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The Voice of SSPC: The Society for Protective Coatings

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Features

From the Offices of SSPC

Departments

Also This Issue

Staff

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Editorial

SSPC 2015 and Our Annual Report

SSPC 2015 was a success this year. Again, we thought "outside the box" and held our show in conjunction with the World of Concrete (WOC), which was also taking place in Las Vegas. When we announced last year in Orlando that our show would be the same time as the WOC, I had several exhibitors who expressed their concerns that this was not in SSPC's best interest. Towards the end of SSPC 2015, many of those same exhibitors came up to me and said that having the meeting at the same time as the WOC had been a good idea. That was favorable news for all the folks who had worked very hard to make sure that the two conferences were seamless, and that those going to the WOC could visit our exhibit hall with minimal paperwork at our registration booth.

We were pleased with the attendance in Las Vegas. That city always seems to be a good draw for SSPC, and our final number surpassed those of each of our last three conferences. I also received many favorable comments about the information presented in the technical program sessions. The feedback I received was that the technical program was stronger, with more relevant papers given this year. For that, I would like to thank the Educational Program Advisory Committee and its members: Pete Ault, Elzly Technology Corp. (chair); Earl Bowry, Jotun Paints; Charlie Brown, GPI; Robert Cloutier, Bath Iron Works; Heather Gilmer, Tampa Tank & Florida Structural Steel; Eric Kline and Cyndi O'Malley, KTA-Tator, Inc.; Bob Murphy and Mark Schultz, The Sherwin-Williams Co.; Steven Reinstadtler, Bayer MaterialScience; David Tarjan, Halox; Dwight Weldon, Weldon Laboratories, Inc.; and Joyce Wright, Newport News Shipbuilding. We are grateful for their work and effort in making the program a success.

At the conference we gave awards for the Honorary Life Member, the John D. Keane Award, achievements in education and technical work; the Women in Coatings Impact award; chapter programs, and other contributions to the conference and the coatings industry. We also recognized the authors of some of our best papers and *JPCL* articles from the past year. All of these award winners will be covered in the April *JPCL*.

We started the Structure Awards in 2007. This year, we again recognized exceptionally well-done painting projects. The George Campbell, William Johnson, E. Crone Knoy and Charles Munger Awards recognize high-quality industrial and commercial coatings projects, as well as projects demonstrating excellence in longevity, aesthetics and complexity. We also presented two Military Coatings Project Awards of Excellence – one to the *USS Dwight D. Eisenhower* (CVN 69), and the other to the National Armor and Cavalry Museum at Ft. Benning, Ga. The museum's award presentation was highlighted by a thank-you given by LTG (Ret.) John Sylvester, chairman of the Armor/Cavalry Foundation, and by the attendance of CSM (Ret.) Rick Young, their executive director. The award-winning museum project will also be covered separately in the April *JPCL*. This award is unique because it was presented to a collaboration of contractors and suppliers coming together to paint seven armored vehicles. Our congratulations and thanks go out to all of the winners who are featured in this month's issue on pp. 32–36.

I cannot say this too many times: thank you to all the attendees for coming; the volunteers on all the committees and special task groups; the sponsors whose outstanding support allows us to have the conference we like to host; all the exhibitors; the Board of Governors for their guidance; and the staff members who work so hard and care so much to put on a show we all want to be proud of. I wish I could thank everyone personally, by name, but space requirements limit me. Thank you from the bottom of my heart.

Also in this issue is the 2014 SSPC Annual Report, found on pp. 56–63. Please take the time to read it. It shows that SSPC is a solid, financially strong association that is ready to tackle the challenges ahead. Of course, if you have any questions or comments, please do not hesitate to contact me or one of our other staff members. Our mission is to support you, the member, and it is your right to know what is going on in your association with your membership dollars.

Again, thank you for your support of SSPC 2015 and of SSPC as a whole.

Bill Shoup
Executive Director, SSPC

Tips on Specifying and Selecting Coatings Offered in New Webinar

"Specifying and Selecting Coatings," the latest free online webinar being made available as part of the SSPC/*JPCL* Webinar Education Series, will be presented on Thursday, April 16, from 11:00 a.m. to 12:00 noon, EST. This webinar will provide guidance on how to properly specify and select a coating system for a specific substrate (steel, concrete, metal, previously coated), structure and environment. Participants will be eligible to receive credit from SSPC.

Troy Fraebel, project development manager in the protective and marine division of The Sherwin-Williams Company, will present this webinar. Fraebel has more than 25 years of experience in the protective coatings industry, including extensive experience in the water, wastewater, bridge, marine, power and petrochemical markets. He is a NACE-certified Coating Inspector, an SSPC Protective Coatings Specialist (PCS) and an instructor for SSPC's C1 and C2 training courses. He is also affiliated with ASTM International, AWWA and numerous rural water associations. Earlier in his career, Fraebel developed the painting quality assurance and maintenance programs for Caldwell Tanks and spent 13 years with KTA-Tator Inc. He has a B.A. from Western Kentucky University and an master of education from William Paterson College.

This webinar is sponsored by The Sherwin-Williams Company.

Troy Fraebel

Registration, CEU Credits

This program is part of the SSPC/*JPCL* Webinar Education Series, which provides continuing education for SSPC re-certifications and technology updates on important topics.

SSPC is an accredited training provider for the Florida Board of Professional Engineers (FBPE), and Professional Engineers in Florida may submit SSPC Webinar Continuing Education Units to the board. To do so, applicants must download the FBPE CEU form and pass the webinar exam, which costs $25.

Register for this online presentation at paintsquare.com/webinars.

PPG, Houston Coating Society Name New Presidents

PPG, the world's largest paint and coatings company, has tapped Chief Operating Officer Michael H. McGarry as its next president. The 34-year PPG veteran will eventually succeed Chairman and CEO Charles E. Bunch, 65.

Michael H. McGarry

McGarry, 56, became COO of PPG in August 2014 and will remain based at PPG's global headquarters in Pittsburgh, Pa. He will continue to report to Bunch, who says he has no immediate plans to retire. McGarry will continue to have executive oversight responsibility for all of PPG's strategic business units and operating regions and for information technology (IT); environment, health and safety (EH&S); and purchasing.

PPG said McGarry had "served in a variety of key business and functional leadership roles" that had helped transform the company's portfolio during his 34-year tenure. In addition to the 2013 AkzoNobel and 2014 Comex acquisitions, he helped lead the 2008 acquisition of SigmaKalon and the 2013 separation of PPG's former commodity chemicals business, the company said.

McGarry joined PPG in 1981 as an engineer at the company's chemicals complex in Lake Charles, La., and rose steadily through management assignments that took him to three continents.

SSPC Accepting 2015 Scholarship Applications

SSPC is pleased to announce that the application is now available for the Society's 2015–2016 College Scholarship Program.

The Program is open to any student who is beginning or continuing his or her education at an institution of higher learning in the U.S. or Canada. To be considered for the scholarship, candidates must be a high school senior planning to enroll full-time or a student already enrolled full-time at an accredited institution of higher learning that has a three- or four-year curriculum. Each candidate also must be a member of SSPC in good standing, or the child of an SSPC member in good standing.

To apply for the scholarship, each candidate must submit a completed application form, two letters of recommendation, high school or college transcripts and a personal letter expressing why he or she deserves the scholarship and what he or she plans to do in his or her field of study. Scholarship funds will be applied to the direct costs of the student's courses. Once awarded, SSPC will work with the financial aid offices of each institution to ensure proper use of the funds. A panel consisting of three members of the SSPC Board of Governors (designated by the entire Board) will choose the scholarship recipients.

For the 2015–2016 year, there are six $2,500 scholarships available. To apply online, visit sspc.org/scholarshipapplication or download the application form from sspc.org. Applications must be received by April 30, 2015. For questions, call SSPC at 412-281-2331 or email students@sspc.org.

His many executive positions have ranged from operations manager, silicas, in Thailand, to vice president, chlor-alkali and derivatives. In 2006, McGarry was named vice president, coatings, Europe, and managing director, PPG Europe. Two years later, he became senior vice president, commodity chemicals. In 2012, he was named executive vice president, overseeing the automotive refinish, aerospace, global architectural and protective and marine coatings businesses, as well as the Europe, Middle East and Africa (EMEA) and Asia Pacific regions, and the EH&S and IT functions. McGarry also serves as a director on the boards of Axiall Corporation and Pittsburgh Glass Works LLC.


Tim Siemek

The Coating Society of the Houston Area recently named Tim Siemek, vice president of multiservices with Safway Group, as its president for the year 2015. Siemek has 28 years of experience in the protective coatings industry and has been active with the Society for over 15 years, serving in various positions on the Society's executive board for the past three.

Siemek joined Safway in 2012. Before Safway, he spent 13 years as the operations/specialty service manager for The Shaw Group, which provides engineering, construction and related services for a variety of industries.

As president of the Society, Siemek says he will advocate for more scholarship support for young people pursuing corrosion-related studies. "There is a growing need for corrosion prevention," Siemek said. "By providing instruction and sharing our knowledge base on safe, best practices, we will ensure that future industry pioneers will have an in-depth understanding of the mitigation of this industry-wide problem."

In the past five years, the Society has awarded more than 50 academic scholarships, totaling over $60,000. It has also started to partner with NACE International, which awarded an additional $10,000 in 2014 for industry-specific scholarships.

Siemek's other duties as president include chairing trade show committees, participating in special scholarship fundraising and facilitating the Society's by-laws.

The Coating Society's officers start as treasurer and advance to president their fourth year in office. The Society's other officers for 2015 are:

- Vice President Joe King, MineralTech;
- Secretary Anthony Grigsby, Carboline; and
- Treasurer Dwayne Lum, Hempel.

Established in 1956, the Coating Society of the Houston Area serves owners, suppliers and contractors as a forum for sharing best practices for corrosion control through the use of protective coatings. The Society holds a variety of networking events throughout the year, including a painters' competition, which will be held April 11 of this year, and an annual trade show, which will be held April 17.

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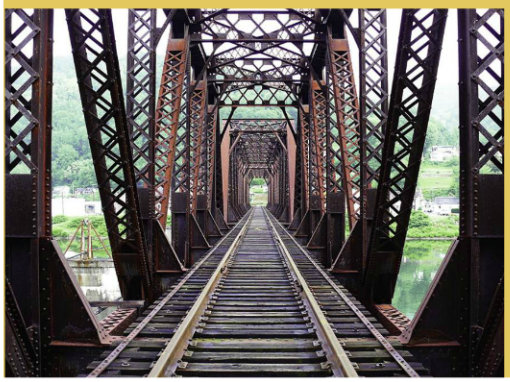
"Railroad Bridge Crashes Spur U.S. Audit" *(Feb. 27)*

After 24 accidents and nearly 400 injuries over 10 years, the federal government has decided to take a closer look at the overseers of the U.S. railroad bridge system. The U.S. Department of Transportation's Office of Inspector General (OIG) has announced a self-initiated audit of the Federal Railroad Administration's (FRA) oversight of railroad bridge safety.



This triple Pratt-style iron truss railroad bridge over West Virginia's Gauley River is one of about 77,000 railroad bridges nationwide. Owners are responsible for safety, maintenance and inspection. Photo courtesy of Ken Thomas, Public Domain.

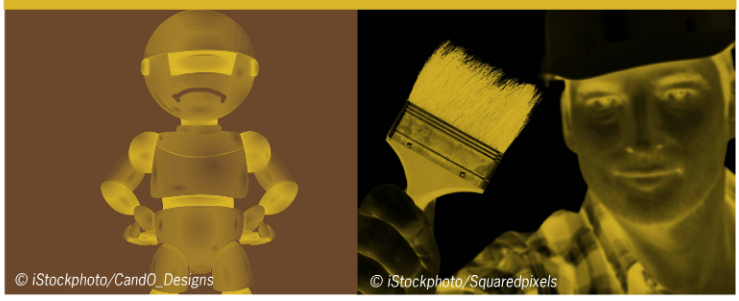
PSN TOP 10 *(as of Mar. 3)*

- Ex-Coatings VP Guilty in 2 Deaths
- New Deals to Absorb 3 Coating Firms
- Bay Bridge Test Shows Signs of Cracking
- Firm to Pay $1.3M in PennDOT Fraud
- Bridge Collapse is 2nd for FL Road
- Company Admits Error in Fatal Collapse
- $3.7M Suit over Crosswalk Paint Revived
- Tower Painter's Death Draws $115K Fine
- China Slaps VOC Tax on Coatings
- No Violations Cited in OR Bridge Death

Most Popular Poll *(as of Mar. 3)*

Assuming the highest level of competence by each, who is generally the better painter: a robot or a human? *(Feb. 16–20)*

Robot 44% Human 56%



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MOST POPULAR QUIZ *(as of Mar. 3)*

What term denotes migration of a substance to the surface of a coating film? *(Feb. 18)*

a) Drifting
b) Flocculation
c) Flooding
d) Exudation

Answer: d) Exudation. Plasticizers can migrate to the surface of a coating film, for instance.

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On Evaluating Non-Visible Contaminants on Concrete

How do you assess salts and other non-visible contaminants on concrete surfaces?

Denis Pazio
Euronavy, Inc.
Salt testing on concrete substrates is not a recommended practice.

A simple basic test that can be performed on concrete substrates for oil or dust contaminants is to drop small amounts of water on the surface. If the water beads, the concrete is contaminated. If the water is spread out evenly and is eventually absorbed into the concrete, it is typically OK to proceed.

Most of the focus should be on the flooring and not the walls. A good evaluation and survey should be conducted beforehand to determine problem areas, and of course, historical data from owners/agencies should be consulted.

Chuck Pease
MMI Tank
I'm not sure I agree with your statement, Denis, that "Salt testing on concrete substrates is not a recommended practice." What is the premise or standard you base this statement on?

The test for chloride content in concrete is very significant because when chloride is present in reinforced concrete, it can cause very severe corrosion of the steel reinforcement. Chlorides can originate from two main sources: "internal" chloride, i.e., chloride added to the concrete at the time of mixing, including calcium chloride accelerating admixtures, contamination of aggregates and the use of sea water or other saline contaminated water; and "external" chloride, i.e., chloride entering the concrete after it has hardened. In this category, we find both rock-salt (used on roads), which gets into concrete structures such as flyovers; and sea salt, either directly from sea water in structures such as bridges, or in the form of air-borne salt spray in structures adjacent to the coast.

From K. Srinivasan
BHEL
We perform swab analyses for presence of chlorides, sulfates and other contaminants, if any.

Vaughn O'Dea
Tnemec Company, Inc.
Can you elaborate on the method or procedure you use to quantitatively measure soluble salts from the surface concrete?

Jim Johnson
CHLOR*RID International Inc.
Many specifications call for testing,

measuring and removal of excess salts from concrete. Most frequently, chloride is being tested for, but due to service and service environment, quite often sulfates and nitrates are tested for, too. Such salts on concrete cause some of the same problems they do on steel, such as blistering and poor adhesion. SSPC Guide 15 lists the various methods to test for chloride, sulfate and nitrate and lists the specific procedures required to perform testing.

Vaughn O'Dea
Tnemec Company, Inc.
SSPC's Guide 15 excludes concrete by its very title with reference to "nonporous surfaces." Are you aware of specific tests that have been used successfully on vertical concrete?

Marco Antonio Alvarado Meneses
Consultant - Lima, Perú
I agree with Denis: "Salt testing on concrete substrates is not a recommended practice." Is it possible to measure soluble salts from the surface of concrete and, if so, what method should be used?

Editor's Note: Problem Solving Forum questions and answers are posted on *JPCL's* sister publication, *PaintSquare News*, a daily electronic newsletter. To subscribe, go to paintsquare.com. Occasionally, PSF questions and answers are republished; answers are sometimes edited to conform to *JPCL* style and space limitations, and participants' company affiliations are published as they were when the answers were originally submitted.

Photo courtesy of Natalie Schilling.

The Missing Man Formation

A Tribute to Mark Schilling by Mark B. Dromgool, Randy Nixon, Mike O'Donoghue and Russell Spotten

On December 7, 2014, Mark S. Schilling, our good friend and collaborator in the technical community, suddenly and tragically passed away. This tribute by friends focuses on a few salient aspects of the great man and the many contributions he made to the fields of corrosion and materials science and engineering.

First, Mark's depth and breadth of knowledge on a wide range of topics; including but not limited to corrosion science, metallurgy, protective coatings, plastics, elastomers, fireproofing and materials testing; was incomprehensible. He had, quite simply, a brilliant mind. His encyclopedic grasp of so many complex scientific and engineering principles in the areas of polymer chemistry, thermodynamics, materials performance properties, analytical techniques and failure analyses was unparalleled by anyone else we knew or know. When we thought we knew the answer to a particular problem, or conversely weren't sure which way to turn, we would call Mark. Sometimes we were headed down the right path, but in the main he would suggest that we turn over a stone which we had yet to consider. And generally, the path to resolution of that specific problem-solving quandary would become apparent and well-illuminated. Often, we had missed the obvious and looked too far. On other occasions, we hadn't considered all of the contributing factors. In nearly every scenario in which his counsel was sought, he set us on the right course. In every case, he was generous to a fault with his time, sharing in-depth, insightful guidance along with the technical reference sources necessary to back up the conclusions which would be taken.

Using his apparently bottomless vessel of a learned, incisive mind and solid technical writing skills, Mark authored and co-authored numerous technical papers and standards through SSPC, NACE and other technical associations. He is perhaps most widely known for his popular and pragmatic series of articles in the *JPCL* called "Truth and Consequences." In these concise, educational and always tongue-in-cheek technical watch-outs, he addressed misunderstood, interpretive and controversial subjects such as solvent entrapment and osmotic blistering, unnecessary delays in construction schedules caused by overzealous paint-inspection practices, and the "sticky business" of adhesion testing.

Mark led the Standards Committee at SSPC for a number of years and ensured the scientific accuracy and clarity of language used in many important documents. In short, Mark's leadership and steadfast determination for SSPC and NACE to achieve technical efficacy and defensible veracity in publications provided invaluable contributions and advancements to the profession. With his remarkable intellect and seemingly photographic recall of scientific principles and facts, he made our industry better.

Secondly, Mark was adamant about getting to the truth in all technical matters. His unyielding dedication to precision made him a highly valued ally, a formidable technical adversary

and a tough reviewer of all written words. For those of us who co-authored reports, articles or papers with him, or had such documents reviewed by him, it was never a completely painless or comfortable experience. But, it always produced a positive result, a better work product soundly rooted in defensible science. For those who stood against him in technical debate, whether in providing expert testimony or at the committee level, he was always better informed and better prepared. He was, in his own words, "often outnumbered, but never outgunned." In nearly ten years at Corrosion Probe, Inc., Mark handled at least a dozen projects in which he ended up providing expert testimony. In all cases, his clients prevailed handily in court.

One of Mark's greatest crusades was his fundamental disdain with the pseudo-science (or junk science) of the salt-frenzy brigade who, over the past dozen or so years, had been peddling that soluble salt, particularly sodium chloride, could regeneratively form acid in corrosion pits, and that this needed a proprietary "salt extraction agent" or "foo-foo juice" that would allegedly dislodge these "insidious and dangerous" materials that had now, somehow, become chemically attached to the substrate or ingrained and were mostly insoluble. Mark repeatedly and fluently demonstrated that the corrodent in atmospheric corrosion was oxygen, that chloride was potentially a corrosive (in some situations) and that "soluble" meant soluble, i.e., all that was needed to dissolve these materials from the surface was water. Mark, almost singlehandedly, stopped or curtailed the many untruths about soluble salts being written into industry tests, textbooks, standards and published papers.

His campaign of truth against salt-frenzy junk science earned Mark the title of "The Detriment," a handle he wore with much pride and indeed for many years he signed his correspondence so.

Mark could be confrontational, contrary, argumentative and unyielding. Those with thin skin and unsupported claims did not enjoy Mark's challenges, nor did he suffer fools easily. Thus, he challenged friend and foe alike. And he did so to seek, find and articulate the truth.

In essence, Mark made us all better writers and providers of technical information. He gave many people, even his friends, an F Grade if the writing didn't meet his exacting standard. There was no compromise. For example, while writing an expert witness report Mark taught us to write it expecting that the "expert" or the attorney for the opposing team would be Mark Schilling who would, and could, drill down deep into each and every detail, claim, hypothesis or conclusion. The compelling lesson for all of us was to get the science right, be precise, make the argument defensible and seek the truth or suffer the consequences. As his friends, we will forever be indebted to him for this mantra.

Photo courtesy of the authors.

That Mark possessed a creatively brilliant and analytical mind can never be overstated. His rigor with scientific inquiry to distinguish what was fact, in contrast to what was interpretation of

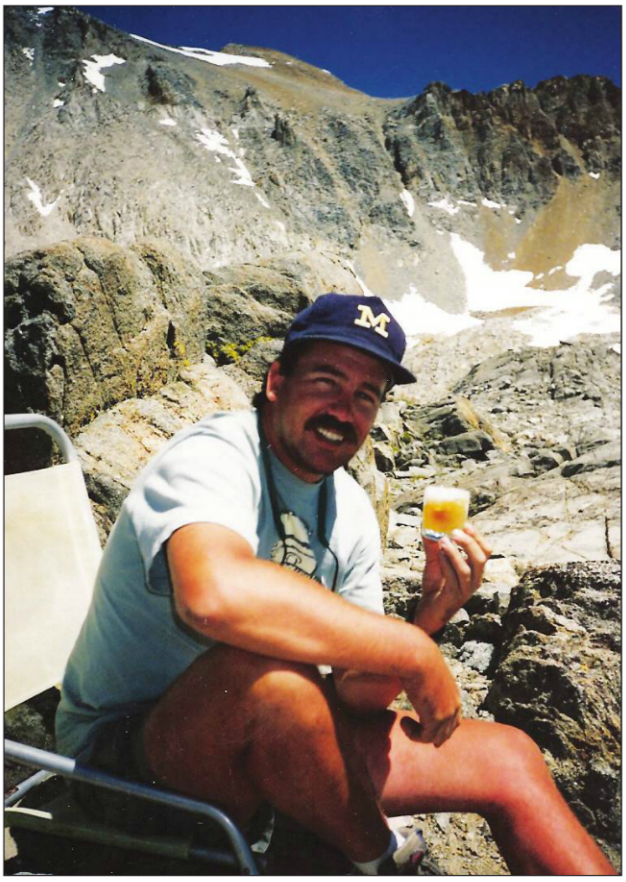


Photo courtesy of Russell Spotten.

fact, stretched into other domains of key interest to Mark, notably astronomy, climate science and the history of alchemy transforming into chemistry. Phone Mark and often he would quip "How many pounds of phlogiston do you want to buy?" Many a night was spent talking into the wee morning hours with this quintessential debunker of myths that relentlessly pursued truth and opened our minds to new paradigms and gave us a sense of wonder. For those of us who walked with Mark through the mysterious fields of corrosion science, protective coatings, and those other areas of Mark's interest, who could have asked for a better guide?

The third and final point of this expression of tribute and friendship is to pay homage to Mark's great sense of humor. He loved practical jokes and played them on all of us at one time or another. He once left salt (from take-out restaurant packets) all over the black counter of the SSPC booth at the annual conference with a note which read, "Compliments of Booth No. XXX" which, unsurprisingly, was a vendor hawking a product for removing chloride from steel surfaces to be painted.

Mark had a tremendous love for the outdoors and could be seen somewhere in the Sierra Nevada mountain range for one week every summer on his annual backpacking trip. To be a part of any one of those epic hikes was truly a special treat and always memorable. You see, Mark was not content on these trips to take with him just the minimum of gear needed to survive (the minimalist approach), but would instead carry with him those things which would allow him and his cohorts to thrive while in the backcountry. If you were to stumble upon Mark and his fellow hikers at a high country trail camp, you would likely see them sitting in portable camp chairs, with fake grass mats sipping a beverage and listening to tunes; or rafting on a high Sierra lake where no one had ever rafted before, or since. You might even see the group enjoying a steak and lobster dinner, with Haagen-Dazs ice cream bars for desert — all kept frozen for the first couple of days on dry ice. Of course, if you were to join Mark on one of those annual treks, your pack would be ridiculously heavy. But the experiences were always great fun, and filled with incredible memories to last a lifetime.

At our last night at the 2015 SSPC annual conference, the undersigned along with a few other old comrades of Mark's enjoyed a special dinner together in Las Vegas. At Mark Dromgool's wise suggestion, we who were seven, booked a table for eight. In aviation, as Dromgool explained, it's called the missing man formation. We reminisced about prior conferences, debates, backpacking trips and many years of laughs. It was our way of continuing to enjoy Schilling's brilliance, insistence on the truth and love of levity.

To close, it would be remiss on our parts not to mention another poignant subject. For many decades, Mark's email address was Welbytoast. When asked why this was so, he wryly replied, "Some days I do what I think is right and I may as well be toast."

Mark S. Schilling; Welbytoast; MSS; MS2; The Detriment; we, your long-held friends, admirers and colleagues; we toast you. You were right most of the time.

Goodbye, dear friend, until we greet again.

Signed by:
Dromgool M., Nixon R., O'Donoghue M., and Spotten R.

Failure of a Coated Concrete Floor

By Dwight G. Weldon, PCS, Weldon Laboratories, Inc.

Fig. 1: This is the cross-section of a sample of floor coating that showed objectionable haziness. Note the aggregate particles that are protruding into the glossy clear coat (the coat beneath the satin clear topcoat), and the curved lines or cracks emanating from these particles. Photos courtesy of Weldon Laboratories, Inc.

This edition of "Investigating Failure" deals with a problem encountered on a 15,000-square-foot coated concrete floor located in a new engineering research facility. The facility included offices, laboratories and a loading bay.

The specification called for the floor to be roughened by vacuum abrasive blast-cleaning to achieve an International Concrete Repair Institute (ICRI) grade of CSP-3 to CSP-4. After surface preparation was finished, the floor was primed with an epoxy primer at 3 to 5 mils dry film thickness (DFT), followed by a basecoat, a glossy clear third coat and a clear satin finish topcoat. The basecoat was advertised by the coating manufacturer as a high-solids flexible epoxy (published elongation of 60 percent) which contained decorative colored aggregate. It was to be trowel-applied at 12 to 16 mils DFT, with colored aggregate broadcast into it while it was still wet. After the basecoat dried overnight, any loose aggregate was swept away and the clear third coat was applied at 3 to 5 mils DFT, followed by the clear satin finish coat at 3 to 5 mils DFT. Both of the clear coats were advertised as having good impact resistance, but were not described as being flexible.

After the coating application had been completed, the appearance of the floor was said to be excellent, and the owner was as happy as could be. However, within a few months the owner was not so happy, as the usage of heavy carts had damaged the floor and left paths or tracks of haziness in the otherwise satin finish. The amount of damage was greatest where cart traffic was the highest. The floor in some of the lab area, which was subject only to normal foot traffic, still looked excellent.

Several samples were submitted to the laboratory for study, including chips of coating, as well as samples that had been removed using a hole saw. Pint quantities of the various coating materials were also submitted.

A stereo zoom microscope with magnification to 70 times (70X) was used to examine the samples in the laboratory. Samples from non-failing areas looked very good, and the coating thicknesses were generally in agreement with their specified values. The failing samples also had the correct number of coats, at generally the correct thicknesses. Some of them could not be visually distinguished from samples labeled as non-failing. This is not unusual, as sometimes appearance differences that are obvious to someone gazing at a large expanse of wall or floor are not obvious at all when small samples are removed and looked at in an office or laboratory setting. However, some of the failing samples were obviously hazy.

When the visually hazy samples were examined in cross-sections at the higher end of the magnification range, several fine curved lines or cracks were apparent in the lower clear coat (the third coat of the four-coat system), which radiated outward from the aggregate particles embedded in, and pro-

Table 1: Percent Nitrogen Of Third Clear Coat at Different Mix Ratios

Sample	Mix Ratio	% Nitrogen
Clear coat	1:1	4.59
Clear coat	2:1 (correct mix ratio)	3.14
Clear coat	4:1	1.68

truding through, the basecoat (Fig. 1, p. 17). Some of these cracks stopped at the interface between the two clear coats, and some proceeded partway into the clear topcoat. Therefore, the source of the haziness was not in the clear satin topcoat, but in the clear coat just beneath it.

A failing and a non-failing sample were both further examined microscopically before and after exerting substantial pressure with the tip of an X-acto knife pressed at an oblique angle onto the surface of the topcoat. In some cases, even with the non-failing sample, this resulted in the formation of a visible haze. The haze developed immediately at or extremely near particles of aggregate that were embedded near the surface of the basecoat and that protruded a short distance into the first (lower) clear coat.

When dealing with a failure involving a two-component coating, it is often necessary to determine if the coating has been applied at the correct mix ratio. The physical and chemical properties of two-component coatings such as epoxies and urethanes can sometimes vary dramatically if the coatings have not been mixed and applied at, or close to, their specified mix ratios. Indeed, in this case, incorrect mixing was suggested by the coating manufacturer as a likely cause of the failure.

It is this author's experience that the preferred method of determining the mix ratio of epoxies and urethanes is by analyzing them for percent nitrogen. In the case of epoxies, the curing agent is usually a polyamide or some type of amine. These are nitrogen-bearing molecules, and hence the more curing

agent which is used, the higher the percent nitrogen. The nitrogen analysis is carried out using a carbon-nitrogen-hydrogen (CNH) analyzer, which measures the amount of nitrogen generated during combustion of the sample.

Liquid samples of the clear third coat were applied in the laboratory at different mix ratios, allowed to cure and analyzed for nitrogen content. The results obtained are displayed in Table 1. The results clearly show an established relationship between mix ratio and nitrogen content. All that remained to be done was to determine the nitrogen content of the clear third coat from some of the jobsite samples, and we would be able to tell if they had been applied at the correct mix ratio. However, sometimes things are not as easy as they seem.

The lab results for the jobsite samples made no sense at all. Nitrogen content varied from 0.80 to 2.32 percent, suggesting that some of the samples (including non-failing ones) had been mixed at ratios as high as 8-to-1, rather than the specified 2-to-1. Not only was this simply hard to believe, but it was also impossible, since a drawdown made in the lab at a ratio of 4-to-1 did not cure at all and was a sticky, gummy mess. A drawdown made at a ratio of 8-to-1 would have been even worse (if such a thing were possible).

The likely explanation for the invalid nitrogen analysis was that the scrapings of the clear third coat (not the clear satin topcoat, but the first coat of clear that was responsible for the haziness) also contained shavings of the underling basecoat (which was also clear), or even residues of aggregate from the basecoat. Any such debris would add to the weight of the sample but would contribute no curing agent, making the weight percent nitrogen appear artificially low. A different technique would have to be used.

The technique finally used to determine the mix ratio of the clear coat was infrared spectroscopy, previously discussed in this author's column in the December 2014 *JPCL*. Very briefly, different materials absorb infrared light at different frequencies, depending on their chemical composition. By "scanning" a sample over a range of frequencies (often from about 4,000 to 400 cm^{-1}), and recording the amount of infrared light either absorbed or transmitted at each frequency, one obtains

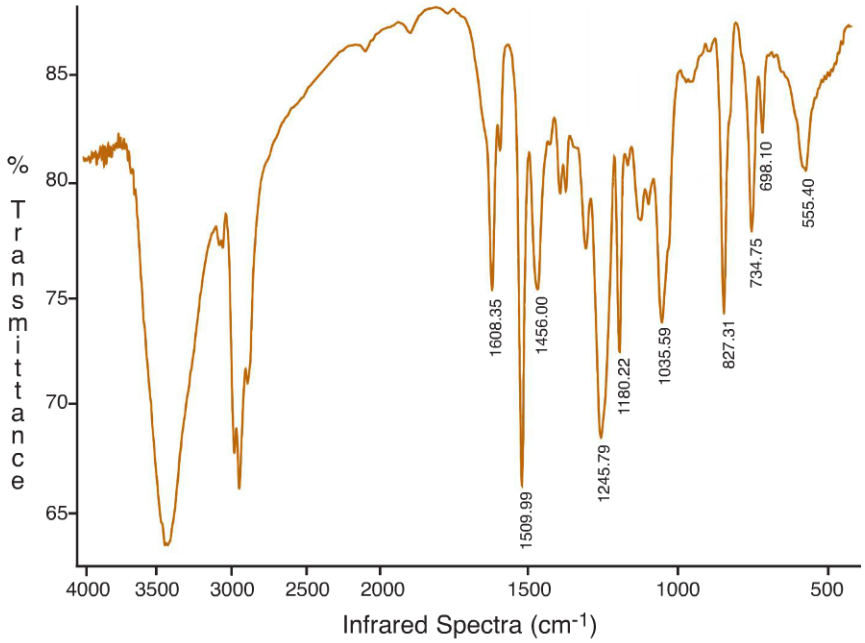


Fig. 2: This figure shows the infrared spectrum of a laboratory-prepared control sample of the glossy clear coat. Bands near 1,610; 1,510; 1,245; 1,180 and 825 cm^{-1} are typical of epoxies. Additional laboratory work showed that the relative intensity of the bands near 825 and 700 cm^{-1} varied with mix ratio, and hence could be used to determine the mix ratio of jobsite samples.

what is called an infrared spectrum. The spectrum, sometimes called an infrared "fingerprint," contains a great deal of information about the chemistry of the sample.

It is not always possible to determine the mix ratio of an epoxy using infrared spectroscopy, but in this case the analyst got lucky. Spectra obtained of the drawdowns applied at different mix ratios not only confirmed that the clear coat was an epoxy, but also showed a pair of bands (one near 825 cm^{-1} and one near 700 cm^{-1}) which varied in relative intensity as the mix ratio of the coating varied (Fig. 2). Thus, after converting the vertical (y-axis) of the spectra to absorbance units rather than percent transmittance (the usual way of displaying infrared spectra) and taking the ratio of this band pair, it was possible to

obtain spectra of the jobsite samples and determine their approximate mix ratios. The reason why this technique worked and the nitrogen technique did not was because only very small amounts of sample were needed, which made it much easier to avoid sampling the wrong coat or inadvertently picking up aggregate particles. The testing showed that the coating had indeed been applied at the correct mix ratio.

Based on the samples and information supplied to the laboratory, the objectionable haziness in the floor coating was caused by fine cracks or fractures that developed in the lower clear coat. The micro-fracturing of the coating was the result of applied stress from the wheels of the heavy carts moved over the floor. This stress would have been focused or intensified at the angular spots or tips of the aggregate particles. Indeed, similar fracturing was caused in the laboratory, at these specific locations, simply by exerting pressure with the blade of an X-acto knife. Although the basecoat is described as a "flexible epoxy," the clear coats were only described as having good impact resistance. Apparently, they were not as flexible as the basecoat, and hence fractured in service.

The laboratory testing also showed that the micro-cracking or haziness was a material problem, and not an application problem. The coating layers in the failing samples had been applied at the correct thicknesses, and the cracked or hazy clear coat had also been applied at the correct mix ratio.

While not an easy problem to fix, especially with furniture and laboratory equipment now installed, it seems like this could have been an easy problem to avoid. The basecoat, which had the decorative aggregate broadcast in it, consisted of a flexible epoxy, with an elongation of 60 percent. This epoxy did not fracture or develop a haze, because it was flexible enough to dissipate the force generated by the heavy cart traffic. Had the first coat of clear epoxy (the third coat in the system) been formulated with this same epoxy resin, it also would likely not have cracked or fractured and no haze would have developed. The final coat of satin clear could have remained the same, with less flexibility and better impact resistance than the lower coats.

JPCL

Breathing the Fresh Air of Compliance

Establishing an OSHA-Compliant Respiratory Protection Program

By Nicholas P. Bozzuto, Bullard

With over 5 million respirator users in approximately 1.3 million U.S. workplaces, it would be expected that employers would be well-versed in their responsibilities for providing the necessary resources to workers in order to promote safe and healthy work environments. However, respiratory protection is a perennial "top 5" most-cited violation by the Occupational Safety and Health Administration (OSHA). The number one reason for citation: lack of a written program.

While what is necessary can be debated, what we do know is what is required. Ideally, the control of occupational diseases caused by contaminated breathing air would be accomplished by engineering control measures such as enclosures or the confinement of operations, ventilation and/or the substitution of less toxic materials. However, when these options are not feasible, the next step is to implement the appropriate use of respirators. Naturally, there must be guidance as to the proper way to introduce, use and maintain such equipment. That is where the written program comes in.

OSHA, a division of the U.S. Department of Labor, directs national compliance initiatives, helping businesses protect their workers and reduce the number of workplace deaths, injuries and illnesses. For respiratory protection, OSHA standard 29 CFR 1910.134 is the guiding document.

Establishing and adhering to a written respiratory protection program ensures OSHA compliance and greatly reduces exposing workers to harm. Photo courtesy of Bullard.

This column woutlines the requirements for development and implementation of a written, worksite-specific respiratory protection program, including program components; administration and monitoring of the program selection, proper use and maintenance of respirators; NIOSH compliance and resources for further information.

Written Program

In an age when everything is turning digital, why does OSHA specifically mandate that the program be written? The simple answer: OSHA has found that health and safety programs have been more effective if the procedures are available in hard copy for study and reference.

A written plan also ensures that any unique characteristics of the specific worksite are considered. OSHA's "Small Entity Compliance Guide for Respirator Protection" states: "Developing the written program encourages [the employer] to thoroughly assess and document information pertaining to respiratory hazards posed to employees" under normal conditions or reasonably foreseeable emergencies.

Essentially, a compliant program must be written, worksite-specific, reviewed for effectiveness and trained upon regularly.

OSHA Requirements

According to 29 CFR 1910.134 an employer is required to develop and implement a written respiratory program with required worksite-specific procedures and elements for required respirator use in any workplace where

respirators are necessary to protect the health of the employee or whenever respirators are required by the employer. The program must outline the respirator selection process; medical evaluations; fit testing; procedures for use; procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing and discarding; procedures to ensure adequate air quality, quantity and flow; training in respiratory hazards; training in use limitations and maintenance; and procedures for regularly evaluating the program's effectiveness.

Even if respirators are worn voluntarily, OSHA's Voluntary Use Policy states that employers must still provide a written program to ensure that any employee using a respirator voluntarily is medically able to use it, and that the respirator is cleaned, stored and maintained so that its use does not present a health hazard to the user.

The only time that a written program is not required is in the case of voluntary use of filtering face pieces, better known as "dust masks."

Selection of Respirators

An employer must evaluate respiratory hazards in the workplace before selecting a respirator. He or she must identify contaminants in their chemical state and physical form, and include a reasonable employee exposure level estimate.

After identification comes analyzing the hazard(s). What is the contaminate concentration? This can be found in a material safety data sheet (MSDS) or you may have to conduct an air-sampling test. Your local OSHA office can be a resource with information on various chemical hazards, and the American Industrial Hygiene Association (AIHA) can provide a list of accredited industrial hygiene consultants who can help.

Next, compute the Assigned Protection Factor (APF), which can be found using the equation:

$$APF = \frac{\text{Contaminate Concentration}}{\text{Permissible Exposure Limit (PEL)}}$$

An APF of 10 will offer enough protection to enter an area with a contaminant concentration of up to 10 times the PEL. OSHA states that the employer must have evidence provided by the respirator manufacturer that testing of these respirators demonstrates performance at a level of protection of 1,000 times the PEL or greater to receive an APF of 1,000. This level of performance can best be demonstrated by performing a workplace protection factor (WPF) or simulated workplace protection factor (SWPF) study or equivalent testing. All other powered air-purifying respirators (PAPRs) and supllied-air respirators (SARs) with helmets/hoods are to be treated as loose-fitting face piece respirators, and receive an APF of 25. A table containing specified APFs for different respirator types is listed within the OSHA standard and should always be referred to.

It is also necessary to take into account other considerations, such as the intended air source, comfort, mobility and cost.

NIOSH Compliance

Finally, the respirator must be approved by the National Institute for Occupational Safety and Health (NIOSH), and maintain the compliance for which it was approved. NIOSH, part of the U.S. Centers for Disease Control and Prevention (CDC), is primarily a research organization, but it also has the responsibility of testing and certifying

respirator assemblies. Essentially, it is OSHA's job to enforce the proper use of NIOSH-approved respirators.

NIOSH 42 CFR, Part 84, the standard for respiratory protection, states: "The Institute shall issue certificates of approval pursuant to the provisions of this subpart only for individual, completely assembled respirators which have been examined, inspected, and tested … " This means that substitutions of any component pieces not included in the NIOSH Approval Label supplied with each approved respirator are not permissible.

Medical Evaluation

An employer must provide a medical evaluation to determine an employee's medical eligibility for respirator use. Medical evaluations must occur before an employee is fit tested or required to use the respirator in the workplace.

Fit Testing

Employees must be fit tested with the same make, model, style and size of respirator that will be used in the field, according to OSHA. Employees should be retested annually, when there is a change in the type of respirator used or when there is a change in an employee's physical condition, such as an obvious change in body weight. Employers must not allow an employee with facial hair or any condition that limits a face-piece seal or valve function to wear a tight-fitting face-piece. If an employee wears glasses, goggles or personal protective equipment, the employer must ensure that the equipment doesn't interfere with a face-piece's seal.

It should be noted that loose-fitting respirators do not require fit testing.

Breathing Air Quality

An employer must provide employees who use atmosphere-supplying respirators

(supplied-air and SCBA) with high-purity breathing gases, according to OSHA. Compressed breathing air must meet at least the Type 1, Grade D breathing-air requirements described in American National Standards Institute (ANSI)/Compressed Gas Association's Commodity Specification for Air, G-7.1-1989.

Respirator Use

Employers must establish rules and procedures for respirator use. Part of these rules must prohibit an employee from removing a mask in a hazardous environment and prevent conditions that could result in face-piece seal leaks.

The rules must also ensure continued effective respirator use throughout work shifts and establish procedures for respirator use in atmospheres that are immediately dangerous to life or health (IDLH), according to OSHA. All use must be in accordance with the manufacturer's instructions.

Cleaning and Maintenance

Employers must provide for the cleaning and disinfecting, storage, inspection and repair of respirators. The cleaning and disinfecting shall be done as needed for exclusively used respirators; before each use for multiple-user respirators; and after each use for rescue respirators and respirators used for fit testing.

Stored respirators should be protected from environmental damage and face-piece and exhalation-valve deformation. Emergency respirators must be accessible and clearly marked.

Respirator inspections should be performed before each use and when cleaning for routine-use respirators; monthly, before and after each use and in accordance with manufacturer's recommendations for emergency respirators; and before each use for escape respirators.

Inspections should include all parts and a check of elastomeric parts for pliability and deterioration. Emergency respirators should include a certification of inspection. Only appropriately trained employees should perform repairs or adjustments, and only NIOSH-approved parts should be used as replacements. All cleaning and maintenance must be in accordance with the manufacturer's instructions.

Who is Responsible?

Program Administrator

A designated program administrator is required to run the program and

also ensure that the labels are not removed and remain legible.

Program Effectiveness

OSHA maintains that the employer is required to conduct evaluations of the workplace to ensure that the written respiratory protection program is properly implemented and that it continues to be effective. The employer should conduct evaluations as necessary, regularly consulting employees regarding respirator fit, selection, use and maintenance.

Record Keeping

The employer is required to establish and retain written information regarding medical evaluations, fit testing and the respirator protection program. This information will facilitate employee involvement in the respirator protection program, assist the employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA. Records of medical evaluations must be retained and made available in accordance with 29 CFR 1910.1020. Fit-testing records must be detailed and retained until the next fit test. The employer must also retain a written copy of the current respirator protection program.

Conclusion

As previously stated, while what is necessary for respiratory protection can be debated, what is required cannot be. OSHA defines the requirements for respiratory protection in 29 CFR 1910.134, which can be found at osha.gov. It is ultimately the employer's responsibility to produce a written respiratory protection program that adheres to these OSHA requirements, and an experienced and capable program administrator must be designated to oversee and evaluate the effectiveness of this written program, making changes as necessary.

About the Author

Nick Bozzuto is the product manager for respiratory protection at Bullard (Cynthiana, Ky.). He is primarily responsible for the abrasive blasting and industrial coatings markets. He is active in several industry safety groups, including the International Safety Equipment Association (ISEA), the National Safety Council (NSC) and the American Society of Safety Engineers (ASSE). He earned his B.S. from the University of South Carolina, along with an MBA from the University of Kentucky.

SSPC Honors Top Coating Projects at Structure Awards

By Jodi Temyer, *PaintSquare News*

Complex containment, strict schedules and rigorous regulations earned eight painting projects top honors as SSPC 2015 opened Tuesday, Feb. 3 in Las Vegas with the ninth annual Structure Awards.

SSPC kicked off its yearly conference and exhibition its Business Meeting and Awards Luncheon, where President James R. King, Jr., and outgoing Executive Director Bill Shoup also updated members on the society's current numbers.

This year's award-winning projects were fraught with danger, difficulty and drama. Crews scrambled around frequent bridge openings high over waterways; navigated wind-buffeted access structures; volunteered their time for historic military projects; designed innovative containment to protect wildlife; and braved a soaking-wet, cold rock-tunnel penstock 80 feet underneath a Canadian generating station.

The Society also honored outstanding individuals whose careers reflect decades of service to the industry, as well as outstanding chapters in the U.S. and abroad. These award winners will be covered in the April *JPCL*.

George Campbell Award

The George Campbell Award honors a difficult or complex industrial or commercial coatings project. Challenges may include extreme environmental conditions, time constraints, limited access or high traffic, complex structural components or coordination with multiple trades or subcontractors. The award is named for the late George Campbell, founder of Campbell Painting Company in New York. Two projects received George Campbell Awards this year.

(L-R): James King, president, SSPC; Kieran Ahern, vice president, Ahern Painting Contractors, Inc.; Guerman Vainblat, P.E., Greenman-Pedersen, Inc.; and Lucian Carusso, regional manager, north U.S.A., International Paint.
All awards ceremony photos courtesy of SSPC.

Brooklyn Bridge

Location: New York, N.Y.
Owner: New York City Department of Transportation
Contractor/Applicator: Ahern Painting Contractors
Coating Supplier: Devoe High Performance Coatings
Project Start: January 2010
Project Completion: October 1, 2014

Once an avenue for P.T. Barnum's elephants to march into town, the Brooklyn Bridge — a 132-year-old hybrid stayed/suspension span — carries 120,000 vehicles and 7,000 pedestrians over the East River every day.

Traffic, existing lead coatings, outside agency coordination and sheer size necessitated a multi-tiered approach to clean and repaint the structure's 4.2 million square feet of steel beams, braces and cables.

The project required coordination with the City of New York, the Boroughs of Manhattan and Brooklyn, City Hall, 1 Police Plaza, NYCDOT and the U.S. Coast Guard.

Abating the existing lead coatings created another set of challenges. The bridge's age and weight limitations, along with a requirement to keep all three lanes open for traffic, nixed any chance of placing abatement vehicles on the roadway. Therefore, a complex system of hoses and duct work was designed, stretching from the SSPC Class 1A containment to a custom grit recycling unit more than 1,200 feet away.

A 20,000-panel system of under-bridge platforms was used for work on the 3,455-foot-long structure. After abrasive blast-cleaning to a Near-White finish (SSPC-SP 10/NACE No. 2), the steelwork was repainted with a four-coat system consisting of an organic zinc-rich epoxy primer, a pre-prime sealer coat, an epoxy intermediate, and an aliphatic urethane gloss finish.

Dealing with traffic, existing lead coatings and coordination with outside agencies were some of the challenges in painting the 132-year-old Brooklyn Bridge. Photos courtesy of New York City DOT.

Contractors painting the Fremont Bridge had to clear the bridge to allow it to open for marine traffic nearly three dozen times per day. Photos courtesy of Seattle DOT.

Fremont Bridge

Location: Seattle, Wash.
Owner: Seattle Dept. of Transportation
Contractor/Applicator: Purcell Painting & Coatings LLC
Coating Supplier: The Sherwin-Williams Company
Project Start: April 7, 2014
Project Completion: December 30, 2014

The low 30-foot vessel clearance of the Fremont Bridge, a double-leaf bascule structure spanning a heavily used navigable waterway, challenged crews to deal with frequent drawbridge interruptions and complex loading conditions.

The 97-year-old bridge, which connects Seattle's Fremont and Queen Anne neighborhoods, was last cleaned and coated in 1970. In this project, the structure was spot repaired and coated with a moisture-cured system to protect against the area's harsh wind and rain.

While working on one of the busiest bascule bridges in the world, the contractor's 37-person team had to quickly secure its work, vacuum up paint chips, and clear the bridge nearly three dozen times per day to allow it to open for marine traffic.

A suspended platform system had to be designed to support the worker and debris load while the bridge was down, but also keep the platform stable when the bridge was raised. Engineers were also concerned that high winds would slam the platform into the underside of the bridge as it lifted vertically with the raising structure.

Therefore, a series of rigid anti-uplift and horizontal bracing members was installed to hold the deck in place, while intentionally passing the load to the stronger framing points of the bridge substructure.

(L-R): King; Elhenish Woubetu, project engineer, Seattle DOT/Fremont Bridge; David Purcell, Sr., president, Purcell Painting, LLC; and Doni Riddle, vice president of global accounts, The Sherwin-Williams Co.

William Johnson Award

The William Johnson Award recognizes outstanding achievement in aesthetic merit in industrial or commercial coatings work. Criteria include color, gloss, texture and how the coating complements the environment while enhancing the structure. The award is named for a late consultant with KTA-Tator, Inc., whose work in coatings formulation, failure analysis and surface preparation was instrumental in advancing the industry.

The original design work by artist Corita Kent was recreated on the Rainbow Swash LNG tank and restored during its most recent overcoating project. Photos courtesy of Marc Cote, John W. Egan Company Inc.

Rainbow Swash LNG Tank

Location: Boston, Mass.
Owner: National Grid
Contractor/Applicator: John W. Egan Company Inc.
Coating Supplier: The Sherwin-Williams Company
Project Start: July 7, 2014
Project Completion: October 3, 2014

At 139 feet tall and 152 feet in diameter, the Rainbow Swash liquid natural gas (LNG) storage tank isn't just a Boston landmark — it's the largest copyrighted work of art in the world.

Overcoating the tank's 73,374-square-foot exterior required detailed application of a tinted epoxy basecoat and polyurethane topcoats to restore the art without compromising the original design work, which was commissioned in 1971 and created by Corita Kent. (The original tank was demolished in 1992, but the "Rainbow Swash" was recreated on an adjacent tank.)

Surface preparation included removing the existing clear coat and surface contamination with waterjet cleaning to SSPC-SP WJ-4/NACE WJ-4; power-tool cleaning localized areas of corrosion to SSPC-SP 3; and abrading the existing coatings.

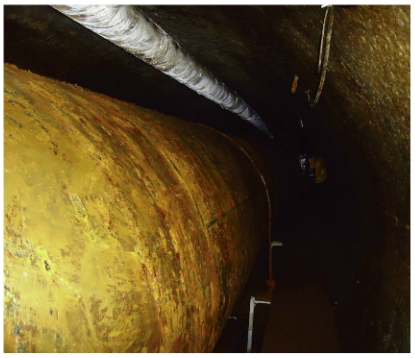
(L-R): Anthony Spatarella, sales manager, The Sherwin-Williams Company; King; Robert Belisle, Sr., and Robert Belisle, Jr., John W. Egan Company Inc.

The tank exterior was spot-primed with a fast-cure polyamide epoxy before receiving a three-coat system consisting of a fast-cure polyamide epoxy, an acrylic polyurethane and a clear coat urethane.

SSPC Structure Awards

E. Crone Knoy Award

Named for the late founder and president of Tank Industry Consultants, the E. Crone Knoy Award acknowledges coatings work that demonstrates innovation, durability or utility. The award recognizes outstanding achievement that may include excellence in craftsmanship, execution of work or the use of state-of-the-art techniques and products to creatively solve a problem or provide long-term service. Two projects received E. Crone Knoy Awards this year.



Contractors faced several challenges cleaning and recoating a 1,750-foot-long penstock located 80 feet underground at the Mamquam Generating Station. Photos courtesy of Certified Coating Specialists Inc.

Mamquam Generating Station

Location: Squamish, British Columbia
Owner: Atlantic Power
Contractor/Applicator: Certified Coating Specialists Inc.
Coating Supplier: Carboline Co.
Project Start: January 2014
Project Completion: April 2014

This project included cleaning and recoating the exterior of the Mamquam Generating Station's 1,750-foot penstock, located 80 feet underground.

Encased in a rock tunnel, working space ranged from five to 15 feet. All of the equipment, scaffolding and personnel had to be transported down a vertical shaft via ladder access.

Workers faced uneven ground, changing elevation, and a constant flow of water; they changed clothes three to four times per shift in order to stay warm and dry.

(L-R): King; David Gould, operations manager, Certified Coatings Inc.; David Griffioen, hydro plant foreman, Atlantic Power; and Doug Moore, director of global marketing, Carboline Company.

The penstock exterior was scraped to remove loose rust before it was abrasive blast-cleaned to a Near-White finish (SSPC-SP 10/NACE No. 2). Afterward, the surface had to be pressure washed and squeegeed to remove abrasive stuck to the penstock due to constant moisture sweating. Three coats of an epoxy were spray- and backroll-applied.

Mokelumne Aqueducts

Location: Contra Costa and San Joaquin Counties, Calif.
Owner: East Bay Municipal Utility District
Contractor/Applicator: Abhe & Svoboda Inc.
Coating Supplier: Carboline Co.
Project Start: July 1, 2011
Project Completion: October 21, 2013

About 1.3 million people rely on three Mokelumne Aqueducts to carry water 90 miles from the Sierra Nevada Mountains to San Francisco's East Bay communities.

A 10-mile portion of the system's steel pipelines are above ground, where they cross four sloughs — sensitive bodies of water that are home to numerous protected wildlife species.

Environmental concerns and strict permitting required an innovative approach to abate the original red lead/aluminum paint system. The team came up with a unique floating containment system that could navigate shallow wetlands waterways influenced by tides.

Floating containment structures were utilized to capture existing lead-based coatings while recoating above-ground, over-water portions of the Mokelumne Aqueducts. Photos courtesy of Mark Lewis, East Bay Municipal Utility District.

(L-R): King; Moore; James Svoboda, vice president, Abhe & Svoboda, Inc.; Mark Lewis, East Bay Municipal Utility District; and Dan Zavesky, sales representative, Carboline Company.

The pipe barrel was abrasive blast-cleaned to Near-White (SSPC-SP 10/NACE No. 2) and coated with an untopcoated inorganic zinc. The steel supports received a three-coat system consisting of an inorganic zinc, an epoxy and a polyurethane.

Charles G. Munger Award

This award honors an outstanding industrial or commercial coatings project that demonstrates the longevity of the original coating. The structure may have had spot repairs or overcoating with the original coating still intact.

Brookfield Waterspheroid

Location: Brookfield, IL
Owner: Village of Brookfield
Contractor/Applicator: LC United/ Chicago Bridge & Iron/Am-Coat
Coating Supplier: Tnemec Company, Inc.

The coatings on the one-million-gallon Brookfield Waterspheroid have been in service for 35 years, with 95 percent of the original coating still intact.

The original system, applied in 1979, included a two-coat polyamide epoxy lining for the interior wet area; a two-coat polyamide epoxy coating on the interior dry area; and a three-coat system on the exterior, consisting of two coats of a polyamide epoxy and a polyester polyurethane.

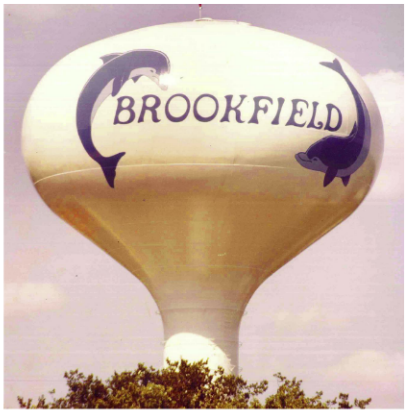
In 1997, the exterior coating and interior wet lining were overcoated and spot repair work was done on the interior dry coating.

In 2013, it was again determined that the exterior coating could be overcoated, and only spot repair work was needed on the interior wet and dry areas.

The exterior was power washed to remove loose paint and contamination, and power-tool cleaned to Bare Metal (SSPC-SP 11) in all failed areas. The bare metal was spot-primed with a modified polyamidoamine epoxy, followed by two complete coats of an aliphatic acrylic polyurethane. The dolphin logos and "Village of Brookfield" lettering were repainted using an advanced thermoset fluoropolymer polyurethane.

The interior wet and dry areas were repaired by spot abrasive blast-cleaning of all failed areas to Near-White (SSPC-SP 10/NACE No. 2) and Commercial (SSPC-SP 6/NACE No. 3) finishes, respectively, followed by a polyamidoamine epoxy spot-prime and spot finish coat.

(L-R): King; Ronald Barker, coatings specialist, Chicago Bridge & Iron; Dan Savage, technical service representative, Tnemec Company, Inc.; and Tom Van Gemert, senior engineer, Dixon Engineering.



A modernized version of the Village of Brookfield's original logo (left) was repainted during the tank's most recent overcoating (right). Photos courtesy of Eric Otten, Taylor Coating.

Military Coatings Project Award of Excellence

The Military Award recognizes exceptional coatings work performed on U.S. military ships, structures or facilities. Two projects were presented with Military Coatings Project Awards of Excellence this year.

Tank Project for the National Armor and Cavalry Heritage Foundation

Location: Ft. Benning, Ga.
Owner: National Armor and Cavalry Heritage Foundation
Contractor/Applicator: Main Industries Inc., Abhe & Svoboda Inc., Coatings Unlimited Inc., Thomas Industrial Coatings Inc., Champion Painting Specialty Services Inc. and Vulcan Painters Inc.
Project Suppliers: The Sherwin-Williams Co., U.S. Coatings, Carboline Co., Chlor*Rid International Inc., RPB Safety LLC, Mohawk Garnet Inc., Corrosion Specialties Inc., Axxiom Manufacturing Inc., IUPAT DC 77, Eagle Industries, Stewart Supply and HCI Chemtec Inc.

Companies across the country donated time and resources to repaint seven armored vehicles at the National Armor and Cavalry Heritage Foundation. Photos courtesy of Susan Boyd, Vulcan Painters Inc.

Working together under the leadership of Vulcan Painters CEO David Boyd, industry companies nationwide donated crews, equipment, materials and services to paint the collection of armor and cavalry vehicles.

Seven armored vehicles dating from World War II to the present were painted in the volunteer effort. They and two others will be displayed along a walking trail at the new Maneuver Center of Excellence.

The coatings work was done to the military's specifications for the tanks. Boyd estimated the donated labor and materials at $125,000 to $150,000.

A profile of the project will appear in next month's *JPCL*.

(L-R): CSM (Ret.) Rick Young, executive director, National Armor Cavalry Foundation; David Boyd, CEO, and Susan Boyd, Vulcan Painters Inc.; Bill Shoup, executive director, SSPC; and LTG (Ret.) John Sylvester, chairman of the Board, National Armor Cavalry Foundation.

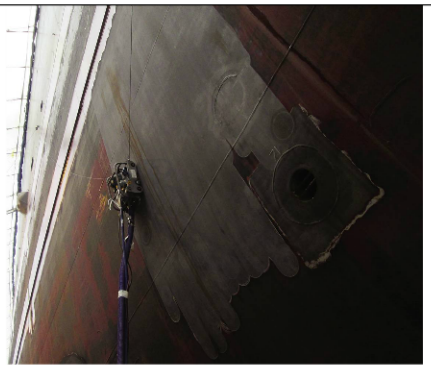
USS Dwight D. Eisenhower (CVN-69)

Location: Norfolk Naval Shipyard, Portsmouth, Va.
Owner: U.S. Navy
Contractor/Applicator: GENERAL DYNAMICS NASSCO-Earl Industries
Coating Supplier: PPG Protective & Marine Coatings
Project Start: November 2013
Project Completion: September 2014

This project required complex planning and scheduling to deal with a high volume of work done by other trades and an abnormally cold winter that affected the contractor's ability to perform surface preparation and apply coatings.

Work also included structural repairs and upgrades and ship system modernizations. Contamination issues of blasting and painting in the hull while blasting and painting over 100 tanks had to be mitigated, and each of the 100 tanks required multiple temporary access openings to be cut into the hull for ventilation.

The existing coating was removed via power tool cleaning to Bare Metal (SSPC-SP 11), abrasive blast-cleaning to Near-White (SSPC-SP 10/NACE No. 2) and waterjetting to SSPC-SP 12.

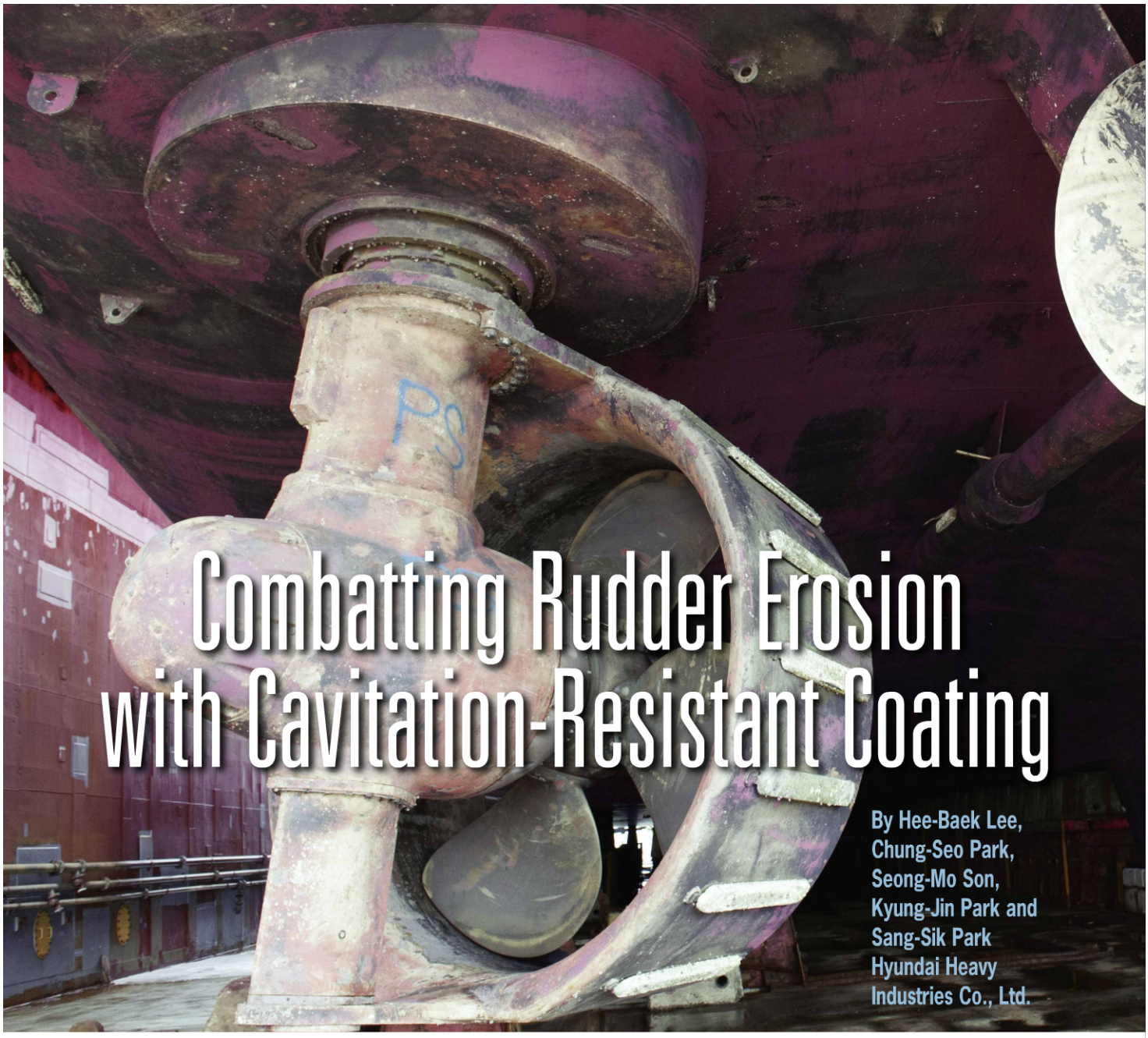


This project is the first time a polysiloxane coating was applied to the USS Dwight D. Eisenhower. *Photos courtesy of GENERAL DYNAMICS NASSCO-Earl Industries.*

(L-R): King; Daniel Dunmire, director, DoD Corrosion Policy and Oversight; Wade Hyatt, project manager, Fred Pasquale, program manager, and Phil Avery, QA manager, GENERAL DYNAMICS NASSCO-Earl Industries; and Steve Ferldman, director of sales, U.S., Mike Masorli, regional manager, Jeff Hall, technical sales manager, and Steve Feldman, director of sales, U.S. and Canada, PPG Protective & Marine Coatings.

A two-coat epoxy/polysiloxane system was applied to the entire exterior of the vessel on the freeboard and island; a five-coat epoxy/copper antifoulant was applied to the underwater hull.

This was the first time a polysiloxane coating was applied to the ship, and it required a change in application procedures from the previous silicone alkyd product.



Combatting Rudder Erosion with Cavitation-Resistant Coating

By Hee-Baek Lee, Chung-Seo Park, Seong-Mo Son, Kyung-Jin Park and Sang-Sik Park
Hyundai Heavy Industries Co., Ltd.

Figures courtesy of the authors.

Cavitation erosion of the rudder has been a serious problem in the high-speed container ship industry. It is well known that the lifetime of a conventional coating system is about six months against cavitation bubble collapse. Although STS 316L stainless steel has been applied to prevent the problem, there are several drawbacks with that method such as high repair cost and poor workability, which necessitated the development of a cavitation-resistant, low-cost coating system with workability.

Metal substrate erosion by cavitation occurs at the ship's rudder because of high-speed sailing and supersizing and has affected large container carriers operating at speeds over 20-knots. Cavitation can cause erosion and corrosion on the edge of the propeller and damage the coated surfaces of the rudder. When damaged by cavitation erosion, the rudder vibrates badly during sailing and the direction of the ship becomes difficult to control. In the worst cases, a ship will become non-operational and thus, cavitation erosion is one of the major factors in determining the rudder's lifetime.

The cavitation erosion problem hasn't been solved yet, although numerous studies have been performed on this issue. In this study, a series of cavitation-resistance tests were conducted with laboratory-scale test apparatus to simulate the actual cavitation and erosion phenomena. Selected test methods that could

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properly simulate the cavitation behavior and reasonably classify cavitation and erosion resistance grade of the candidate materials were identified.

Cavitation Mechanism

There are two theories that explain cavitation: the micro jet and the shock wave theory. The micro jet theory suggests that a liquid jet is generated very fast by the asymmetrical collapse of cavitation bubbles. The jet crushes the surface of a metal substrate and creates damage such as a crack or erosion. This theory has been documented by using high-speed photography and various studies about the cavity collapse. It is the dominant damage mechanism on the initial collapse of a cavity.

Secondly, the shock wave theory proposes that the shock wave is created by the rapid movement of the interface between a cavity and liquid. In his book, *Cavitation and Bubble Dynamics*, Christopher Earls Brennen maintains that it causes fatigue and plastic deformation on the surface of a material. A cavity's explosive power can measure about 10,000 atmosphere of pressure (atm) and this power can causes a noise, vibration and plastic deformation, and a ship's rudder will suffer from repetitive pressure wave impact. That collapse pressure causes damage to protective coatings on rudders and as a result, the corrosion of a rudder's surface can be accelerated by exposure to seawater.

Specimen Preparation and Test Methods

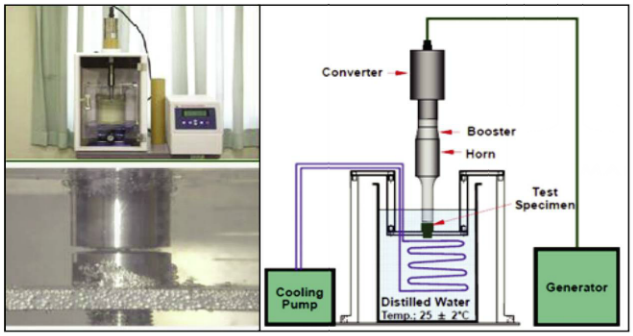
Specimen Preparation

Two types of conventional coating systems and three types of cavitation-resistant coating systems were prepared as shown in Table 1 (p. 40). In the case of coating system A, a self-polishing copolymer (SPC) anti-fouling paint was applied to an epoxy primer and tie coat. Coating B was an anticorrosion epoxy paint. Coatings C and D were commercial products for cavitation-resistant coatings consisting of an unsaturated polyester resin with glass flake. Coating E was an unsaturated polyester resin type with four layers of carbon sheets. The film thickness of the coatings tested was based on the recommendation of each manufacturer.

Test Methods

Cavitation erosion-resistance tests were performed according to ASTM G32, "Standard Test Method for Cavitation Erosion Using Vibratory Apparatus," and ASTM G134, "Standard Test Method for Erosion of Solid Materials by Cavitating Liquid Jet." Figure 1 (p. 40) shows the test apparatus configurations.

The mass losses of the test specimens were evaluated using a precision balance with an accuracy of 0.0001 grams. Prior to the measurements, the test specimens were dried in an oven at 80 C. The test was run until the coating was eroded to the metal surface; measurements were performed at



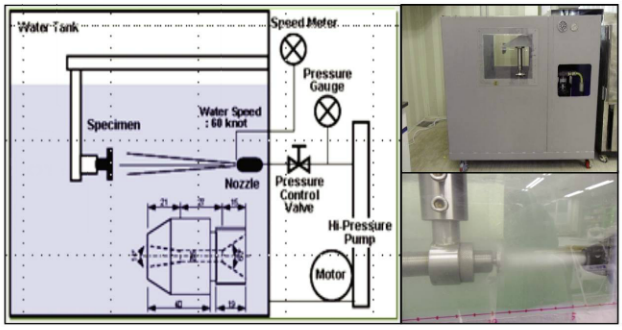


Fig. 1 Schematic overview of the cavitation test apparatus. (left) Vibratory apparatus (ASTM G32). (right) Water jet apparatus (ASTM G134).

Table 1: Test Specimen Coatings

Sample	Coating System	Film Thickness	Film Specific Gravity	Application Method
Coating A	A/C(300 μm)+T/C (50 μm)+A/F (300 μm)	650 μm	2.47	spray
Coating B	A/C (450 μm)	450 μm	1.66	spray
Coating C	Unsaturated polyester with glass flake	1,000 μm	1.34	spray/putty
Coating D	Unsaturated polyester with glass flake	1,000 μm	1.67	spray/putty
Coating E	Unsaturated polyester + carbon sheet	750 μm	1.76	putty

*1) A/C: Anticorrosive coating 2) T/C: Tie coating 3) A/F: Anti-fouling coating

10-minute intervals. The mean depth of erosion (MDE) in microns, for each sample after each 10-minute exposure was calculated as follows:

$$MDE = \Delta W / 10\rho A$$

Where ΔW is weight loss in mg/ Δt
ρ is specific gravity of dry film
A is surface area of specimen (cm^2)

The cumulative mean depth of errosion (CMDE) was calculated from Σ MDE

The time to come to CDME 50, (the time taken to reduce the coating to 50 um), was calculated from the slope of CMDE-time curve and the time to erode to the metal surface was also calculated to evaluate the erosion resistance. Optical microscopy was used to help determine the mechanism of the erosion and interpret the results of the cavitation tests.

Results and Discussion

Vibratory Apparatus Test (ASTM G32)

The antifouling coating of system A was eroded in 10 minutes by cavity collapse due to its low abrasion resistance and the hydrolysis reaction in water. System A was eroded to the metal surface in 40 minutes and coating B was eroded to the metal surface in 50 minutes. Coating C was eroded to the metal surface after 220 minutes and had the best performance compared to the other test specimens.

Cavitation-resistant coatings C and D had a high erosion rate in the initial stage because the resin was mainly being eroded, but the erosion rate decreased as the glass flake, having high durability, became gradually exposed on the surface. Coatings C and D are the same generically, but performed differently most likely due to differentiation in the manufacturers' selection of resin monomers and pigments such as glass flake, extender or filler.

The carbon fiber sheet was less effective than the glass flake because coating E was eroded up to the metal surface after 130 minutes, but coating E showed the best performance as far as time to CDME 50 (t50). Although t50 is an important index showing the erosion resistance, it is considered in this study to be more important for excellent performance to measure the time to erode to the metal surface. As a result of the vibratory apparatus test method, coating C, consisting of unsaturated polyester with glass flake, had the best cavitation erosion resistance compared to other candidate coatings.

Table 2: Comparison of the Test Results Between Test Methods

Item	Vibratory apparatus (ASTM G32)	Cavitating liquid jet (ASTM G134)
Formation of cavity	Vibration	Difference of flow velocity
Damage mechanism	Cavity collapse	Cavity collapse, flow friction
Suface shape	Uniformed erosion 	Mainly edge erosion 
Feature	Good for high hardness	Similar to actual condition
Workability	Small size, short testing time	Big size, long testing time
Test condition	Difinite set-up value	Difference as the apparatus
Suitability on organic coating	Excellent	Good

Cavitating Liquid Jet Test (ASTM G134)

The result of the erosion test by cavitating liquid jet showed similarity to the test results from the vibratory apparatus test. Coating A was eroded to the metal surface after 70 minutes but the anti-fouling coating was completely eroded after only 10 minutes.

In the case of coatings C and D, erosion time to the metal surface was 150 and 40 minutes, respectively. Coating E was eroded after 170 minutes and time to CDME 50 (t50) was 59 minutes. This means that coating E showed the best performance against high-speed water flow, including the cavity. From these results it was concluded that coating E, containing four layered-carbon sheets, had the best cavitation erosion resistance compared to the other coatings tested.

Conclusion

A comparison of the vibratory test (ASTM G32) and the cavitating liquid jet test (ASTM G134) is shown in Table 2. The vibratory apparatus test method proved to be more suitable in evaluating the erosion resistance of organic coatings compared to the cavitating liquid jet test method because it had better reproducibility and sensitivity, as well as uniform surface erosion characteristics by cavity contact.

It was therefore concluded that the best coating for cavitation erosion resistance was an unsaturated polyester with glass flake pigmentation.

About the Authors

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Coatings for the Oil & Gas Market

A Simplified Approach to Formulating for High-Temperature and High-Pressure Applications

By Andrew Recker, BASF Corporation

Many protective coatings markets have recently seen high demand for better performing coatings or linings. For example, with enhanced oil recovery, many more assets are now used throughout these processes from the oil/water separation tanks to the acid injectors. The temperatures are higher and corrosive environments are more severe. Formulation chemists are working hard, trying to push the extent of the performance of typical resin systems, but it seems that most of the development has been done and the extent of the performance available has been maximized. However, before throwing in the towel and going to expensive alloys … maybe something was overlooked.

This article will look at how to formulate for high-performance properties, in particular, high-temperature immersion applications with epoxy thermoset coatings, and the impact of formulation additives on achieving this performance. The data presented will show how minor adjustments in formulation can have a significant impact on coating performance. More specifically, it will show that with proper dispersant selection, the viscosity of the coating system can be reduced, leading to increased filler loadings and ultimately higher performance. Furthermore, data will show how going through a step-by-step formulating process, from resin selection to choosing the right defoamer, can provide for higher-performing coatings than typically seen with the selected chemistries.

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Purpose

The requirements for protective coatings are ever-changing, mainly driven by regulations calling for VOC reduction. If the coating isn't directly targeted by regulation, the market containing the asset it protects may be. Currently, one of the most dynamic protective coatings markets is the energy market of oil and gas which has exploded with asset creation that needs protection from a very diverse range of environments. In the enhanced oil-recovery process pipes, tanks and other separation vessels must be protected from acidic, high-salt and high-temperature environments. As reserves are depleted, new ways of extracting thicker, sand-laden oil have been developed. One such method is by injecting steam into the ground and extracting the oil and water mix into separating tanks. Steam is pumped deep into the ground at around 600 F to lower the viscosity of thick oil and essentially push it towards extraction well bores. The material being extracted contains hydrogen sulfide, salt, water and solvent at high pressure and temperatures as high as 400 to 500 F. The mixture comes out of the ground at 200 to 250 F and is pumped into separation tanks. All of the steel work, inside and out, must be coated with the highest-performing coating chemistry available. If there is a weakness in the coating chemistry it will definitely be exposed here.

Before jumping into formulating for such coating applications, the methodology for evaluation of coatings for these

applications needs to be determined. One published method is NACE TM0185, "Evaluation of Internal Plastic Coating," which outlines the use of an autoclave to generate the pressures and temperatures using the three probable environments; water, hydrocarbon and H_2S/CO_2 gas. The relevance of such high pressures can be validated by calculating the depth of the well and using the equation, *P=dhg* (pressure equals density multiplied by depth multiplied by acceleration of gravity). Using 10,000 psi and 500 F should capture the deepest well.

Most traditional formulations won't withstand the extremes of the environment and if they do, they're likely too difficult to apply to make them a viable solution and the current high-performance, high-temperature coatings based on novolac resin are at the limit of their performance, particularly considering the corrosive nature of the extracted oil. So other, more expensive options such alloys, begin to find applications. Formulating for such environments is very difficult, but not impossible. Adhering to formulations of the past and assumptions that haven't been evaluated will only limit the possibilities of realizing the full potential of the chemistries available. The new formulation should contain only those materials that add value to the properties and application. There are some general guidelines that can be adhered to that provide the basis for heat and pressure resistance and take much of the initial screening out of the process.

Resin Selection

A first step in formulating for high-temperature applications, either dry or wet, is to select the proper base resin. In making this selection, the main properties of concern are functionality and glass transition temperature (Tg). The molecular weight (MW) of the resin backbone between crosslinks can be determined for a linear polymer by taking the MW divided by the functionality minus 1. This applies to a linear polymer only, but shows the general principle of functionality increasing the crosslink density of the polymer. The MW between crosslinks or crosslink density (Mc) will indicate what the relative Tg of the final crosslinked film will be at high conversion, given a similar phenolic backbone content. A high Tg (or crosslink density) results in a lower permeation rate, given that there is lower free volume or space in the polymer for molecules like water vapor to permeate through. Lower Tgs are generally more flexible which means that there is more spacing within crosslinks allowing molecules to pass through the polymer and therefore, a flexible coating is generally less corrosion resistant. Achieving a high Tg through the reaction of the functional sites will provide a higher chemical resistance. The simple comparison is a novolac resin versus a bisphenol-A resin with the novolac having much higher corrosion resistance.

The other property that a high Tg will impact is the coefficient of thermal expansion (CTE). There are two rates of dimensional change of a polymer (measured by thermal mechanical analysis or TMA). The rate below the Tg will be much lower than the rate above the Tg. This is critical when heating a coating above its Tg. The stress of expansion along with the softening of the coating will cause the coating to buckle and lose adhesion to the steel

substrate which has a much lower CTE.

A simple room-temperature (RT)-cured bisphenol-A epoxy without fillers will soften above its Tg and lose adhesion seen with the translucent blister caused by expansion even on small panels (Fig. 1). There are other ways to manipulate the CTE besides Tg that will be discussed with incorporation of various fillers.

It is generally accepted that a higher Tg will result in lower permeation and higher heat resistance. This is true, but without a post-cure, the coating will only react so far, typically yielding similar Tgs to RT cure. The percent of conversion of the reactive sites needs to be considered when choosing a resin for a coating formula. A higher Tg with a higher functional resin may only be marginally realized due to the coating vitrifying well before the desired conversion was obtained (Table 1).

Resins will typically have a specific cure schedule with various curing agents to allow for high conversion, but it's generally not feasible to adhere to such a cure schedule for these coating applications. The ability to post-cure a steel structure isn't normally possible due to size and location. Another consideration is the amount of stress that a polymer coating experiences with high functionality and increased conversion. For example, a standard resin used for high performance is a novolac phenolic resin with multiple reactive sites per molecule. The increased branching and connection of the network creates tremendous stress due to shrinkage and lack of mobility. The free volume of the coating is decreased, lowering the permeability which is a great benefit, but for high-temperature

Fig. 1: Epoxy coating exposed for short duration at 350 to 400 F.

applications, the coating is exposed to temperatures that will push the conversion of the coating to greater than 90 percent, which could cause shrinkage as high as 10 percent .[1,2,3] The stress accumulation typically culminates with cracking either at temperature or more commonly when the coating is allowed to cool (Fig. 2). Therefore, the selection of the resin for high-temperature applications isn't as simple as going to a novolac, higher-functional resin. Actually, it is likely that the addition of a reactive diluent will be necessary to decrease viscosity to aid application which will then decrease the crosslink density anyway. Add to that, many formulations will include a mono-glycidyl ether diluent which detracts from MW and ultimately, from performance. And that's just the epoxy portion.

There are many more types of resin that will react with epoxide groups to create a polymer coating. Amines, amides, amidoamines and thiols are most widely used. The amine group is probably the most common available in a variety of different MWs and structures. With so many choices, what is the logic behind the selection for high-temperature coating applications? The most important characteristics to assess in an amine curing agent are how volatile the curing agent is and whether or not it contains material that will volatilize at the service temperature. Many of the curing agents will contain a catalyst such as bisphenol-A, nonyl phenol or benzyl alcohol. Without the catalyst, cure times of many of the amines with a standard bisphenol-A epoxy would be fairly slow which could cause application issues. With the formulations going towards higher solids or ultimately 100%-solids systems, the use of the catalyst isn't as necessary due to the

Fig. 2: Novolac epoxy coating exposed for short duration at 350 to 400 F.

Table 1: DSC Data

RT Cure for 7 days	Tg (C)
Epoxy bis-A / Polyamide blend	61
Epoxy bis-A / Cycloaliphatic amine	57
Epoxy bis-A / 1, 3 BAC	62
Post cure at 110 C for 7 days	Tg (C)
Epoxy bis-A / Polyamide blend	88
Epoxy bis-A / Cycloaliphatic amine	109
Epoxy bis-A / 1, 3 BAC	118

Fig. 3: Bis-A epoxy/cycloaliphatic amine with benzyl alcohol exposed to 500 F.

lack of solvent to retard the reaction. Many of the standard cycloaliphatic amine curing agents will contain anywhere from 30-to-50 percent weight benzyl alcohol. Benzyl alcohol, which has a boiling point of 402 F, will volatilize out of the coating. As it leaves the coating, stress is applied across the coating with the adhesion to the substrate and cohesion of the polymer resulting in the coating cracking or delaminating from the substrate or both (Fig. 3). The use of these catalysts should be taken into consideration with regard to the temperature of service for the coating. In addition to temperature performance, it's quite possible that regulatory bodies will eliminate them from formulations regardless, so formulating without them is inevitable. As a side note, the volatility of all formulation components needs to be in line with the end use temperature. For high-temperature performance, the MW of the coating needs to be as high as possible to overcome the stress. With this in mind, primary pendant amine functional curing agents are preferred to maximize the network by reduction in steric hindrance.

Extender Selection

The next step in the formulation is choosing the filler or extenders that are typically added to lower the cost of the formulation. Higher-performing fillers are micas, micaceous iron oxide and glass flake. These fillers provide a less permeable film due to orientation of the plates in a laminar order, creating a more tortuous path for water vapor. Decrease in permeation with increased filler content is limited by the viscosity increase. Another group of "fillers" are fibers or high aspect ratio particulates that reinforce the resin to provide tensile strength and increase resistance to thermal deformation with shrinkage or expansion. Glass fibers such as chopped mat or woven roving work very well at bringing the CTE down to that of steel or concrete substrates. However, the glass fibers do little to benefit the permeation rate. Ideally, a filler or combination of fillers would perform both tasks; lowering permeation and decreasing the CTE, which is one of the most critical properties for high-temperature performance.

Particulate fillers have been well-documented at associating with resin molecules and decreasing the mobility of the polymer chains to reduce the stress in the polymer by reducing the CTE — with incremental increases in the volume of filler, the CTE will decrease. It has been well-established that adding filler to a resin will make the resin more thermally stable and lower the permeability by reduction in polymer-free volume.

Formulation Additives

Once a resin system is selected and an efficient filler determined, a functional coating exists, but the formulation may not be suitable for spray or trowel application because the neat resin and high filler loading required for the necessary performance criteria resulted in high viscosity.

The first option typically employed by a contractor or applicator is to thin the material with a solvent. However, the smallest amounts of solvent can inhibit corrosion-protection performance by being retained in the polymer matrix, and increasing the free volume of the coating which increases permeation. Another typical option is to heat the material to lower the viscosity with a heated plural component airless system which is quite expensive and difficult to control in certain environments.

Therefore, the formulator must select the correct dispersant for the particular filler particle that will dissociate the filler particle from the resin allowing for lower viscosities, particularly at low shear. This will allow for a few formulating benefits. The first is having the ability to add more filler which will likely lower the cost of the formulation substantially. Many of the filler materials are less than $0.50 per pound and resins can be as high as $3.00 per pound. This concept not only increases the profit margin, but may also allow for the use of very expensive resins and monomers with better properties. The ability to add more filler can also benefit the performance of the coating with regard to corrosion and heat resistance. The added filler, regardless of aspect ratio or dimensions, will lower permeation of a coating due to decreasing the free volume of the polymer. The data in Table 2 (p. 46) show the magnitude of water vapor permeation reduction with the

Table 2: Permeation Reduction with Filler Content

ASTM D 1653 / E 96 at 120 F	Perm-inch	Reduction
Bis-A / cycloaliphatic amine	0.06360	**94.38%**
w/ 66% Filler and dispersant	0.00357	

addition of round ceramic microspheres, to a bisphenol-A epoxy resin coating. Even without platy fillers the permeation rate can be lowered closer to that of a flake-filled resin. However, the amount of filler needed is significantly higher than the amount of glass flake that would typically be needed to create the same tortuous path as a plate-like particle. Achieving a higher loading of filler by using the proper dispersant also impacts the CTE without significantly influencing Tg. The additional filler content provided with the proper dispersant could provide an edge in permeation and heat resistance with a single filler type.

Along with the obvious cost benefit and polymer property enhancement, the right dispersant can be the best approach to releasing entrained air that occurs during the manufacturing or application process. The entrained air leads to early failure by yielding higher permeation rates with voids and possible pinholes in the coating. Most of the solutions to the air-entrapment problem are based on silicone chemistry and incompatibility giving a de-aerating effect. This may provide some benefit, but introduces something very incompatible into the coating that may cause other problems.

A more complete solution is found in the synergy between a dispersant, defoamer and wetting agent — use of the dispersant to wet out the fillers in production displacing the air on the surface of the particle, a compatible polymer defoamer to facilitate coalescence of the air to increase buoyant force, and a wetting agent to provide a slight increase in the movement of the air out of the film. It's even possible, with some optimization, to allow for a lag in the recovery of viscosity after shear is applied, which will allow for just enough time during application for the air to move out of the film.

Summary

It is very difficult to formulate a long-lasting high-performance coating that resists the heat and pressure criteria of certain markets such as oil and gas production. As a formulating chemist, it may seem that all the resin combinations have been attempted and with today's regulations, other options aren't permitted. Then when something does show promise, the applicator doesn't want to invest in the special equipment necessary to apply it correctly. Many of these coatings make it 95 percent of the way to commercialization and just can't cross the finish line. This is where formulation additives can provide more of a benefit in the formulating process than once thought. They can ultimately provide the ability of fine tuning with small additions that can provide great advances in performance in a performance driven market.

About the Author

Andrew Recker is a technical service specialist for the formulation additives business in BASF's dispersions & pigments division and focuses on industrial coatings applications. He holds a Bachelor of Science from the University of Toledo and a MBA from Cleveland State University. Recker has also completed the NACE CIP Level 2.

He has worked in research and development for several companies over the past 14 years in various markets. Recker's experience ranges from pressure-sensitive adhesive development for a tier one automotive supplier to protective coatings for high-value steel structures. He has spent much time researching the corrosion process and methods of protection from barrier type to passivation. Through his development work, Recker has produced novel ideas for patent applications still pending. His immediate interests are value creation and development of possible cross-over technologies as applied to the industrial coatings markets.

References

1. Khoun, Loleï and Hubert, Pascal *Characterizing the cure shrinkage of an epoxy resin in situ.* Society of Plastics Engineers (SPE), 2010.
2. Cho, Kilwon; Lee, Daeho; Park, Chan Eon and Huh, Wansoo *Effect of molecular weight between crosslinks on fracture behavior of diallylterephthalate resins.* Polymer, 1996.
3. Zarrelli, Mauro; Skordos, Alexandros A. and Partridge, Ivana K. *Investigation of cure induced shrinkage in unreinforced epoxy resin.* Plastics, Rubber and Composites: Processing and Applications 2002. JPCL

MANAGING EMPLOYEE ASSETS

Photo courtesy of the author.

By Robert Ikenberry
California Engineering Contractors, Inc.

In preparing to write this, I conducted extensive interviews with painting contractors, suppliers and others. I have chosen not to attribute comments, thoughts, or opinions expressed in those interviews to any specific individuals or organizations because I want you to think about how you deal with your employees (or your boss) without being influenced by thoughts of "if he/she does it that way it must be right/wrong."

Human resources, the employer/employee relationship, is complex, but it's critically important and deserves a lot of attention and effort. Personnel issues range from determining appropriate salaries to dealing with regulatory requirements, evaluating harassment claims, resolving employee disputes, and so forth, almost without end.

IT'S ALL ABOUT THE MONEY— REALLY

As a business owner, your single most important consideration is making money. This may seem obvious, but it's worth reinforcing. If you don't have a reasonably steady stream of profitable jobs, your firm will not survive. Questions about the kind of employees you need and how best to find and keep them, would be moot and you would be looking for a job yourself. For your employees, it's not so simple.

Many of the contractors I spoke with said that their employees were their firm's single most important asset. Easy to say. I think most actually believe it. But do owners of small firms think and do enough to ensure these most important assets are properly cared for? A compressor doesn't care if it's

poorly maintained. It may not run reliably if it doesn't get regular maintenance, but it doesn't think, or feel. Your people certainly do.

PICKING THE RIGHT PEOPLE

How do you select your next hire? First, you need to have a clear idea of what position you need to fill. What are the duties of this new worker? What technical skills must they possess in order to successfully complete their tasks? What people skills do they need? Will they be working with customers or owners, or suppliers, or the general public? It's assured that they will be dealing with your other existing employees. And they will need to understand and fit in with your corporate culture and management style. You should also think about what career path you intend to foster for this new worker. Will they start out as a helper or apprentice? Do you expect them to grow their skills to eventually supervise others?

There is no correct answer, but each of these questions needs an answer for your business. One company I spoke with said they had pretty much given up on bringing in seasoned and experienced managers because they just couldn't get them to fit into the current organization. They are now committed to growing their own next generation of leaders, selecting candidates in school, giving them summer internships and then bringing them up through the ranks under the mentorship of senior management. Another firm said they had essentially given up on inexperienced and unseasoned managers and would only consider someone with at least 10, and better 15 years, of direct experience. How your corporate culture is set up is going to make a big difference in the kind of employee you need and who will fit best into your organization. Have you thought about what your corporate culture really is? You have one. Know what it is, and how you want it to grow.

WHERE DO YOU LOOK?

Inside the Organization

Your best next generation of leaders may be found close to home. Current workers know the culture of your firm and the normal workings of the organization. Many successful firms are committed to first advancing their current employees into positions of greater responsibility and making potential for advancement a part of every new employee evaluation before they are hired.

Schools

Industrial painting may not be a glamorous profession that attracts lots of college graduates, but it is increasingly complex. Managers and supervisors need a solid educational background. Operators of high-pressure waterjetting equipment, plural-component pumps and grit recycling machines need strong mechanical skills. As an industry, we need to do more outreach to community colleges and universities to make industrial coatings a more attractive choice for students. You can start in your community.

Networking

Active participation in organizations such as SSPC can provide multiple benefits. You will expand your contacts with others in the field, and may just find that perfect candidate. It could be someone who isn't happy at their current position, someone ready to move into a position of more responsibility, or you may meet someone who knows a qualified candidate. Most of the successful placements I hear about didn't come from a resume that showed up in the mail. Most are due to visibility in the industry and being perceived as a company that people want to work for. Your wider circle of contacts can be a source of qualified applicants. If you are looking, put the word out wherever potential new employees might be.

WHAT EMPLOYERS NEED TO DO

Instilling Corporate Culture

You can help by making sure new employees understand your corporate philosophy. What are your values as a company? When a customer asks for something beyond the specifications, how is your worker expected to respond? Do they say, "That's not in our job scope, but we can prepare an estimate of the extra cost for you," or do they say, "Absolutely! If you need it, we'll do it. We'll let you know beforehand if there's extra cost, but our first priority is your satisfaction." Dr. Frank I. Luntz, the sometimes controversial author, political consultant, and language advisor covers some of these issues in his book, *Win*. He says you need to "ask the right questions of your employees (or customers), really listen, and then act on what you learn." A survey he cites (about customers, but much of it applies to employees as well) indicates that the top three things people want are: to be respected (40 percent), valued (29 percent), and well-serviced (27 percent). Never forget that your employees are people, not just "assets." The more you understand them, the better success you'll have in dealing with them.

Integrating Employees into the Team

Have confidence your selection process resulted in hiring the right person. Offer trust first. Trust is often a self-fulfilling proposition. If you show trust, it will usually be returned, and the same with distrust. Recognize that you may also make decisions you later come to regret or find difficult to honor. Several workers I talked to indicated their reason for

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leaving came from a loss of trust in their employer. Once lost, trust is almost impossible to rebuild. If you make a promise you can't honor, talk to the employees involved and explain the situation as soon as you become aware of the problem. You may be able to mutually agree to revise or defer your promise, or you may not be able to resolve the situation. Admit your error, understand that the relationship may be critically damaged, and if it is, the employee may leave. Make the transition as clean as possible, pick up and start over. Learn from the situation, ensure that your mistakes don't reflect badly on the prior worker, forgive yourself, and move on.

Your workers will make mistakes that cost you, as well. Ignore the trivial ones, point out the ones that are significant and take a measured, logical and appropriate response. A mistake indicates a lack of information, training or judgment. If information, communicate better; if training, determine if additional instruction is needed and arrange for it; if judgment, some disciplinary action may be appropriate, including a position with less responsibility. Take steps to find and fix the cause of the problem. Then forgive the employee and move on. If the mistake is unforgivable, fire the offender.

With full recognition of the risks, make sure your employees know that that they are empowered to make appropriate decisions, and that they will have your support and backing. Give them clear guidelines. Coach them if you think they need direction, and gently steer them in the right direction if you think a better decision could have been made, but failure to make a decision is often worse than making a poor one. Say a supervisor in a remote location decides to approve overtime to meet a schedule, rather than hire new workers. You might not agree, but it was probably much better than doing nothing and missing the deadline.

Growing Your Staff and Retaining Key Employees

Initially, the most important training is in-house, one-on-one. Explain how you do things, what procedures and reporting are necessary for good communication within the organization. Don't assume experienced workers are used to doing things your way.

Key employees need to grow to stay valuable. Most of us will learn significant lessons about how best to perform our

jobs and how best to deal with people from being faced with, and solving, a number of challenges on various projects over our careers. But in today's environment the playing field also changes. Owners now demand certifications for your firm and for key employees. Regulatory changes require your workers and key staff to keep up with changing rules and regulations relating to everything from hazardous waste tracking, to minority subcontractor participation, to reporting of work hours to the government. Providing additional training to your workers not only keeps you in compliance with owner and government requirements, but also tells your workers that you value their skill sets and are willing to invest in them. Some companies worry that training their workers will just make them more attractive to competitors. It very well might. But if they feel respected and valued, they'll stay.

Evaluation and Coaching

Owners and supervisors need to be visible and involved. By spending time in the yard or on the jobsite, you not only get first-hand exposure to the real-world conditions your workers face, you also show you are engaged and care about the actual field production work. Your physical presence also makes you available for informal feedback that you might not get if someone has to pick up the phone and call you in the office or send a memo or email. How to interact most effectively may depend on generational factors (see "Generation Matters" sidebar, p. 52).

Evaluate your workers frequently. You do it, at least informally, even if you don't think about it as a review. It's better to do a formal, documented, consistent review at least annually, not only for your benefit but also to give workers the chance to tell you how they think things are going.

ADVANCING EMPLOYEES

Not every employee aspires to more responsibility. Even those who do should not be promoted beyond their abilities. Businesses are not like the military where officers must move up or out. If you have a superior craft worker, make sure that it is a welcome and appropriate move before you make him or her a foreman. He or she may not want the extra responsibility, the additional paperwork, or having to direct those who were previously co-workers. You may risk losing an excellent painter and gaining a mediocre foreman. Pride and prestige make a bad decision in this area hard to successfully undo. Talk frankly to the worker before making the promotion and make sure he or she understands that declining the advancement is truly a choice that will not reflect badly on him or her.

LONG-TERM COMPANY LEADERSHIP

One of the toughest challenges for smaller, family-owned companies is succession. How does one deal with passing on the reigns of control to the next generation? There are no easy answers to this, particularly if the company has a charismatic and entrepreneurial leader. Maintaining a generational balance may be one way. Providing opportunities for new workers to grow incrementally into positions of more responsibility can help. Several firms I spoke with recognized that they were "gentrifying." Leadership's average age was advancing each year without bringing in enough "new blood." You need to plan for this eventuality. Have a clear, consistent corporate culture that guides new supervisors. Develop regular operating principles and procedures, while maintaining reasonably current technologies and you will be much better positioned than most. Take advantage of the knowledge gained through years of experience by letting senior executives retire into part-time or consultancy positions. They can be available when you need them, and can contribute when they want to, without feeling like they have to compete with younger managers.

WHEN IT'S TIME FOR SOMEONE TO LEAVE

When it's time to go, GO. Many managers, especially in small firms, wait too long to make termination decisions. If any employment relationship really is not working, chances are both parties will benefit if it is terminated. There are parallels between professional relationships and marriages. Even in the best of circumstances there will be disputes, misunderstandings and disappointments. Every important relationship takes hard work. Employer/employee relationships are no different. What I mean is, after you have done your due diligence to train your workers in what is expected, clarified misunderstandings, given appropriate feedback when expectations were not met and listened to valid critiques or requests for assistance, then, if it's still not working, make the hard decision to terminate employment. Yes, it will cost you a lot to replace a key worker, and yes, you might end up with someone worse than your current employee, but if you have a clear idea of the person you need and take the time to search out and evaluate qualified candidates, you *will* find a better employee.

WHAT WORKERS WANT FROM EMPLOYERS

Ideally your workers are dependable. They show up every day and perform consistently and diligently. Perfect workers are proactive. They understand how to plan ahead, anticipate problems and provide for them. They weigh options with the same values and criteria you would, and put their efforts into areas that will be the most productive

and profitable. At best, they compliment the skills that you have, especially when you are short on patience, perspective, planning or any other area where you may have limitations. (None of us is perfect, right?)

WHAT DO WORKERS WANT?

New employees want to know what's expected of them. They need clear direction and want to know what they need to do to succeed. They also want to know what's in it for them. You owe it to new workers (and to yourself) to clearly communicate how you expect workers to perform their duties, how you expect them to interact with customers and who to go to for problem resolution.

Some details are generational, but almost all workers I spoke with stressed the importance of recognition. It may mean different things for different people, but workers who feel they are valued as individuals will give you that extra effort you are looking for.

For seasoned employees, recognition can simply mean leaving them alone to do their work. When they know that you have confidence and trust in their abilities, they will perform.

In general, most employees I spoke with ranked their workplace desires in this order:

1. Respect and recognition
2. Advancement opportunities, employment stability
3. Compensation

What Have You Done For Me Lately?

Workers often have views and needs that operate on a shorter timeline than you, as an owner, need to consider for your overall business. While they may not live paycheck-to-paycheck, they will remember the frustrations of last week much more clearly than the bonus they got last year. When praise is due, give it now. If a problem arises, deal with it now. Workers value security, stability and predictability. The more often they know when they are doing a good job, the more they can perform up to your expectations. Consider implementing standard operating procedures (SOPs) wherever they can help give workers guidance on what is expected and needed, whether it's setting up a job file, performing a jobsite safety inspection or using a formal purchase order for materials.

Incentives

Rewarding good workers and guiding or motivating those that are capable of more, but aren't currently performing to expectations, is complex and really beyond the scope of this article. Suffice it to say that financial rewards, such as bonuses, are often welcome recognition, but they must be handled carefully to avoid becoming a disincentive. Generally, incentives should balance direct financial awards with other measures. Consider the specifics of your company, worker teams and locations to come up with shared activities that can show you appreciate workers and want them to both be rewarded and work better together. Company outings, such as participating in a Friday onsite barbeque, or jointly attending a sporting event, can really help employees enjoy time together. Seeing their co-workers in an environment outside of work can help foster greater appreciation of their skills and interests. Think about what's most cost-effective for your firm. It may not be just a check.

CONCLUSION

Think. Successful owners plan for what they want, including who works for them. Spending time considering how you want your company to function and what your employees need to do to make that happen is a necessary part of your management responsibility.

Listen. Feedback from workers is critical. They not only have good ideas that will compliment and temper your own thoughts, but you don't really know what's happening at each level of your firm unless you hear it directly from your workers, and you really listen to what they say.

Act. Factor where you want to go with where your people tell you things are now, and use that information to make your company better. Information is of little value unless you act on it.

Stay up-to-date. Use your workers to keep your company current. Assign specific duties to key workers to stay abreast of developments in their areas of expertise be it labor relations, regulatory compliance or technology, and make sure they report to you on a regular basis. When you send workers to a conference or training class, ask them what they learned and what they thought of the experience so that you can gain from their new knowledge or discover this particular effort wasn't worth repeating. Have confidence in your workers and let them do their jobs well. Then you will have achieved real success.

ABOUT THE AUTHOR

Robert Ikenberry, PCS, has been in industrial painting and construction since 1975. Currently safety director and project manager for California Engineering Contractors, Robert stays busy rehabbing, retrofitting and painting bridges and blogging for *PaintSquare News*. His documentary on the demolition of the 1927 Carquinez Bridge was the pilot for National Geographic's *Break it Down* and an episode of *MegaStructures*. He's also working on documenting the demolition of the San Francisco-Oakland Bay Bridge, currently underway. **JPCL**

SSPC Annual Report

(January 1, 2014 to December 31, 2014)

PART I: INTRODUCTION

This annual report gives an overview of the activities, plans and status of SSPC: The Society for Protective Coatings from January 1, 2014 through December 31, 2014. The information enclosed gives the most current figures for all programs.

SSPC had another successful year by increasing training program delivery and and continuing to develop and market new training programs.

We continue to look at foreign markets as a way to expand SSPC and continue to reinforce our message that the use of protective coatings is the best solution for corrosion control.

Marketing efforts will focus on core SSPC member demographics spread across a broad range of industries and disciplines that use protective coatings.

PART II: ACCOMPLISHMENTS

Individual training and certification remain the hallmarks of our association. In 2014, training and certification classes given and revenues increased as SSPC's courses were requested or specified to meet the needs of the industry in general. New training courses developed in 2014 are noted later in this document. We have also continued to conduct training for all our armed forces, the U.S. Coast Guard and NASA under the auspices of the University of Akron contract with the Department of Defense Office of Corrosion Policy and Oversight.

SSPC's Protective Coatings Inspector (PCI) certification was also written into the specifications for several companies in 2014, shown in Table 1.

Similar to 2014, the Florida Board of Professional Engineers approved our entire program for the 2015 conference for Professional Education Units, and the American Institute of Architects approved four sessions at our 2015 conference for continuing education units.

In the area of providing information, SSPC posted headlines on our website relating to government activities that may affect the coatings industry. We also had 1,002 technical information inquiries in 2014, an increase of 28 percent.

Many of the technical coatings conversations continue to take place on social media outlets such as LinkedIn or Facebook, not on SSPC's Coatings Talk. By participating in these interactions, a user may make use of the outstanding knowledge and expertise of the SSPC membership.

Table 1: SSPC Protective Coatings Inspector (PCI) Certification Specification Companies in 2014

NEW FACILITY OWNERS FOR PCI IN 2014
Bahrain Petroleum (Middle East – Bahrain)
Bayer MaterialScience (Global)
BP (Gulf of Mexico)
BP – Exploration (Far East – Singapore)
Dow Chemical (USA)
Exxon (Far East – Malaysia)
Formosa Plastics (Taiwan)
Indiana DOT
Maine DOT
Monroe County Water (Rochester, NY)
National Grid (Northeast USA)
Ohio DOT
Ohio Turnpike
Petronas (Far East – Malaysia)
PTT (Far East – Thailand)
Qatar Petroleum (Middle East – Qatar)
SABIC (Middle East – Saudi Arabia)
SASREF (Middle East – Saudi Arabia)
Saudi Aramco (Middle East – Saudi Arabia)
Shell Sarawak (Far East – Malaysia)
TransCanada (USA, Canada)
West Virginia DOT

This year SSPC awarded six scholarships to deserving students who are related to SSPC members. The Board has directed that this program continue in the near future.

PART III: MEMBER PROGRAMS

SSPC is a member-based organization. We are evaluated on how well our programs and services meet the needs of our members and the protective coatings industry.

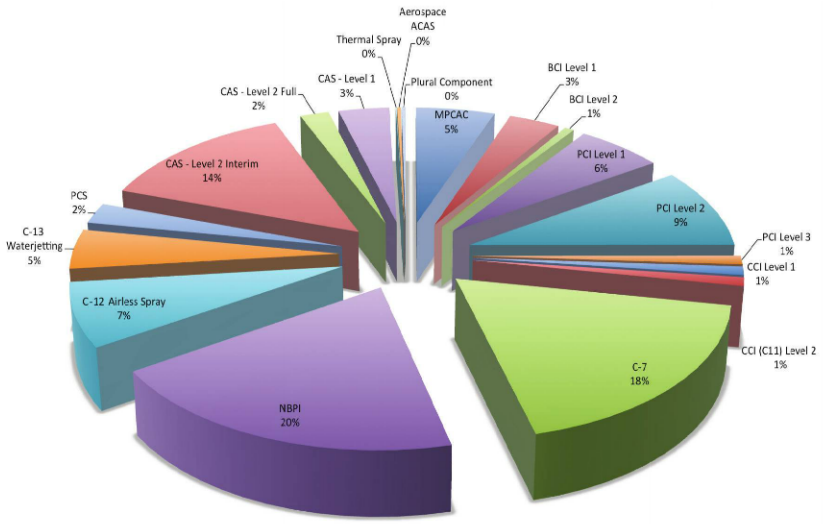

Figure 1: Individual Certification Programs

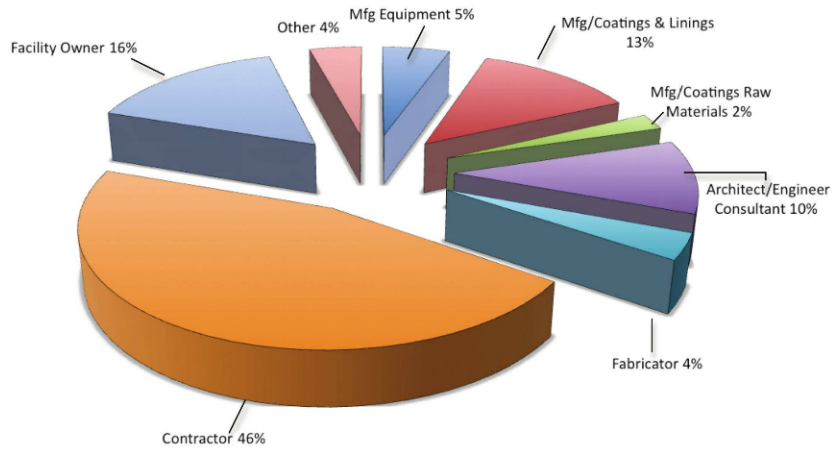

Figure 2: Individual Membership Demographics

Standards and Publications

Our core product is our standards. There were no new standards issued in 2014; however, five standards were revised. The updated standards are listed in Table 2.

Certification (Company)

The past year saw a decrease in the total number of certified contractors. Three hundred forty-seven contractors, many holding multiple certifications, have achieved certification, a decrease of 3.6 percent over 2013.

Training and Individual Certification

Note: The numbers shown in brackets are the percentage increase or decrease from last year.

SSPC training programs continue to grow overall. Last year we trained or certified 6,070 students, an increase of 4.6 percent over 2013. SSPC launched two new courses. They are Bridge Maintenance: Conducting Coating Assessments and CCI Supplement: Determining the Level of Moisture in Concrete.

In the Protective Coatings Specialist Certification (PCS) program, we have 296, an increase of 4.6 percent over last year. A breakdown of the certification programs is shown in Figure 1. For Lead Supervisor Competent Person Training and Refresher courses

Table 2: Standards and Publications Completed in Year Ending December 2014

REVISED
SSPC-Paint 29, Zinc Dust Pigmented Primer, Performance-Based
SSPC-QP 7, Qualification of Contractors with Limited Work Experience
SSPC-TU 10 (now Guide 20), Guide for Applying Thick-Film Coatings and Surfacing Over Concrete
SSPC-PA Guide 13, AASHTO/NSBA Steel Bridge Collaboration, Guide for Application of Coating Systems with Zinc-Rich Primers to Steel Bridges
SSPC-PA 2, Determining Compliance to Dry Coating Thickness Requirements (BOG has approved as of December 21, 2014)

(C-3 and C-5) 2,097 [+0.4%] students received training. The C-7 Abrasive Blasting Course had 367 [+30.1%] personnel trained. Airless Spray (C-12) had 250 [+46.2%] students trained; Water Jetting (C-13) had 97 [+22.8%], and Marine Plural Component (C-14) had 86 [+6.2%]. The Applicator Train-the-Trainer course had 15 [-71.2%]. The Quality Control Supervisor (QCS) course had 19 [+27.3] students with another 167 [+16%] taking the online version of the course. Fifteen students attended the Evaluation Common Contract Clauses [+114.3%]; 15 trained

Table 3: Board of Governors

NAME	COMPANY	REPRESENTING
James R. King, Jr. President	**John B. Conomos, Inc Bridgeville, Pa.**	**Coating Contractors**
L. Skip Vernon President-Elect	**CLT, Inc. Tijeras, N.M.**	**Other Service Providers**
Gunnar Ackx Vice-President	**SCICON Worldwide bvba Brugge, Belgium**	**International Representative and Other Service Providers**
Benjamin S. Fultz Immediate Past-President	**Bechtel Corporation Houston, Texas**	**Facility Owners**
Derrick Castle	Kentucky Transportation Cabinet Frankfort, Ky.	Facility Owners
Stephen Collins	Air Products and Chemicals, Inc. Thomaston, Ga.	Coating Material Suppliers
Jay Kranker	DRYCO, LLC Palm Desert, Calif.	Other Product Suppliers
Garry D. Manous	Atsalis Brothers Painting Warren, Mich.	Coating Contractors
Victor Pallotta	ARS Recycling Systems, LLC. Lowellville, Ohio	Other Product Suppliers
Brian Skerry	The Sherwin-Williams Company Cleveland, Ohio	Coating Material Suppliers
Marty Stamey	The Brock Group Beaumont, Texas	Coating Contractors
Joseph Walker	Elcometer Rochester Hills, Mich.	Other Product Suppliers
Gail A. Warner	Huntington Ingalls Industries – Newport News Shipbuilding, Newport News, Va.	Facility Owners
Robert McMurdy Ex-Officio	Mohawk Garnet, Inc. Ontario, Canada	International Representative and Other Product Suppliers

**Note: Officers in bold*

Table 4: Revenue Versus Expense (Unaudited and Before Final Adjustment)

**Includes revenue from royalties, interest, and external projects.*
***Includes expenses for SSPC chapters, governance, regulatory advocacy, knowledge center, external projects, general administration, and strategic plan implementation.*

REVENUE	FY 13	FY 14
Memberships	$1,098,000	$1,108,000
Standards and publications	$576,000	$554,000
Conferences	$855,000	$917,000
Certification & training	$4,556,000	$4,528,000
Other *	$1,774,000	$1,068,000
Total Revenue	**$8,859,000**	**$8,175,000**
EXPENSE	**FY 13**	**FY 14**
Memberships	$882,000	$924,000
Standards and publications	$587,000	$439,000
Conferences	$705,000	$689,000
Certification & Training	$2,881,000	$3,182,000
Other **	$824,000	$894,000
Total Expense	**$5,879,000**	**$6,128,000**
Net Surplus (Loss)	**$2,980,000**	**$2,047,000**

in Navigating 009-32 [-28.6%]; 36 in the Basics of Estimating Industrial Coatings Projects [+33.3%] and 21 in the Project Management course [+40%]. Twenty-seven attended the Thermal Spray course [+35%] and 54 students took the Using SSPC-PA 2 Effectively course [+671.4%]. The SSPC C-1 Fundamentals of Protective Coatings and the C-2 Planning and Specifying Industrial Coatings Projects courses had 113 [-5.3%] students trained this past year. The number of students taking advantage of our online offerings for these courses has decreased slightly this year to 172 [-3.4%].

The Applicator Basics online e-course was taken by 37 students [+48%]; Basics of Concrete Surface Preparation online short course by 20 [+5.3%] students; Basics of Steel Surface Preparation online short course by 53

Table 5: Statement of Financial Position as of 12/31/14 (Unaudited)

	Total All Funds	General Operating Fund	Reserve Fund
Assets - Current Assets			
Cash	$792,000	$792,000	
Investments	$14,791,000	$3,064,000	$11,727,000
Accounts receivable	$341,000	$341,000	
Inventory	$122,000	$122,000	
Total	**$16,046,000**	**$4,319,000**	**$11,727,000**
Furniture, Fixtures, and Equipment			
Equipment	$427,000	$427,000	
Less depreciation	($414,000)	($414,000)	
Net equipment/building	$13,000	$13,000	
Total	**$13,000**	**$13,000**	**-0-**
Other Assets			
Prepaid expenses	$205,000	$205,000	-0-
Total Assets	**$16,264,000**	**$4,537,000**	**$11,727,000**
Current Liabilities			
Accounts payable	$95,000	$95,000	
Deferred revenue	$1,618,000	$1,618,000	
Accrued expenses	$449,000	$449,000	
Total Liabilities	**$2,162,000**	**$2,162,000**	**-0-**
Net Assets - Unrestricted	**$14,102,000**	**$2,375,000**	**$11,727,000**
Total Liabilities and Net Assets	**$16,264,000**	**$4,537,000**	**$11,727,000**

Table 6: Change in Net Assets (Unaudited)

	Total All Funds	General Operating Fund	Reserve Fund
Unrestricted net assets - December 31, 2013	$12,055,000	$3,949,000	$8,106,000
Transfer from general operating fund to reserve fund		($3,000,000)	$3,000,000
Change in net assets as a result of current operation	$2,047,000	$1,426,000	$621,000
Unrestricted net assets - December 31, 2014	$14,102,000	$2,375,000	$11,727,000

[+23.3%] students; and the Basics of Non-Ferrous Metal Surface Preparation online short course was taken by seven [-61.1%] students.

The Coating Applicator Specialist (CAS) program had 70 [+6.1%] students achieving CAS Level 1 and 709 [-22.3%] achieving CAS Level 2 or Level 2 Interim Status. Also, 95 individuals attended the one-day CAS Refresher course. SSPC's Aerospace Coating Applicator Specialist program had 10 participants this year [+25%].

SSPC's Concrete Coating Inspector (CCI) Certification Program had 47 [-7.8%] and the Floor Coating Basics course had 44 [+4.8%] students. There were 307 [-22.1%] students in the NAVSEA Basic Paint Inspector (NBPI) Program, 106 [-0.9%] in the Bridge Coating Inspector (BCI) Program, and 831 [+44.5%] students completing the Protective Coating Inspector (PCI) program. An additional 79 [+243.5%] individuals achieved PCI Level 3 certification. Fourteen students took the online PCI course [-44%] and five attended the Protective Coating Inspection Workshop, the same as last year.

Webinars

The SSPC/*JPCL* Webinar Education Series continued last year with twelve webinars being given in 2014. Our attendance was 1,837. SSPC continues to offer a short online exam for each webinar that provides recertification units toward an individual's Protective Coating Specialist (PCS) Credentials. Two-hundred and fourteen individuals took an online webinar exam in 2014. All of the webinars in the 2014 series are archived and can be viewed on Paintsquare.com.

Website

The average number of unique visitors to our site is 20,620 per month, a 12.9 percent increase from last year.

ISO/US TAG

SSPC is now participating in U.S. ISO Technical Advisory Groups. We are presently involved in ISO TC 35-Paint and Varnishes SC 14/WG 10, Qualification of Personnel (Inspectors and Craftworkers) where a meeting was last held in Paris, France. The working group discussed two items: qualification of inspectors and qualification of contractor craftworkers. SSPC also attended a meeting for TC 67/WG 11, Materials, Equipment and Offshore Structures for Petroleum, Petrochemical and Natural Gas Industries in Doha, Qatar. The meeting was to help finalize the specification for coatings applied to splash zones.

PART IV: MEMBERSHIP AND ADMINISTRATION

Membership

During the reporting period, SSPC organizational membership (OM) increased to 951, or 5.5 percent. Individual membership grew from 10,068 in December 2013 to 10,820 in December 2014, an increase of 7.5 percent.

A breakdown of individual members' demographics is shown in Figure 2 (p. 57); however, it remains nearly the same as the previous year. We are pleased with the progress in increased organizational and individual membership. However, we can never remain satisfied with the status quo.

Governance

There were no changes to the Board of Governors in 2014. Table 3 (p. 58) displays the current SSPC Board of Governors members.

Administration

Key staff members remained the same. They are: Bill Shoup, executive director; Michael Damiano, director of product development; Barbara Fisher, controller; Mike Kline, director of marketing; and Terry Sowers, director of member services.

PART V: FINANCES

We are pleased to report that SSPC again met its financial goals for the FY that ended December 31, 2014. The reserve fund now stands at $11.72 million, which would cover more than one year of the 2014 annual operating revenue.

SSPC's investment income decreased by $805,000 from $1.705 million in 2012 to $900,000 in 2013. The financial details for the last fiscal year and the prior fiscal year are presented in Tables 4 through 6 (pp. 60-62). These charts demonstrate that SSPC continues to be a financially sound organization and all of our financial indicators and ratios are very healthy.

Respectfully Submitted:

William L. Shoup, Executive Director

Photo: NürnbergMesse.

European Coatings Show Returns to Germany

From April 19 to 23, the Exhibition Centre (Messezentrum) in Nuremberg, Germany will host the 2015 European Coatings Congress and Show.

The Congress, held April 19 to 21, will open with a series of pre-Congress tutorials, followed by two days of information sessions that are comprised from 144 papers pertaining to coatings, adhesives, sealants and construction chemicals. The Show, open from April 21 to 23, will feature over 900 exhibitors from the protective coatings and other related industries.

The following preview contains information about the Congress and Show that may be of interest to persons involved in industrial protective coatings. All information is current as of press time. For more information, visit www.european-coatings-show.com.

Pre-Congress Tutorials

Sun., April 19, 3:00 to 7:00 p.m.

- Architectural coatings
- Polyurethanes
- Formulating adhesives and sealants
- Testing of anticorrosive coatings
- Understanding biocides and the latest regulations
- Dispersing pigments and fillers - from theory to practice
- Design of experiments
- Functional coatings
- Radiation curing
- Fundamentals of epoxy coatings

Parallel Sessions

Mon., April 20, 10:00 a.m. to 1:30 p.m.

- 1: Science today - coatings tomorrow
- 2: Pigments
- 3: Surface active agents
- 4: Waterborne coatings
- 5: Printing inks
- 6: Functional coatings

2:30 to 6:00 p.m.

- 7: Powder coatings and radiation curing
- 8: Titanium dioxide technology
- 9: Production technology
- 10: Novel materials
- 11: Polyurethanes
- 12: Bio-based coatings

Tues., April 21, 9:00 a.m. to 12:30 p.m.

- 13: Adhesives & sealants I
- 14: Construction chemicals I
- 15: Architectural coatings I
- 16: Testing & measuring I
- 17: 2K industrial coatings
- 18: Anti-microbial coatings

1:30 to 5:00 p.m.

- 19: Adhesives & sealants II
- 20: Construction chemicals II
- 21: Architectural coatings II
- 22: Testing & measuring II
- 23: Nanotechnology
- 24: Protective coatings

SSPC Certified Contractors

QP1, QP2, QP3, QP8, QS1

QP1, QP2, QP3, QP6

QP1, QP2, QP3

SSPC Certifications

QS 1 assures the highest standard of work with more stringent quality control and record-keeping procedures than those required by QP certifications. QP 1 evaluates contractors who perform surface preparation and industrial coating application to complex industrial and marine structures in the field. QP 2 is a supplement to QP 1 that evaluates the contractor's ability to safely remove and properly manage hazardous coating material in the field. QP 3 evaluates a contracting company's ability to perform surface preparation and protective coating application in a fixed shop facility. QP 5 evaluates an inspection company's ability to provide consistent quality inspection of coatings & linings. QP 6 evaluates the qualifications of industrial thermal spray (metallizing) contractors. QP 8 evaluates the qualifications of contractors hired to install polymers on concrete and other cementitious surfaces. QP 9 certification evaluates the qualifications of painting contractors who apply architectural coatings on commercial or institutional structures.

QP1, QP2, QS1

QP1, QP2

QP1

QP3

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Coming Up

SSPC Courses

Course information available at sspc.org

April 6–11 PCI Prot Ctg Insp Levels 1 & 2, Manila, Philippines

April 6–11 PCI Levels 1 & 2, St. Petersburg, Fla.

April 8–10 High Solids Ctgs Training, Rowlett, Texas

April 9 Estimating, Burnsville, Minn.

April 9 CAS Ctg App Spclst Refresher, Pittsburgh, Pa.

April 9–10 ATT Train-the-Trainer, Zephyrhills, Fla.

April 9–10 QCS Qual Cntrl Spvr, Duluth, Ga.

April 10 CAS Level 1 Exam, Pittsburgh, Pa.

April 11–12 C12 Airless Spray, Chesapeake, Va.

April 12 PCI Level 3, Manila, Philippines

April 12 PCI Level 3, St. Petersburg, Fla.

April 13–14 CCB Conc Ctg Basics, Phoeniz, Ariz.

April 13–15 Ctg Spec Essentials, Houston, Texas

April 13–15 C7 Abrasive Blast, Hemet, Calif.

April 13–16 C3 Lead Pt Removal, Sulphur, La.

April 13–17 C1 Fundamentals, San Diego, Calif.

April 13–17 NBPI NAVSEA Basic Pt Insp, Seattle, Wash.

April 13–18 CCI Conc Ctg Insp, Phoenix, Ariz.

April 15 PCI Workshop, Norfolk, Va.

April 16 Ctg Selection, Houston, Texas

April 16 Using PA 2, Norfolk, Va.

April 16–17 C13 Water Jetting, Hemet, Calif.

April 17 C5 Lead Pt Refresher, Sulphur, La.

April 17 Nav Std Item 009-32, Norfolk, Va.

April 19 CCI Supplement, Phoenix, Ariz.

April 20 CAS Refresher, Jacksonville, Fla.

April 20–24 NBPI, Norfolk, Va.

April 20–24 BCI Bridge Ctg Insp Level 1, Annapolis Junction, Md.

April 20–25 PCI Levels 1 & 2, Ventura, Calif.

April 20–25 BCI Level 2, Annapolis Junction, Md.

April 21–22 CASE Levels 1 & 2 Exams, Jacksonville, Fla.

April 26 PCI Level 3, Ventura, Calif.

April 27–May 2 PCI Levels 1 & 2, Balikpapan, Indonesia

April 30 Using PA 2, Newington, N.H.

Conferences & Meetings

April 12–15 SSCT Annual Tech Conf, West Palm Beach, Fla., ssct.org

April 13–15 AFPM 2015 Security Conf, New Orleans, La., afpm.org

April 14–16 WorkBoat Maintenance & Repair Conf & Expo, New Orleans, La., workboatmaintenanceandrepair.com

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