guide 7.

Work for this project will begin in May and is expected to take about three years to complete. “We look forward to working with MASS-DOT on this complicated and challenging project,” said Liberty President Emanouel Frangos.

Continued

WaterOne Awards Basin Coating Contract to Genesis

Genesis Environmental Solutions (Blue Springs, MO) was awarded a contract of $2,121,586 to clean and coat steel mechanisms in four clarifier basins, as well as two ground storage tanks and other metal structures for the Johnson County (KS) Water District #1 (WaterOne.)

The owner also awarded a separate $86,400 contract to The Larkin Group (Kansas City, MO) to perform coatings inspection services for the project.

Genesis, founded in 2004, has worked on similar projects in the past, but none of this size, according to Mark Marmon, the firm’s coatings and linings manager. “This is a rather large project, one we don’t see every day,” said Marmon. He also said that WaterOne has been a client for several past projects, particularly within Genesis’s Industrial Cleaning Department. “We’ve had a good working relationship with WaterOne for some time,” he said.

Photos courtesy of Mark Marmon

The project includes abrasive blast cleaning and recoating submerged surfaces, as well as overcoating exposed surfaces associated with treatment basins, the exterior of existing dry chemical storage tanks and associated conveyor piping, wash water tanks, and various mechanical equipment.

“We’re very comfortable with the larger items in this project,” said Marmon, a former applicator and foreman. Work for this project began in September and is expected to be completed by May 1, 2012.

Learn the True Cost of Coating Work

The true cost of coating work can be calculated by knowing both the installed cost of a coating system and its anticipated service life in a given environment.

Understanding how to make this calculation is the subject of the SSPC/*JPCL* webinar, **"Calculating Coating Lifetime Costs,"** which will be presented by Jayson Helsel of KTA-Tator on Dec. 19 from 11:00 to Noon EST. This webinar will explain how to identify coating systems for your service environment, estimate their service lives, calculate the installed cost, and determine the most cost-effective system on a long-term basis (life-time cost).

Free registration for the webinar is currently available online at www.paintsquare.com/education.

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Date:
December 19, 2011
11:00 a.m.-Noon, EST

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Project Preview

Blastco to Recoat 14 MG Tank

The East Bay Municipal Utility District (Oakland, CA) awarded a $3,881,040 contract to Blastco, Inc. (Gardena, CA) to rehabilitate the Alamo Reservoir, a 14 MG welded-steel water storage tank (225-foot-diameter x 50-foot-high). SSPC-QP 1 and QP 2 certifications are required. The interior of the tank will be abrasive blast cleaned to SSPC-SP 5 (White Metal) and lined with a 100%-solids epoxy system. Solid desiccant dehumidification and ventilation are required. The exterior will be power washed, spot power-tool cleaned to SSPC-SP 11 (Bare Metal) and coated with an epoxy-polyurethane system. Containment is required to capture lead that is present in the existing coatings.

P.R. Steelecoate Wins Absorber Coating Contract

P.R. Steelecoate, Inc. (Tampa, FL) received a contract of $557,000 from the Jacksonville (FL) Electric Authority to clean and line approximately 11,000 square feet of interior surfaces in two existing absorber towers at the St. Johns River Power Park. The Authority will provide initial water blast cleaning and scaffold erection under separate agreements. The interior surfaces will be abrasive blast cleaned to SSPC-SP 5 (White Metal), tested for soluble salts with as-needed chloride remediation, and coated with a trowel-applied, fiberglass-reinforced, novolac vinyl ester liner system.

Southwest Coatings to Repair Tank

Southwest Coatings, Inc. (San Pedro, CA) won a $64,314 contract from the U.S. Department of Agriculture to repair a 120-foot-long x 8-foot-diameter underground storage tank at an Agricultural Research Station in Maricopa, AZ. The corrugated metal rainwater tank, which is galvanized on the cylindrical walls but not the end walls, is leaking. The metal will be abrasive blast cleaned to SSPC-SP 10 (Near-White) before coating. The project includes lining repaired interior tank surfaces and wall and floor surfaces in a concrete sump basin (manhole) with a 100%-solids, bio-based polyurethane system.

Fuel Tank Maintenance to Recoat Dam Gates

Photo courtesy of U.S. Army Corps of Engineers

The U.S. Army Corps of Engineers, Nashville (TN) District has awarded a $1,173,780 contract to Fuel Tank Maintenance Co. (Cookeville, TN) to clean and recoat five existing 41-foot-high x 45-foot-wide steel tainter gates at the Cordell Hull Dam. SSPC-QP 1 certification is required. The gates will be abrasive blast cleaned to SSPC-SP 5 (White Metal) and recoated with an epoxy-urethane system. The existing coatings contain low levels of lead and will require containment.

Commonwealth Epoxy Coating to Seal Secondary Containment

The U.S. Department of Homeland Security has awarded a contract of $22,040 to Commonwealth Epoxy Coatings (Newport News, VA) to seal surfaces in an existing three-cell, 20-year-old, concrete secondary containment area at a Coast Guard hazardous waste facility in Portsmouth, VA. The concrete will be diamond grinded or shot blast cleaned, repaired with epoxy paste, and coated with a high-solids, chemical-resistant epoxy and two coats of non-skid urethane.

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