VOLUME 30, NUMBER 9

PAINTSQUARE.COM
jpcl
SEPTEMBER 2013

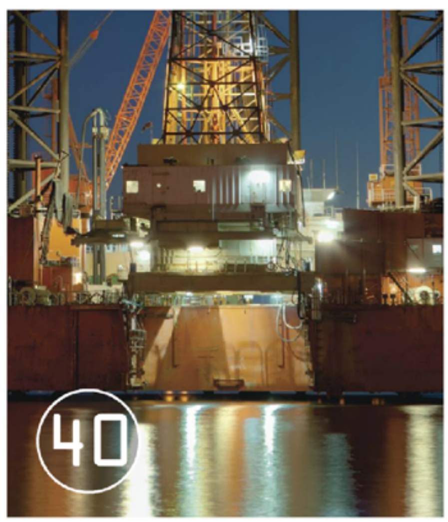
JOURNAL OF PROTECTIVE COATINGS & LININGS

SSPC The Society For Protective Coatings

The Voice of SSPC: The Society for Protective Coatings

Cover: © istockphoto.com/Creativaimage

FEATURES



DEPARTMENTS

Also This Month

From the Offices of

SSPC The Society For Protective Coatings

Staff

Editorial:

Editor in Chief: Karen A. Kapsanis / kkapsanis@paintsquare.com
Managing Editor & Directory Manager: Anita M. Socci / asocci@paintsquare.com
Assistant Editor: Charles Lange / clange@paintsquare.com
Technical Editor: Brian Goldie / brianpce@aol.com

Contributing Editors:

Rob Francis, Gary Hall, Robert Ikenberry, Alan Kehr, Robert Kogler, Vaughn O'Dea, E. Bud Senkowski, Lloyd M. Smith, PhD, Dwight Weldon

Production / Circulation:

Director, Production Operations:
Milissa M. Bogats / mbogats@paintsquare.com
Art Director: Peter F. Salvati / psalvati@paintsquare.com
Production/Design Assistant: Daniel Yauger / dyauger@paintsquare.com
Circulation Manager: JoAnn Binz / jocbinz@aol.com

Ad Sales Account Representatives:

Publisher: Marian Welsh / mwelsh@paintsquare.com
Bernadette Landon / blandon@paintsquare.com
Bill Dey / bdey@paintsquare.com
Classified and Service Directory Manager:
Lauren Skrainy / lskrainy@paintsquare.com

PaintSquare:

Director of Operations: Andy Folmer / afolmer@paintsquare.com
Director of Technology: D'Juan Stevens / dstevens@paintsquare.com
Digital Media Production Manager: Tricia Chicka / tchicka@paintsquare.com
Vice President, Content and Marketing: Pamela Simmons / psimmons@paintsquare.com

SSPC:

SSPC Individual Membership: Terry McNeill / mcneill@sspc.org
SSPC Organizational Membership: Ernie Szoke / szoke@sspc.org

Finance:

Accounting Manager: Michele Lackey / mlackey@technologypub.com
Andrew Thomas / athomas@technologypub.com

Assistant to the President: Larinda Branch / lbranch@technologypub.com
President and CEO: Peter Mitchel / pmitchel@technologypub.com
President, International Operations: Harold Hower / hhower@technologypub.com

Periodical class postage at Pittsburgh, PA and additional mailing offices. Canada Post: Publications Mail Agreement #40612608 • Canada returns are to be sent to: American International Mailing, PO Box 122, Niagara Falls, ON L2E 6S4 Canada The Journal of Protective Coatings & Linings (ISSN 8755-1985) is published monthly by Technology Publishing Company in cooperation with the SSPC (877/281-7772). Editorial offices are at 2100 Wharton Street, Suite 310, Pittsburgh, PA 15203. Telephone 412/431-8300 or 800/837-8303; fax: 412/431-5428

Copies of articles are available from the UMI Article Clearinghouse, University Microfilms International, 300 North Zeeb Road, Box 91, Ann Arbor, MI 48106. **Subscription Rates:** $90.00 per year North America; $120.00 per year (other countries). Single issue: $10.00. **Postmaster:** Send address changes to Journal of Protective Coatings & Linings, 2100 Wharton Street, Suite 310, Pittsburgh, PA 15203. Subscription Customer Service: PO Box 17005, North Hollywood, CA 91615 USA, Toll Free: 866 368-5650, Direct: 818-487-2041, Fax: 818-487-4550, Email: paintsquare@espcomp.com

Printed in the USA PAINTSQUARE www.paintsquare.com

Time Flies When Your Oldest Kid Is Getting Ready to Drive: A Look Ahead at the SSPC 2014 Show

My son will turn 16 in 2014, a few short weeks after the SSPC show in Orlando, so we've started talking about driving. Naturally, I've been reflecting back on the years and wondering where the time went. When I started at SSPC, he was only four years old. That year, we were in Tampa for the first time. I still have the alligator stress toy mascot sitting on a shelf in my office.

As is often the case here at SSPC Headquarters, the years and the shows all seem to blend together. Weren't we just in San Antonio a few weeks back? Or was it Las Vegas or New Orleans? At SSPC, we know that many of you spend so much time on the trade show circuit that the lines blur between the years.

Companies consolidate. Technology changes. Discoveries are made.

In 1998, when my son was born, people were worried about the looming risks of Y2K, and the Pittsburgh Pirates were only six years into their stretch of futility. At SSPC '98 in Orlando, the topics were familiar and included seminars on lead paint, surface preparation, and standards. The 2014 show will cover some of the same topics, but the trends now lean toward others like green coatings and advances in nanotechnology. Y2K was a bust, and the Pirates are still chasing a winning season, but SSPC and the coatings industry are moving on.

This September, *JPCL* will be your first look at the show at Coronado Springs Resort, set for February 10–13, 2014. Not only is the *Preliminary Event Guide* bundled with the magazine, but the *JPCL* will also begin previewing parts of the show over the next three months, leading up to the show issue in December.

Highlights of the 2014 conference include popular sessions on failure analysis, marine/ships, bridges, and coatings for concrete. Readers will find information regarding surface preparation, coating application, inspection, environmental health and safety, and GreenCOAT topics. We've expanded coverage of the commercial/light industrial segment, and continued the special programs for Women in Coatings and Paperless QA.

New this year are seven hour-long Mini Sessions to get you going on Wednesday and Thursday mornings. And along with the traditional indoor exhibition, SSPC 2014 will feature an outdoor exhibit and demonstration area.

The 2014 show offers a great balance between the traditional and the new. If you have never been to an SSPC show, or it has been a while since you've attended, 2014 would be a great year to check out what you've been missing. Time marches on. When 2015 rolls around, I'll be a little grayer, and my son will have almost a year of driving experience. But we'll all be that much further ahead because of the time we'll have spent at SSPC 2014.

Michael Kline
Director of Marketing, SSPC

Two New, Free Webinars Scheduled for September

JPCL SSPC The Society For Protective Coatings
Webinar Education Series

The SSPC/*JPCL* Webinar Education Series continues through September, with two new, free webinars available.

"New PA 2: Procedure for Determining Conformance to Dry Coating," will be presented on Wednesday, September 25, from 11:00 a.m. to 12:00 noon, EST. SSPC's Coating Thickness Measurement Standard was revised in July 2012. It focuses on the frequency and acceptability of measurement acquisition, while leaving gage usage procedures to ASTM D7091. This webinar will describe the content and application of the widely-specified industry standard and the basic content of ASTM D7091.

Bill Corbett, Vice President and Professional Services Group Manager for KTA-Tator, Inc., will present this webinar. Employed at KTA for 33 years, he chairs SSPC committees C.3.2 (Dry Film Thickness) and C.6 (Education); is an SSPC-approved instructor for four SSPC courses; and holds SSPC certifications as a Protective Coatings Specialist, Protective Coatings Inspector (Level 3), and Bridge Coatings Inspector (Level 2). He is also a NACE Level III-certified Coatings Inspector. He was the co-recipient of the SSPC 1992 Outstanding Publication Award, co-recipient of the 2001 *JPCL* Editors' Award, recipient of SSPC's 2006 Coatings Education Award, and recipient of SSPC's 2011 John D. Keane Award of Merit.

This webinar is sponsored by DeFelsko Corporation.


Bill Corbett


Kevin Morris

"Comparing Equality Through Performance Data—Hocus, Pocus, or Just Misunderstood?" will be presented on Monday, September 30, from 11:00 a.m. to 12:00 noon, EST. This webinar will highlight issues related to comparing products based solely on ASTM methods and how a misunderstanding or lack of knowledge of these standards could lead one down a path of excluding quality products. The webinar will also briefly look at the function of marketing practices as it relates to published results by manufacturers. The webinar will also discuss the possibility of better alternatives for pass/fail criteria such as SSPC standards.

Presenting this webinar will be Kevin Morris, Global Market Segment Director, Water & Wastewater, for The Sherwin-Williams Company. Morris has been employed with Sherwin-Williams for 21 years and is a NACE Level III-certified Coatings Inspector, an SSPC-certified Concrete Coating Inspector, and an instructor of SSPC's Concrete Coating Basics and Concrete Coating Inspector programs. He has written and published numerous papers and articles

D+D Welcomes New Editor

Technology Publishing Co., publisher of *Durability + Design,* has named Gina R. Johnson as the magazine's editor in chief. The former chief editor at *Solar Today* and *USGlass* magazines, Johnson brings to the position two decades of experience with a focus on architectural and construction trade publishing.


Gina Johnson

Johnson's appointment at *Durability + Design,* effective Aug. 13, puts her at the helm of the three-year-old publication, which serves 20,000 architects, specifiers, contractors, and facility owners with in-depth features, news, and analysis on building performance and aesthetics. The magazine will increase frequency in 2014, publishing monthly.

Johnson holds a bachelor's degree from Ohio University's Scripps School of Journalism and a master's in English/professional writing and editing from George Mason University.

for organizations such as SSPC, International Concrete Repair Institute, American Water Works Association, Water Environment & Technology, and *JPCL* (e.g., pp. 30–39, this month).

This webinar is sponsored by The Sherwin-Williams Company.

Registration, CEU Credits

The SSPC/*JPCL* Webinar Education Series 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). 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 these online presentations at paintsquare.com/webinars.

Architect Who Restored Cincinnati Landmark to Speak at D+D 2014

Richard Rauh

Award-winning architect Richard Rauh, who led the 15-year, $100 million historical restoration of Cincinnati's groundbreaking Carew Tower, will give a presentation on the project at D+D 2014, to be held, appropriately enough, at the Carew Tower's Hilton Netherland Plaza Hotel, May 20–22, 2014. D+D 2014 is the conference of *Durability + Design*, a sister publication of *JPCL*.

Carew Tower's public spaces epitomize the 1920s Jazz Age, embodying speed, high style, and a mass-market machine age. Photo courtesy of Hilton Cincinnati Netherland Plaza.

Considered one of the nation's finest examples of Art Deco skyscraper modernism, the Carew Tower has dominated Cincinnati's skyline since its construction in 1930. The mixed-use skyscraper complex was the first experiment in the development of "a city within a city," originally comprised of three towers on half a city block: a 48-story office tower, the 29-story Netherland Plaza Hotel, and the 28-story parking tower, which used three freight elevators for vertical transport of cars. The complex's five-story base and basement were divided into hotel and retail spaces. It cost $33 million to build, an exorbitant sum at the time.

From its riveted steel frame and fast elevators, to its extravagant use of French metalwork from the Paris decorative arts international exhibition of 1925, the Carew Tower embodied 1920s Jazz Age optimism, and it was designated as a National Historic Landmark in 1994.

Rauh knows better than anyone its significance. Raised just across the Ohio River in northern Kentucky, he recalls Carew Tower in all its glowing magnificence against the night skyline as an iconic image from his childhood. Decades later, after earning art history and architecture degrees at Harvard and developing hands-on experience in historic restorations of large hotels, particularly the bureaucratic aspects of the work, Rauh came full circle.

"Here I was, sitting in the Carew Tower, just some kid who grew up across the river, now about to restore it," said Rauh. The project "was an amazing personal experience for me," he said.

As the architect on the restoration project, Rauh acted as go-between on behalf of the project's big-budget re-constructors, with the federal program managers charged with granting historic preservation tax incentives. Rauh's ability to gain consensus from these and other stakeholders was critical with a property so central to the region's economy. He also was responsible for finding skilled trades people for the restoration and ensuring that their work complied with historic preservation standards.

For more information on D+D 2014, visit durabilityanddesign.com/show.

JPCL

for organizations such as SSPC, International Concrete Repair Institute, American Water Works Association, Water Environment & Technology, and *JPCL* (e.g., pp. 30–39, this month).

This webinar is sponsored by The Sherwin-Williams Company.

Registration, CEU Credits

The SSPC/*JPCL* Webinar Education Series 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). 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 these online presentations at paintsquare.com/webinars.

Architect Who Restored Cincinnati Landmark to Speak at D+D 2014

Award-winning architect Richard Rauh, who led the 15-year, $100 million historical restoration of Cincinnati's ground-breaking Carew Tower, will give a presentation on the project at D+D 2014, to be held, appropriately enough, at the Carew Tower's Hilton Netherland Plaza Hotel, May 20–22, 2014. D+D 2014 is the conference of *Durability + Design*, a sister publication of *JPCL*.

Richard Rauh

Carew Tower's public spaces epitomize the 1920s Jazz Age, embodying speed, high style, and a mass-market machine age. Photo courtesy of Hilton Cincinnati Netherland Plaza.

Considered one of the nation's finest examples of Art Deco skyscraper modernism, the Carew Tower has dominated Cincinnati's skyline since its construction in 1930. The mixed-use skyscraper complex was the first experiment in the development of "a city within a city," originally comprised of three towers on half a city block: a 48-story office tower, the 29-story Netherland Plaza Hotel, and the 28-story parking tower, which used three freight elevators for vertical transport of cars. The complex's five-story base and basement were divided into hotel and retail spaces. It cost $33 million to build, an exorbitant sum at the time.

From its riveted steel frame and fast elevators, to its extravagant use of French metalwork from the Paris decorative arts international exhibition of 1925, the Carew Tower embodied 1920s Jazz Age optimism, and it was designated as a National Historic Landmark in 1994.

Rauh knows better than anyone its significance. Raised just across the Ohio River in northern Kentucky, he recalls Carew Tower in all its glowing magnificence against the night skyline as an iconic image from his childhood. Decades later, after earning art history and architecture degrees at Harvard and developing hands-on experience in historic restorations of large hotels, particularly the bureaucratic aspects of the work, Rauh came full circle.

"Here I was, sitting in the Carew Tower, just some kid who grew up across the river, now about to restore it," said Rauh. The project "was an amazing personal experience for me," he said.

As the architect on the restoration project, Rauh acted as go-between on behalf of the project's big-budget re-constructors, with the federal program managers charged with granting historic preservation tax incentives. Rauh's ability to gain consensus from these and other stakeholders was critical with a property so central to the region's economy. He also was responsible for finding skilled trades people for the restoration and ensuring that their work complied with historic preservation standards.

For more information on D+D 2014, visit durabilityanddesign.com/show.

JPCL

The Buzz on PaintSquare.com

By Anita Socci, JPCL

HOT TOPIC:

The Hot Topic in this month's The Buzz isn't about death, destruction, or corruption. Much conversation was generated over "The Cold War over the Cold Wall Effect," a blog by Warren Brand. Check out Warren's and six other blogs at paintsquare.com and tell us what you think.

Most Popular Poll

Four-year vs. two-year degrees and skilled trades
New high school seniors are weighing options for after graduation. What next step would you advise for a new high school graduate?

- **39%** 4-year college or university
- **37%** Technical or trade school
- **18%** Military service
- **6%** "Gap year" off to work or travel

Car F.: *"Kids don't know what they want and they tend to drop off and change their minds several times before finding something they like; it's best to take a year off and either get a temporary job or go traveling and exploring the real world."*

N. Bufford: *"I would actually recommend attending a 2+2 program at a community college partnered with four-year universities."*

David Lemke: *"In the time between now and when the baby boomers entered the job force, the emphasis has been on a four-year degree. Recently developed two-year Associate's degrees have been added to the mix, which leads high school seniors to think the only way they could get a decent paying job was to get a degree. But nothing replaces on-the-job training when it comes to the skilled trades and that is why apprentice programs were established by the skilled trade unions."*

PSN TOP 10 *(As of Sept. 6)*

- OSHA Probes Tower Painter's Death
- Battle Lines Drawn over Silica Rule
- Painter Dispute Wipes Smile From Tower
- DuPont to Pay $72M in Price-Fixing Case
- Corruption to Cost Engineering Firm $1M
- New Bay Bridge Trolls for Next Steps
- Painting a Solution to Eagle Deaths?
- Offshore Workers Target Troubled Copter
- Contractor Error Cited in Deadly Blast
- Contractor Cited after Earlier Death

MOST POPULAR QUIZ *(as of Sept. 6)*

How is a fingerprint technique used in coatings technology?

Robert Cloutier 21/22
Robin Hasak 21/22
William Turcotte 21/22
Shabbir Hussain Shah 21/22
Douglas Steitz 21/22

Results

Get the coatings industry buzz at paintsquare.com, or scan the QR code with your smart phone for instant access!

Causes of Amine Blush

What causes amine blush in epoxy topcoats?

From Stephen Bothello
Jotun Paints

Amine blush is caused by the preferential reaction of the amine curing agent with atmospheric carbon dioxide and moisture to form ammonium carbamate compounds. It is typically a surface phenomenon, where the free amine functional groups on the surface film layer combine with carbon dioxide and humid air (water) to form hydrates of amine carbonates.

External risk factors for occurrence of amine blush are high humidity, a difference of at least 3 C not being maintained between the steel temperature and dew point at the point of application, the cold wall effect, and low ambient temperatures (dampness). All of the aforesaid risk factors facilitate water availability to the amine by the condensation process for the carbamate formation.

Intrinsic risk factors attributed to the product are a slow epoxy-amine reaction, improper mixing (excess of curing agent), inadequate mixing (not complying with the data sheet's instruction for minimum induction time after mixing of base and curing agent), or the presence of low molecular weight amine in the curing agent/hardener. (These amines are hygroscopic by nature and easily react with water in preference to epoxy and have high vapor pressure.)

Normally, the amine type used in the product can be identified from the safety data sheet.

From Juan I. Ordinas
LOTUM, SA

Blistering can be seen in water tanks due to amine blush. Typical conditions in water tanks are high humidity and medium to low temperatures. With these conditions, amines can react faster with CO_2 and humidity than with the epoxy component, producing a carbamate derivative. This carbamate remains on the surface, and, if it is not detected and removed by solvent wash, adhesion failure will occur when the second layer of material is applied. Adhesion fails due to this carbamate contamination, and you can see blistering—bubbles filled with water between the different coats of the system.

From Jorge Lizarraga
International Paint

An excess of amines (part II) in the mixture of the base and converter on the surface of an epoxy topcoat results in amine blush when reacting with CO_2 from the air and moisture. Generally, this reaction produces a greasy pink shade on the surface.

A poor mix between the epoxy base (part I), and the amine converter (part II) will also produce this effect when the free amine reaches the coating surface and reacts with the air. In both cases, the unreacted amine may also produce blistering by water absorption if it remains inside the film.

Editor's Note: Problem Solving Forum (PSF) is published in *JPCL* and its sister publication, *PaintSquare News* (*PSN*), a daily electronic newsletter. Answers are edited to conform to the style of each publication.

Not all answers to PSF questions appear in both publications. To read archived PSF questions and answers from *PSN*, go to PaintSquare.com.

Recent questions include the following.

- How do you prepare an oil-stained, bare concrete floor for coating?
- Where are errors most likely to occur when measuring dry film thickness on steel, and how can they be avoided?
- How does the concave or convex curvature of a surface affect a coating's shore hardness reading?
- How do you gauge the remaining service life of a weathered alkyd paint system and determine whether it should be removed or overcoated?
- For coatings with a high-solids content (95% or more), what kinds of defects, such as holidays or micropores, are possible or likely to occur in the applied film? How can these be prevented or remedied?
- Why would a pull-off adhesion test give a high value (no failure) for a solventless epoxy that later showed poor adhesion in service?
- How does the concave or convex curvature of a surface affect the WFT reading?
- What are some ways to improve transfer efficiency of airless spray application?
- How do you accurately measure the adhesion of inorganic zinc?
- How can I determine when concrete has cured sufficiently to be coated, besides waiting the 28 days typically specified?
- How does one accurately measure coating thickness on the inside and outside of a small diameter pipe?

Q&A with Anton Ruesing

By Charles Lange, JPCL

Anton Ruesing is the Director of the Florida Finishing Trades Institute (FTI), a protective coatings job training program partnered with the International Union of Painters and Allied Trades (IUPAT). Ruesing has been with the Florida FTI for ten years, and has held his current position for six years. He is responsible for training around 1,000 apprentices and journeymen and overseeing the day-to-day operations at the FTI's seven training centers throughout the state. His duties include reviewing program curriculum; ensuring compliance with the U.S. Department of Education, Department of Labor, and local city and county regulations; and managing the program's seven full-time and 70 part-time instructors.

JPCL: How did you get your start in the protective coatings industry?

AR: I started painting in St. Louis, MO, when I got out of the Marine Corps. I needed a job during the day that paid well, so that I could go to college in the evening. A friend of mine from high school suggested I talk to his father, who was one of the owners of Ackerman Painting. A few days later, dressed in crisp new whites, I showed up on my first job. I had no idea, then, that after college and a two-year hiatus working in IT, I would return to the industry and turn what started out as just a job into not only a career, but my passion.

JPCL: What makes the Florida coatings market unique from other areas of the country? What are some of the special considerations one might have to take to accomplish a successful coatings project in Florida?

AR: Florida presents a lot of unique challenges to coatings. The east coast of Florida, or the "Space Coast," as it is affectionately called, is one of the most corrosive environments in the world—so much so that in the 1960s, NASA actually set up a Corrosion Research Laboratory at Kennedy Space Center. Florida also has very high humidity, one of the highest average precipitation levels in the country, a six-month hurricane season, tornadoes, and is known as the lightning capital of the U.S., so while Florida's nickname is, "The Sunshine State" the sun is not always shining. Most of Florida is a severe environment when it comes to coatings projects.

Environmental controls are often a big concern and a big expense, especially with ever-present morning dew and afternoon thunderstorms. Soluble salts are always a big issue, in a state with so much coastline. Due to the high probability of storms and the need to protect the environment and people, containment is a crucial component.

In addition to all of the environmental challenges, Florida also faces some manpower issues. The workforce here is very transient. It is not uncommon for workers to move in and out of the state. Florida wages overall are comparatively lower than in many other states, and quite often in the winter, there is a large influx of workers who are laid off in the northeastern states looking for work in Florida. However, once winter fades into spring, many of those workers will leave for higher wage jobs, causing manpower shortages.

JPCL: Can you talk about the importance of membership in unions such as the IUPAT and other industry associations? How have these associations benefited you, personally?

AR: I believe that industry organizations like

SSPC, NACE, the IUPAT, the FCA, the PDCA, and others are all fighting for a common goal—to make the industry better. We are all working towards raising that proverbial bar, and by doing so we are improving people's lives. Owners get a better finished product that will last longer and have a lower total cost of ownership. Workers can be more productive and receive better wages that help stimulate the economy, and their work is safer so that they can go home to their families at the end of the day. Contractors realize higher profit margins with a more productive, better-educated workforce. The public gets a safer, cleaner (non-contaminated) environment. The list goes on and on. All of us who work in the industry have a responsibility to do our part to raise that bar, whether it's participating in industry group meetings and events, upgrading training programs, and getting involved in community outreach and education.

I am very proud of my membership in the IUPAT. Just like a lot of other folks, I didn't know *anything* about painting when I joined. I had no idea that a house painter was any different than an automotive painter or an industrial coatings applicator. The Union took that kid who didn't know anything and gave him a career. I had to bring the work ethic, but the Union gave me the knowledge and taught me the skills to put food on my family's plate for over 16 years now.

JPCL: What advice would you give to a young person who might be interested in the protective coatings industry?

AR: Learn everything you can and be proud. I can't count the number of times I have heard painters ask each other, "How did you end up painting?" or introduce themselves to a class and say something along the lines of, "and that's how I ended up here." Although I have caught myself saying similar things, I despise it when painters act like our profession is substandard, unprofessional, or somewhere you "end up" if you don't play your cards right. Painting is an honorable, technical profession that takes a skilled applicator. Don't ever be ashamed of the good work that you do as a painter, and know the appreciation for the job you do extends far beyond just your boss.

JPCL: What has been the proudest moment or highlight of your career thus far?

AR: There are two that instantly come to mind. When I served my apprenticeship in St. Louis, the director of training was a man named Tim Klotz. He was the first painter I met that carried himself as a professional, and through his actions taught me not only the trade, but to be a professional, as well. Several years after I moved to Florida, after I had just recently become the director of the Florida FTI, I saw Tim again. He came up and shook my hand, and I could tell he was proud of me. I will never forget the day Tim called me to talk about training workers to work in nuclear power plants, and he actually asked me for my advice. I felt honored to be considered not just one of his former apprentices, but one of his peers.

The second story starts about eight years ago, when a coworker and I got into work early and found someone parked behind the union hall, sleeping in his car. He said he was unemployed, had just gotten kicked out of his apartment, and was just looking for a place to rest. We were looking for apprentices at the time, and we could both see something in him, so we sent him out to work as a first-year apprentice. Four years later, he had finished his training and was graduating. He had become a very good painter with a great work ethic, and he was being promoted to foreman at work. By this time, he had a nice apartment, a child, and a very loving spouse. He came up and shook my hand and said, "thank you." I immediately said, "you're welcome," and he said, "no, I really mean it…thank you!" It was one of the most heartfelt "thank you's" that I have ever received. He did all the hard work—we just created an opportunity for him, but he was truly grateful for the opportunity.

JPCL: If you had to go back and choose a different career for yourself, what would you choose, and why?

AR: International Law. I know everyone reading this probably just slammed on the brakes and said, "What?!" The law has always fascinated me, and studying languages and cultures has always been a passion of mine. I enjoy problem solving and helping people. I am happy where I am, but if I had a "do-over," law school would have been part of that plan. It still might be!

JPCL: What are some of your hobbies outside of protective coatings? How do you like to spend your free time?

AR: I spend as much time with my family as possible. I love the industry, I love the work that I do, but I am a family man. My wife, two children and I love to travel together and experience new things. We go to the theme parks here in Florida a lot, the beach occasionally, ride bikes, play games, and just spend time together. When I am alone I like to read and study, and I have never quite grown out of computer games.

JPCL

Tools and Methods of Hand Tool Cleaning

Editor's Note: The original version of this article, written in 1989 by Craig Henry (with Service Painting Company of Texas at the time) and Burke Bennett (with Clemtex at the time), was published in the February 1989 JPCL as part of the original Applicator Training Bulletin Series developed by the Coating Society of the Houston Area. The article was subsequently updated and published in the February 2006 JPCL, and updated again for publication this month.

Hand tool cleaning is one of the oldest methods of preparing steel surfaces. It is widely used for preparing small areas and for areas that cannot be blast cleaned. A hand tool-cleaned surface is one that is free of loose rust, loose paint, and loose mill scale. Tight rust, tight mill scale, and tight paint are allowed to remain on the surface. Before you start hand tool cleaning, remove dirt and grease from the surface by solvent or detergent cleaning. A hand tool-cleaned surface is achieved with wire brushes, sanders, chipping hammers, and other hand tools listed below.

Industry Standards

The SSPC specification for hand tool cleaning is SSPC-SP 2, defined as follows: "Hand tool cleaning removes all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter. It is not intended that adherent mill scale, rust, and paint be removed by this process. Mill scale, rust, and paint are considered adherent if they cannot be removed by lifting with a dull putty knife." However, SSPC-SP 2, Hand Tool Cleaning, requires you to remove all visible deposits of oil and grease in accordance with SSPC-SP 1, Solvent Cleaning, before starting the process of hand tool cleaning.

Photographs that illustrate the appearance of an SSPC-SP 2 (Figs. 1 and 2) surface are found in the publication, SSPC-Vis 3. These photographs were developed by SSPC. In Europe and other parts of the world, the industry standard is ISO 8501-1 (Preparation of Steel Substrates Before

Fig. 1: (Left) Unpainted steel, pitted and rusted. (Right) The same steel specimen after hand tool cleaning to SSPC-SP 2. Courtesy of SSPC. Note: Fig. 1 and Fig. 2 are not equal in photographic quality to the actual reference photographs in VIS 3 and should not be used as substitutes for the actual standard.

Fig. 2: (Left) Previously painted steel with rust and several layers of deteriorated coating. (Right) The same specimen after hand tool cleaning to SSPC-SP 2.

A hand tool-cleaned surface is achieved with wire brushes, sanders, chipping hammers, and other hand tools.

Application of Paints and Related Products—Visual Assessment of Surface Cleanliness—Part 1: Rust Grades and Preparation of Uncoated Steel Substrates and of Steel Substrates After Overall Removal of Previous Coatings), which uses photographs developed by the Swedish Standards Institute.

In ISO 8501-1, the color and appearance (metallic sheen) of a surface after thorough hand tool (or power tool) cleaning are shown as St2. The color and appearance of a surface after very thorough hand tool or power tool cleaning are shown as St3. The end result will vary depending on the condition of steel before it is cleaned. The four initial conditions or grades of steel in the ISO specification are:

- Grade A: Adherent Mill Scale;
- Grade B: Rusted Mill Scale;
- Grade C: Rusted; and
- Grade D: Pitted and Rusted.

For example, if a bid specification calls for a steel surface to meet C SA2, it tells the applicator that the initial condition of the steel is rusted and it must be hand tool cleaned and have a faint metallic sheen, as shown in the photo depicting C SA2.

SSPC recognizes Grades A–D but also recognizes three additional grades of steel.

- Grade E: light-colored paint (mostly intact) applied to blast cleaned steel;
- Grade F: zinc-rich paint (mostly intact) applied to blast cleaned steel; and
- Grade G: painting system (thoroughly weathered, blistered, or stained) applied to steel with mill scale.

Therefore, the pictorial standards must be used with care—those of ISO only depict uncoated steel, whereas those of SSPC additionally depict pre-coated steel.

Description of Tools

Common tools used for hand tool cleaning are sandpaper, non-woven abrasive pads, wire brushes, chipping hammers, scrapers, and hammers and chisels. The type of equipment selected depends on the condition and location of the surface. A chipping hammer or hammer and chisel are used in areas of heavy rust scale, deep rust pits, or thick build-up of paint. Various types and styles of chisels are available for use, depending on the surface to be cleaned.

There are many types of wire brushes. Within each type, brushes are classified by wire stiffness and the size, number, and rows of wire. The following are a few types of wire brushes.

- Shoe Handle Scratch: all-purpose wire scratch brush for brushing pipe threads and removing paint and rust scale
- Wire Scratch and Scraper: for removing loose, scaling paint and varnish
- Hand Wire Scraper: curved wire face for removing paint, varnish, and wax from large flat surfaces (The curved face enables better brushing control because fewer wires are in contact with the surface at one time.)

• Flat Block Wire Scratch: longer and more flexible wires to remove paint, rust, and grease from large, flat surfaces

Sandpaper and non-woven pads are used to remove loose paint and rust and to achieve a feathered edge on well-bonded paint, allowing touch-up paint to be applied consistently.

Assuring Quality Work

Hand tool cleaning is laborious and tiring. The quality of work can suffer as the day wears on. A worker must realize this and be more aware late in the day that the specification is followed.

Before you begin hand tool cleaning, make sure that dirt, grease, and oil have been removed from the surface. This can be achieved by solvent or detergent cleaning.

Some hand tools, such as chipping hammers, can cause a steel surface to burr. Special care must be taken because burrs may protrude through the protective coating, causing a rust bloom and premature coating failure. After a surface is cleaned and is suspected to have burrs, it should be wiped with a rag, and if burrs are found, they should be sanded smooth. A chipping hammer should have a blunt edge. The intent is to remove rust, paint, and mill scale, and not to gouge the steel.

Safety

Proper safety procedures should be observed when hand tool cleaning a surface. Because these tools can create respirable dust, flying paint chips, rust, and other contaminants, NIOSH-approved cartridge respirators, safety glasses or goggles, gloves, and other protective equipment should be used. These dangers may seem trivial, but they can cause serious injuries.

Responsibility for the correct safety equipment should be based on the following guidelines.

• The Contractor—Should provide proper safety equipment for the job being performed; ensure that the workers are trained to correctly use the equipment; and ensure that they do use the equipment.

• The Worker—Should be familiar with the safety equipment provided; maintain it in proper condition; and notify the owner if a replacement is required.

• The Owner—Should assure that proper safety practices are followed; and not allow questionable materials on the jobsite.

When to Use Hand Tool Cleaning

A coating on a metal surface that has been abrasive blast cleaned to White Metal or

Near-White Metal generally is expected to last much longer than a coating on a surface that has been prepared by hand tool cleaning. Therefore, considerations of coating life expectancy should be determined before a job is specified.

Hand tool cleaning can provide an important alternative to other means of surface preparation in a maintenance-painting program. As areas of corrosion failure occur on a structure, hand tools are used to remove rust and failing paint selectively so that only the areas affected are prepared. In this instance, hand tool cleaning can be accomplished quickly and inexpensively to maintain the life of a coating system. Other benefits of hand tool cleaning are that it can be done in confined areas and that it produces a very small amount of dust. Therefore, hand tool cleaning may be appropriate near sensitive equipment or in areas where people are working.

For small areas, it is often less expensive per square foot to use hand tools, but on larger jobs, hand tool cleaning becomes very slow and labor intensive compared with other means of surface preparation.

The most proven coating for a hand tool-cleaned surface is a slow drying, oil-based paint. This type of paint will provide for good coverage over uneven surfaces and will adhere adequately. This is important when applying paint on a failed area that has been hand tool cleaned, because hand tools can scar the surface, leaving it with high and low areas. Epoxy mastics are also quite popular for hand tool-cleaned surfaces.

A hand tool-cleaned surface is desirable for applications where a low-cost cleaning method is required and a short-life paint system can be tolerated. Remember to be thorough in hand tool cleaning operations, and don't let fatigue lower the quality of your work. Always clean the surface with solvent to get rid of grease and oil before you begin hand tool cleaning, and avoid creating burrs on the steel.

JPCL

This article is the ninth in JPCL's updated Applicator Training Bulletin Series. The Series was first published from 1988 to 1992. It was expanded in 1993 and updated the first time starting in 1997. The current update began in January 2013. The series is intended as an introduction to protective coatings work, with topics divided into five categories:

- Basics of Corrosion and Coatings,
- Surface Preparation,
- Application
- Quality Control, and
- Safety and Health.

By James D. Machen, PCS, KTA-Tator, Inc.

Richard Burgess, KTA-Tator, Inc., Series Editor

The Case of... Bubbles, and Pinholes, and Blisters, Oh My!

This month's Case from the F-Files describes the problem of bubbles, pinholes, and blisters in a polyurethane finish coat applied to new structural steel members at a coal-fired power generation plant. Many of the pinholes and bubbles were so small that they were difficult to detect with the unaided eye. Many of the largest blisters on the webs of structural members were very flat and shallow and also difficult to detect by eye. These conditions became more difficult to see overtime as thin layers of dirt from normal plant operating processes formed on the surface of the polyurethane finish coat. This case file illustrates that interacting variables, rather than a single cause, can combine to cause a failure.

Fig. 1: Sections of newly-coated steel members at a coal-fired power plant displayed blistering and other signs of coating failure. Photos courtesy of James D. Machen, KTA-Tator, Inc.

Background

The specification required that the structural steel be blast cleaned in the shop in accordance with SSPC-SP 6/NACE No. 3, Commercial Blast Cleaning. Following blast cleaning, a two-coat system, consisting of a moisture cured urethane (MCU) zinc-rich primer and an aliphatic polyurethane finish, was shop-applied. The MCU primer was specified to be applied at a dry film thickness (DFT) of 2.5 to 3.5 mils, and the polyurethane finish was to be applied at a DFT of 4.0 to 5.0 mils. The total two-coat DFT was to be 6.5 to 8.5 mils.

Field touchup work was specified to be SSPC-SP 2, Hand Tool Cleaning, and/or SSPC-SP 3, Power Tool Cleaning, followed by the application of a coat of surface-tolerant epoxy mastic (4.0 to 6.0 mils' DFT) and a finish coat of polyurethane (4.0 to 5.0 mils' DFT).

The steel was delivered to the project site for sequenced erection. In mid-summer, near the completion of the project, blistering and peeling were observed. At that time, the shop contractor mobilized a field team to make repairs. Repairs were reported to have been performed using low-pressure

Fig. 2: Close-up of typical concentrations of small, fine blisters in the polyureathane finish coat

water cleaning (4,000–5,000 psi), in conjunction with hand and power tool cleaning, to identify and remove defective areas, which were then touchup repaired.

In the spring of the next year, additional coating defects were discovered and field touchup was again performed. However, the same problems reportedly continued to appear. As a result of the continuing problems, an independent investigation of the coating problem was undertaken.

Field Investigation

The tests and inspections performed during the field investigation were those typically associated with failure investigations, and included the following.

- A visual assessment was performed to determine the degree and distribution of coating defects (in this instance bubbles, pinholes, blisters, and peeling).
- Total coating thickness was measured using a Type 2 electronic film thickness gage operated according to ASTM D7091, Nondestructive Measurement of Thickness of Nonmagnetic Coatings on a Ferrous Base.
- The number of coatings present and the thickness of each were determined using a

destructive coating thickness gage as described in ASTM D4138, Standard Test Methods for Measurement of Dry Film Thickness of Protective Coating Systems by Destructive Means. An integral portable microscope (50X) was used to observe a cross-section of the applied coating. The number of coating layers and thickness of each were measured. Further, evidence of intercoat contamination, voids, underlying rust, mill scale, and pinholes was recorded.

- Adhesion testing was conducted using Method A (X-Cut) of ASTM D3359, Measuring Adhesion by Tape Test. Method A involves cutting an "X" through the coating to the substrate using a razor knife. Pressure sensitive tape is placed over the X-cut, then rapidly removed. The amount of coating detached by the tape is rated in accordance with the ASTM rating scale. Ratings of 4A and 5A are considered to represent good adhesion, 2A to 3A represent fair adhesion, while 0A and 1A represent poor adhesion.
- The coating system was removed in small areas, and the substrate was examined for under-film corrosion or mill scale. Active under-film corrosion may be associated with the coating failure and may also contribute to a shortened life of the system.

Coating samples at both failing and non-failing areas were removed for laboratory analysis, and digital images of the typical field coating conditions were obtained.

Visual Observations

The structural steel consisted primarily of vertical and horizontal I-beam members. Both intact and fractured (peeling) blisters were observed. Blisters were observed on virtually all members inspected. Some of the blisters appeared to be fractured as a result of someone physically scraping the areas, while others appeared to have cracked and fractured on their own.

Fig. 3: Blisters formed in the polyurethane finish coat on a flange

Fig. 4: Blisters in the polyurethane finish coat on a lateral brace web

Blistering ranged in size from concentrations of very fine blisters (approximately $\frac{1}{64}$ to $\frac{1}{128}$ of an inch in diameter) up to single blisters with diameters of approximately 2 to 3 inches. Both irregularly shaped and circular blisters were observed. The fine concentrations of blisters were located primarily on beam flanges and in the corner areas where the webs and flanges meet. Larger shallow blisters were generally located on the webs of the I-beams. The fine blisters and larger shallow blisters on the webs were more difficult to see, oftentimes becoming visible only when viewed at the proper angle with sunlight hitting the surface after the film of surface dirt and grime was removed.

Upon scoring around the perimeter of the larger blisters or areas of concentrated fine blisters with a razor knife, the full blister area could be removed. Upon removal, a portion of the zinc-rich primer remained on the steel surface, and a portion remained attached to the backside of the removed blister (cohesive break within the zinc primer). Both faces of the split primer films contained a visible white powder-like residue.

Areas that had been repaired by field touch-up were visible across the structure. Blisters were still visible in some touch-up areas. It was not apparent if the blisters had re-occurred in the touch-up area or if some of the blisters were not completely removed and touch-up material was applied over them.

Coating Thickness

The results of the total system thickness measurements from various locations on the structural steel are summarized below.

Fig. 5: Formation of whitish-colored zinc salts on the surface of the zinc-rich primer, beneath areas where the blistered finish coat was removed

- Minimum DFT (mils): 6.3
- Maximum DFT (mils): 15.7
- DFT Average (mils): 13.2

Destructive film thickness measurements most often identified two distinct layers of paint on the steel. In some instances where touch-up repairs had been made, additional coats were apparent, and three to five individual layers were evident. When two coats were present, the first coat was a metallic gray/green and ranged from 4 to 10 mils; the second coat was dark green and ranged from 3 to 7 mils.

Adhesion

Adhesion of the coating system in and immediately around blistered areas was rated poor (0A to 1A rating); however, adhesion of the coating system in blister-free areas was rated fair to good (3A to 4A rating). The adhesion test process consistently forced a break within or at the surface of the zinc-rich primer layer.

Substrate Examination

The substrate was examined at destructive film thickness measurement areas and sample acquisition areas. Because a thin layer of zinc-rich primer remained adherent to the

steel surface, a thorough inspection of the underlying substrate was not possible. However, under 50X power illuminated magnification of the destructive coating thickness gage, a roughened bright metal substrate was sometimes visible. This evidence suggests that the steel surface had been abrasive blast cleaned.

Laboratory Investigation

The laboratory investigation consisted of visual and microscopic examination, infrared spectroscopy and scanning electron microscopy-energy dispersive x-ray spectroscopy (SEM-EDS). The test methods and results are described below.

Microscopic Examination

Microscopic examination of the samples was conducted using a digital microscope with magnification to 200X. The samples had between two and five coating layers. Coating layer thickness measurements, obtained by laboratory microscopic methods, are in Table 1.

Infrared Spectroscopy

Infrared spectroscopic analysis revealed the following.

- The spectrum obtained of the green topcoat was consistent with a urethane. Water (moisture) and crystalline silica were also indicated.
- The spectrum obtained of the gray primer was most consistent with a zinc urethane. No distinct characteristic bands are associated with zinc coatings although the baseline noise appearance was consistent with a zinc coating (confirmed by elemental analysis).

SEM-EDS

SEM-EDS analysis revealed that the white powdery substance on the gray surface of the primer was primarily zinc. Other elements detected included magnesium, aluminum, and silicon.

Conclusions

The field investigation and laboratory analysis identified multiple variables that contributed to the blistering coating problems on the structural steel.

The zinc-rich primer used on the project was a MCU material. MCUs react with moisture (atmospheric humidity or other moisture source) to cure. During the curing reaction with moisture, carbon dioxide gas (CO_2) is liberated as a reaction product. The CO_2 gas escapes from the coating film in a process commonly referred to as "out-gassing." When a lot of moisture is available, MCUs cure at an accelerated rate, and CO_2 formation and out-gassing increase. When an additional paint layer is applied while the MCU is still out-gassing, the release of CO_2 from the MCU can be inhibited. The gas must now pass out of the MCU and through the newly applied layer. Depending on the state of drying and curing of the newly applied layer, some CO_2 gas may escape, and some may become trapped in the new film. The CO_2 that escapes produces pinholes or craters when the topcoat has begun to gel, while CO_2 that is trapped creates sufficient pressure

Table 1: Coating Layer Thickness Measurements

Sample #	Coating Layers and Thickness (mils)	
Sample 1 (Fine Blisters)	*Two Layers*	
	Green—Top	3.0–6.9
	Metallic Gray—Bottom	3.8–7.3
Sample 2 (Fine Blisters)	*Two Layers*	
	Green—Top	2.2–4.4
	Metallic Gray—Bottom	2.3–3.6
Sample 3 (Fine Blisters)	*Two Layers*	
	Green—Top	3.8–6.0
	Metallic Gray—Bottom	5.2–7.2
Sample 4 (Large Blisters)	*Two Layers*	
	Green—Top	4.9–8.4
	Metallic Gray—Bottom	5.0–7.9
Sample 5 (Non-Failing)	*Two Layers*	
	Green—Top	6.9–8.5
	Metallic Gray—Bottom	2.6–3.9
Sample 6 (Non-Failing Repair Area)	*Five Layers*	
	Green—Top	2.0–4.0
	Light Green	2.5–5.5
	Green	4.0–6.0
	Green	3.0–5.0
	Metallic Gray—Bottom	5.2–9.9
Sample 7 (Non-Failing Repair Area)	*Four Layers*	
	Green—Top	4.0–5.5
	Gray	3.5–4.0
	Green	1.8–3.5
	Metallic Gray—Bottom	3.9–5.2
Sample 8 (Single Blister)	*Three Layers*	
	Green—Top	2.9–5.8
	Gray	3.1–6.8
	Metallic Gray—Bottom	3.9–8.0

to form bubbles through the cross-section and at the surface of the new film.

Laboratory microscopic examination of the paint samples consistently revealed that pinholes and bubbles were present in the green topcoat layer applied over the MCU primer. This evidence indicates that the MCU zinc-rich primer was topcoated with the polyurethane before the primer had sufficiently cured.

Infrared spectroscopic analysis of the green polyurethane finish coat identified bound moisture within the film. In order for moisture to become bound within this layer, the moisture would have had to have been present on the MCU zinc-rich primer layer over which the polyurethane finish was applied. This evidence indicates that the surface of the MCU zinc-rich primer where defects occurred (i.e., bubbling, pinholes) was damp when the polyurethane was applied.

Field thickness measurements and laboratory microscopic measurements revealed that the MCU zinc-rich primer was often applied above the specified DFT range of 2.5 to 3.5 mils. Destructive thickness measurements and laboratory microscopic measurements indicated DFTs of up to 7 mils and 9.9 mils respectively. Excessive primer thickness prolongs the dry and cure time of the primer; as a result, the CO_2 out-gassing is also prolonged, serving to increase the likelihood of pinholes and bubbling.

The polyurethane finish coat was also applied above the specified DFT range of 4.0 to 5.0 mils, with measurements up to 8.7 mils in some instances. These thicker films could slow the escape of the CO_2 or trap it, possibly contributing to increased bubble and pinhole formation.

The white powdery residue on the backside of the detached blister area and on the substrate was identified as zinc oxide in the laboratory. Zinc oxide ("white rust") is produced as the zinc dust in the primer oxidizes. This finding indicates that the MCU zinc-rich primer layer was performing as designed: providing galvanic/sacrificial corrosion protection to the carbon steel substrate. Moisture (rain, condensing moisture)

Fig. 6: Close-up of zinc salt formation on the zinc-rich primer surface, beneath the removed blistered finish coat

was gaining access to the MCU zinc-rich primer through the voids (i.e., pinholes, fractured bubbles) in the polyurethane finish coat. The moisture served as the electrolyte, allowing the MCU zinc-rich primer to oxidize. Moisture condensing on the steel was likely contaminated with sulfides from the coal-fired power generating station. Water-soluble salts such as sulfides, in combination with moisture, increased the corrosivity of the exposure environment.

Recommendations

The defective areas (i.e., bubbles, pinholes) were identified and removed by high-pressure water cleaning. Industry experience has shown that water pressures in excess of 4,000 psi are usually effective for revealing and removing defective coatings. However, because each individual project is unique, some experimentation is needed to arrive at the optimal cleaning pressure. It was ultimately determined that the best removal method involved the use of a zero-degree, rotating tip on the pressure washer gun, with careful observation to maintain the equipment manufacturer's gun-to-work-piece distance and dwell times. In areas where pressure washing was not entirely effective, supplemental mechanical cleaning with power tools (i.e., power sanding) was used. Once the defective coating was completely removed, any coating that remained was probed with a dull putty knife as described in SSPC-SP 2 and SSPC-SP 3, Hand Tool and Power Tool Cleaning, respectively. Remaining coating that passed the dull putty knife test criteria was considered "tightly adherent" for touchup repairs. The periphery of touchup areas was feather-edged to provide a smooth transition from the repair area to surrounding intact coatings.

Once surface preparation was accomplished, touchup proceeded using the field touchup system, consisting of a coat of epoxy mastic followed by a matching green polyurethane finish coat.

JPCL

James D. Machen is a Senior Coatings Consultant with KTA-Tator, Inc., a coatings consulting engineering firm and distributor of inspection instruments, where he has been employed for over 20 years. Machen is an SSPC-certified Protective Coatings Specialist, a NACE-certified Coatings Inspector Level 3 (Peer Review), and a Level II Inspector in accordance with ASTM D4537. He performs coating failure analyses, coating system recommendations, specification preparation, and major project management for a variety of clients in the transportation, water and waste, power generation, chemical processing, and marine industries. He holds a B.A. from the Pennsylvania State University.

The Role Linings Play in Manhole Rehabilitation

By Kevin Morris, The Sherwin-Williams Company

Today's sewer collection system is a maintenance challenge for municipal water and wastewater owners because it is exposed to more aggressive conditions than in the past, and these conditions speed the rate of deterioration. Factors that have increased corrosive content include less water in the waste stream, longer transport times, and slower flows. Also, in some locales, industrial waste streams enter the municipal system, contributing fatty acids and other corrosive materials. Other factors complicating sewer maintenance are freeze-thaw cycles, traffic loading, soil movement, and erosion caused by cavitation.

Fortunately, high-performance, chemical-resistant linings are available to protect against deterioration by creating a protective barrier between the substrate and the waste flow. Linings come in a variety of chemistries and formulations with different functional characteristics and application requirements. This article explains how corrosion occurs in the sewer collection system, the various generic lining products available in the marketplace today, required application methods, and potential issues associated with each material. Additional discussion will take place around ancillary work required to achieve a successful long-term installation.

How Microbial Agents Induce Corrosion

Microbiologically Induced Corrosion (MIC) is responsible for the deterioration of sewer manholes, most of which today are made of concrete. Older ones were constructed using brick and mortar. Concrete and mortar, which share cement as a common ingredient, are highly alkaline, porous substrates. When they are exposed to carbon dioxide and hydrogen sulfide gas carried in the sewage, a complex, multi-phase process of corrosion is set in motion. A detailed discussion of the process is beyond the scope of this paper, but a basic description of MIC is necessary.[1]

In the first phase, sulfate-reducing bacteria (SRB) break down sulfates in the waste stream and produce hydrogen sulfide gas (H_2S) and carbon dioxide (CO_2). In the second phase, these mild acidic gases reduce the pH of the concrete above the waterline from 12 to as low as 9. As the pH of the concrete is reduced, more sulfates are pro-

Editor's Note: This article is based on a paper the author gave at SSPC 2012, the annual conference of SSPC: The Society for Protective Coatings, held January 30–February 2, 2012, in Tampa, FL. For more on SSPC, go to sspc.org.

duced on the surface above the waterline. Sulfur-oxidizing bacteria (SOB) attach to the surface as the sulfates are produced.

Next, in phase three, the SOB (Thiobacillus thioxidans) consume the H_2S and elemental sulfur, and discharge sulfuric acid (H_2SO_4), which is very aggressive. The pH of the substrate continues to drop, accelerating microbial growth. As the bacteria colonize above the waterline, more concentrated pockets of H_2SO_4 are created.

Finally, in phase four, the sulfuric acid attacking the concrete creates a visible layer of gypsum (calcium sulfate) that allows the microorganisms to reproduce, so more acid is created, and attack intensifies (Figs. 1 and 2).

This process repeats itself until structural failure occurs.

Protecting Waste Stream Infrastructure from MIC

High-performance linings, including high-performance cements, have been employed for years to protect against the corrosive process caused by MIC. These liners protect the original substrate through the principle of barrier protection mechanisms, isolating the substrate from its environment to prevent corrosion from taking place. The different chemistries of the linings determine their functional properties.

Contemporary coatings used in new and rehabilitated structures fall into six generic categories.

Fig. 1: Severely corroded sanitary sewer manhole
Courtesy of The Sherwin-Williams Company

Fig. 2: Severe concrete corrosion in the ceiling of a regional wet well structure
Courtesy of Carolina Management Team

1. Cementitious Liners: Microsilica Mortars
2. Cementitious Liners: Calcium Aluminate Mortars
3. Cementitious Liners: Microsilica Mortars containing MIC-preventing additives.
4. Epoxy Liners: Epoxy Resins; Fiber Reinforced Epoxies; Epoxy Mortars
5. Polyurethane and Hybrid Polyurea Liners
6. Pure Polyurea Liners

Cementitious Liners: Microsilica Mortars

Cementitious microsilica mortar liners use typical Portland cement, which is porous without the addition of additives. When the manufacturer adds fumed silica to the cement mixture, the result is a much denser finished product that slows the penetration rate of water and/or chemicals. This class of cementitious liner approximately doubles the life cycle of the substrate compared to typical Portland-based cements, according to a study conducted on life cycle improvement over typical Portland-based cements.[2]

Cementitious Liners: Calcium Aluminate Mortars

Cementitious liners that use calcium aluminate cement rather than Portland cement maintain a higher pH level that is less affected by the corrosive gases in the sewer system. The higher pH level limits the growth of SOB, thereby prolonging service life approximately four to five times over that of typical Portland-based cements.[2]

Fig. 3: Cementitious rehabilitation of a sanitary sewer structure
Courtesy of Carolina Management Team

Fig. 4: Cementitious rehabilitation of a sanitary sewer manhole
Courtesy of Southern Trenchless Technologies

Cementitious Liners: With MIC-Preventing Additives

These cementitious liners are typically made from microsilica repair mortars that have an additional additive to kill the Thiobacillus thioxidan bacteria and prevent colonization. These chemical additives act to pierce the exoskeleton of the bacteria and prevent the four phases of MIC described above. (These types of cementitious liners were not part of the study in Reference #2 regarding life cycle improvement over typical Portland-based cements.)

Cementitious Liners as Stand-Alone Protection

The generic class of cementitious liners can be used as stand-alone linings applied to the substrate by low-pressure wet spray or by being centrifugally cast ("spin-cast") in the substrate (Figs. 3 and 4).

Cementitious liners have many benefits associated with their use as stand-alone liners, such as cost, ease of application, and tolerance of cure conditions in manhole environments. However, these liners will corrode as the original substrate did but at a much-reduced rate over the Portland cement used to cast the structures for sewer manholes. Cementitious products also will not provide long-term protection against infiltration because of the capillary pores within the cement matrix. These pores allow moisture to migrate through these liners once they become completely saturated. They will also crack as the original substrate did when exposed to heavy traffic loading. Moreover, they still have the propensity to have issues with freeze/thaw cycling.

Resinous Liners

Each of the following three groups of resinous coatings serves as a chemical-resistant protective barrier between the substrate and the corrosive environment. After application and cure, the linings should be spark tested (high-voltage holiday testing) per NACE International SP0188 to ensure that they are monolithic and free of any holidays or voids.

Fig. 5: High-build epoxy lining system in a sanitary sewer manhole
Courtesy of Carolina Management Team

Fig. 6: Epoxy mortar lining in a sanitary sewer manhole
Courtesy of Carolina Management Team

Epoxy Liners (Epoxy Resin, Fiber-Reinforced, and Epoxy Mortar Liners)

Owners and specifiers have long favored epoxy liners for manhole rehabilitation (Figs. 5 and 6, p. 32). In addition to their excellent chemical resistance properties, they are strong and unaffected by humidity or other wetness, making them ideal for application to damp substrates. However, these coatings are rigid, which creates problems if the structure moves beyond the coating's ability to expand. Epoxy liners are typically bonded directly to the substrate and may require the use of primer. They are spray applied or troweled, or they can be used as saturates/topcoats with geotextile cloth. They are typically applied at dry film thicknesses of 60–250 mils. The linings require either manual application and thus personnel entry into the confined space, or rotary spray application without entry into the manhole.

Fig. 7: Flexible polyurethane elastomer lining in a sanitary sewer collection system
Courtesy of Carolina Management Team

Fig. 8: Flexible polyurethane elastomer lining system in a sanitary sewer manhole
Courtesy of The Sherwin-Williams Company

Polyurethane and Hybrid Polyurea Liners

While these technologies have been slower than epoxy liners in gaining acceptance among specifiers and owners, polyurethane (Figs. 7 and 8) and hybrid polyurea liners are now becoming more widely used. These coatings offer physical toughness and improved elongation over epoxies. A moisture-tolerant primer is required to bond to damp surfaces. This type of resin can be formulated to offer ideal film-build characteristics, allowing the applicator to fill surface voids with the spray-applied liner. Because the liner can fill surface voids, it can eliminate the need for surface repair before application, and roadway disruption time can be shortened.

Polyurethanes and hybrid polyureas can be formulated to have varying performance characteristics, making it difficult to compare them to one another and to epoxy resins, especially. The flexible films bond to the substrate with a moisture-tolerant epoxy primer; have crack-bridging capabilities; and can withstand constant, heavy traffic as well has minor soil movement and pipe shifting. There are rigid film versions, like epoxies, that could crack if the substrate moves more than the film will expand, or they could disbond from the substrate and remain self-supporting. These liners can be spray-applied with plural-component equipment at dry film thicknesses of 80–250 mils using personnel entry into the confined space, or rotary spray application can be used without personnel entry into the manhole.

Fig. 9: Polyurea lining system in a sanitary sewer manhole
Courtesy of PCT 360

Pure Polyurea Liners

Pure polyurea liners also have been slow to gain acceptance among specifiers and owners (Fig. 9). However, they offer physical toughness and improved elongation over other technologies. A moisture-tolerant primer is required to bond to damp surfaces. This type of resinous liner offers an extremely fast dry-to-the-

Regardless of what coating is used, measures must be taken to prevent water infiltration before application.

touch time (15–45 seconds), which forces the resin to build up around surface imperfections rather than filling them in. For this reason, the substrate needs to be repaired before application to achieve a monolithic liner. The extremely short dry times also necessitate sophisticated application equipment that is hard to maneuver in tight sewer manholes. If the coating is difficult to spray by hand without problems, then remote centrifugal spray application equipment is available that eliminates problems caused by triggering (off and on) the application gun. This remote centrifugal spray equipment ensures the coating will not be applied "off ratio" due to human error.

Pure polyureas typically have the lowest permeability rating of any of the generic classifications of resinous liners; however, their use in industrial waste streams is problematic because they offer only moderate resistance to concentrated acids. These liners are spray applied at dry film thicknesses of 80–250 mils.

All resinous liners offer physical performance attributes unique to the formulation of each individual manufacturer. The list of attributes is long, and the specific attributes of all formulations are not the focus of this paper, but a brief discussion of bonded liners vs. self-supporting (structural) liners can show key characteristics of each type.

- Bonded Liners: Just as the name suggests, these liners are intended to bond directly to the structure that they protect. The liners provide indications of issues and/or concerns that may exist with the surface preparation, application, or operating conditions within a manhole structure. If problems with the structure are taking place or are a concern, they are typically reflected in the applied liner by cracking, delaminating, or blistering. While the owner may consider these issues a failure of the liner, they can also be viewed as indicators of larger problems that should have been addressed or need to be addressed now that the environment has changed.
- Self-Supporting (Structural) Liners: These liners, unlike bonded liners, are initially applied in the structure with the intent to bond to the substrate, but the biggest difference between structural and bonded liners is that if structural liners do not remain bonded to the substrate, they will support themselves within the structure and show no sign of failure. While these types of liners can prevent the deterioration of the structure by providing a barrier from the environment, they can also allow corrosion of the original substrate to take place behind the liner or water infiltration between the substrate and now free-standing liner that will still enter the collection system in the pipe. This non-visible issue can prevent the liner from providing the most effective protection compared to other alternatives.

Ancillary Work Necessary to Provide the Longest Life Expectancy

Regardless of what coating is used, measures must be taken to prevent water infiltration before application. Otherwise, moisture will permeate back through the cementitious liners, causing blisters or other defects in resinous liners, or running into the waste stream between the substrate and a disbonded self-supporting liner. Water infiltration is best stopped by using a reactive

Fig. 10: Injection of hydrophilic polyurethane chemical grout Courtesy of DeNeef Construction Chemicals

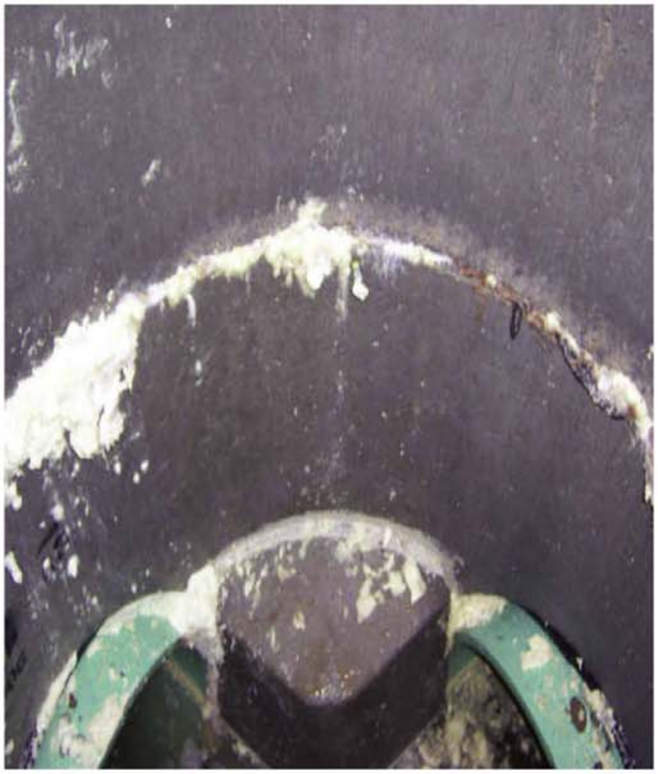


Fig. 11: Stopping a high-volume leak with hydrophillic polyurethane chemical grouts
Courtesy of DeNeef Construction Chemicals

polyurethane resin—activated by groundwater leaking into the structure or "twin streamed" through an "F" pipe assembly with water—to create a permanent waterproof barrier.

Injection grouts (polyurethane resins) offer nothing in the way of structural stability like epoxy resins, but, unlike epoxy resins, injection grouts have an affinity for damp/wet surfaces.

Injection grouts are available in several different chemistries, but polyurethane grouts are most common for the occasional user and come in two generic chemistries.

1. Hydrophilic—absorbing water (literally, the love of water)

2. Hydrophobic—repelling or tending not to combine with water (literally, the fear of water)

Hydrophilic resins are flexible and are available in foams or gels (Figs. 10 and 11, pp. 36–37). These resins absorb large amounts of water and offer medium volumes of expansion, typically around 10 in volume. The high amount of water absorption can be problematic in areas of cyclic water table depth. If they are injected during a period of an elevated water table, and then the water table is lowered for long periods of time, the water absorbed by the hydrophilic grouts can evaporate, causing the grout material to shrink drastically. If this occurs, water could infiltrate a structure at the same location that had already been treated. A secondary problem with large amounts of water absorption comes up depending on the geographical location of a project and the depth of the frost zone. Products that retain large amounts of water are utilized in the northern parts of the U.S. and can be subject to problems associated with freeze/thaw cycling.

Hydrophobic resins are typically rigid and come in foam only. There are only a few versions of hydrophobic foams available in the market today that remain flexible. These resins take in very small amounts of water, just enough to start the reaction, and then they chase away the remaining water. These resins do not have the same potential to be affected by freeze/thaw cycling, but because the majority of the resins are rigid, they present some concerns with traffic loading, pipe shifting, or unstable soils, and they can crack.

The use of polyurethane injection resins offers an owner the lowest cost permanent repair procedure available. In some projects, a polyurethane grout may be all that is needed to fix the owner's concerns with water infiltration and increased cost associated with treating unnecessary groundwater. In other cases, polyurethane grouts may be needed as part of a system that includes structural repair mortars and resinous liners for corrosion control.

Conclusion

The millions of sewer manholes in the U.S. today offer many challenges to repair; unfortunately, it is not a "one size fits all" market. The systems presented in this article are intended to provide an overview of the available materials, methods of application, and some advantages and disadvantages of each. When considering or selecting a repair method for manhole rehabilitation, be sure to speak with manufacturers and contractors, and verify references to determine suitability for your specific project.

Acknowledgements

A special thanks goes to the following persons and companies for their assistance with photos for this article.

- David VanZee and Wendy Banks, Carolina Management Team, Enka, NC
- Mike Francis, PCT360, Toledo, OH
- Eric Dupre, Southern Trenchless Technologies, Laredo, TX
- Ed Paradis, DeNeef Construction Chemicals, Houston, TX

References

1. For a detailed discussion, see, for example, the article by Randy Nixon, "Deterioration of Wastewater Treatment and Collection System Assets," *JPCL*, October 2006, pp. 50–63.
2. Data obtained through a study conducted by Bio-Industrie Heidelburg for Lehigh Cement Company. An exact service life cannot be determined due to the varying corrosive content of individual sewer systems.

Kevin Morris is the Global Market Director of Water Wastewater for The Sherwin-Williams Protective and Marine Coatings Division. He has worked for Sherwin-Williams for 21 years. Over the past 11 years, he has held other positions with the Protective and Marine Coatings Division of the company, including Protective and Marine Coatings Sales Representative and Corrosion Specification Specialist in the Southeastern United States. He is a NACE Level III Certified Coating Inspector, a Certified Concrete Coating Inspector with SSPC: The Society for Protective Coatings, and an Instructor for SSPC's Concrete Coating Basics and Concrete Coating Inspector programs. He has written and published numerous papers and articles for organizations such as SSPC, the International Concrete Repair Institute (ICRI), the American Water Works Association (AWWA), the Water Environment & Technology (WE&T), and the *Journal of Protective Coatings & Linings* (*JPCL*). **JPCL**

CONVENTIONAL EPOXY SYSTEMS FOR PROTECTIVE AND MARINE COATINGS

By Dr. Daniel J. Weinmann, Momentive Specialty Chemicals Inc.

Since the late 1950s, conventional (solvent-borne) epoxy resins have been a mainstay in coatings designed for the most demanding applications. Whether to protect an oceangoing tanker hull from years of exposure to salt and seawater, or to maintain the safety of a bridge suspended over a river, coatings formulators have known that a solvent-borne epoxy system with conventional solids is often a very good option. For protective and marine coatings, epoxy resin systems bring an unmatched combination of superior adhesion, high corrosion resistance, and broad-based chemical resistance, as well as superior mechanical and barrier properties.

When selecting the specific type of epoxy resin system to use, it's important to understand the kinds of epoxy resins that are available and the various types of curing agents and modifiers used to achieve specific properties. Protective and marine coating systems are comprised of multiple coating layers. Each coating layer must be formulated so that the coatings system can achieve service life times of five, ten, or twenty years, depending on its environment and the applicable service category.

This article provides an overview of the chemistry and properties of conventional epoxy systems that are typically used for protective and marine coatings.

Editor's Note: This article is the seventh in JPCL's 2013 series on generic coating types.

iStockphoto

APPLICATION SUB-SEGMENTS

A heavy-duty protective coating is defined as a paint or film that protects a substrate—such as blasted steel, smooth steel, phosphated steel, masonry, or concrete—from chemical and corrosion attack.

Marine coatings protect structures in contact with fresh water, salt water, and/or salt spray. The various sub-segments of marine coatings are oceangoing vessels (commercial and defense), offshore platforms for oil and gas, pleasure crafts, and shipping containers.

Protective coatings are used in onshore oil and gas facilities, chemical processing equipment, power plants, pulp and paper plants, mining and mineral works, bridges and other parts of infrastructure, potable water and wastewater treatment facilities, pharmaceuticals, and food processing plants.

ENVIRONMENTAL SERVICE CATEGORIES

Industry trade groups and specification agencies divide applications into various categories based on the severity of exposure and durability requirements. These classifications help guide the selection of appropriate coatings for a given service level. Applications are typically designated as light-, medium-, or heavy-duty, but exposure classifications are needed to clearly define the type of environmental effects that the coating system must withstand in the real world.

One example of an exposure classification system comes from ISO (International Organization for Standardization) and is named International Standard ISO 12944, "Paints and varnishes—corrosion protection of steel structures by protective paint systems." This standard identifies various atmospheric corrosivity and durability categories as shown in Table 1.

Another classification system is available from SSPC: The Society for Protective Coatings. SSPC recommends specific types of painting systems for a wide variety of service environments. (For these standards, please refer sspc.org.[1]) Service classification systems, such as the ones described in these two examples, help industry specifiers to determine the right coating system for a given application.

Table 1: ISO 12944 Atmospheric Corrosivity Categories

C1	Very Low	C4	High
C2	Low	C5-I	Very High (Industrial)
C3	Medium	C5-M	Very High (Marine)
Durability		**Time**	
Low—L		2 to 5 years	
Medium—M		5 to 10 years	
High—H		More than 15 years	

PROTECTIVE AND MARINE COATINGS

For higher performance, protective and marine coatings are normally applied in three distinct layers. Each layer has a specific function related to sealing, corrosion protection, and/or adhesion. The total dry film thickness of the coatings system (all of the individual layers combined) is usually 200-400 µm, although for the highest corrosive categories, it may be as high as 800 µm.

The metal or concrete substrate is first coated with a primer designed for good adhesion and corrosion protection. For medium- to heavy-duty applications, a mid-coat layer is then applied to increase the protection level. A topcoat is applied to complete the coating system.

One of the well-known limitations of epoxy resins is found in applications where there is exterior UV exposure. In practice, if the coating will be exposed to direct sunlight for extended periods, or if the aesthetic appearance of the coating is critical, then the recommended topcoat is normally based on a polyurethane, alkyd, or acrylic resin.

However, if the topcoat is indoors, or under the water line, or in cases where the final coating layer must provide superior chemical resistance, then epoxy resins are the primary material of choice. For instance, a full epoxy lining helps to prevent a steel tank from rusting or corroding and contaminating its contents, while at the same time, keeps the content from "eating" its way out of the tank. Epoxy coatings are also used to protect factory floors from chemicals and to maintain hard, durable surfaces even under daily tow motor traffic.

Epoxy coatings for protective or marine coatings are supplied as dual component products that must be combined before use. Manufacturers' step-by-step instructions for mixing and proportioning the components must be strictly followed for the coatings to perform as intended. Some epoxy coatings require an induction period before they are ready to be applied. The working pot life is temperature dependent, so although most epoxy coatings become more viscous at the end of their pot life, some do not. The manufacturer's maximum pot life, or working time, should be the guide regarding when to stop application rather than simply relying on a perceived viscosity increase or difficulties with spray application due to higher viscosity.

Conventional epoxy coatings can be applied by spray, brush, or roller. A specified minimum recoat time is needed to allow the coating layer to release solvent and to form a good film before the next layer of coating is applied. Many epoxy coatings have a maximum recoat time, after which they will not accept another coat unless the surface is prepared by solvent wiping or mechanical abrasion. Conventional solids, solvent-borne epoxy coatings should be applied when the surface temperature is at least 5 degrees F (3 degrees C) above the dew point.

STRUCTURE OF EPOXY RESINS

Epoxy resins are a family of synthetic resins available in a range of physical states, from viscous liquids to high melting point solids.

Each resin molecule contains two or more epoxide groups (Fig. 1).

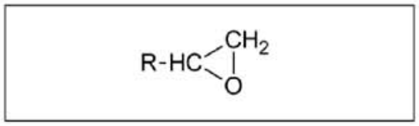


Fig. 1: General epoxide structure

The epoxide rings are very reactive. By ring opening, the epoxy group cross-links with proton-donor curing agents, such as amine hydrogens, to form a thermoset polymer matrix (Fig. 2). Higher molecular weight epoxies contain secondary hydroxyl functional groups (-OH), but these hydroxyl groups react only under high temperature baking conditions that aren't possible when coating large ships or bridges.

The final result of combining epoxy resins with amine hardeners is a fully cross-linked, or fully cured, coating with excellent adhesion, good corrosion and chemical resistance, and good mechanical properties. Epoxy resins undergo very little shrinkage on cure because the epoxy-amine reaction does not generate any volatile byproducts. Low shrinkage helps to ensure superior adhesion and minimizes internal stress in the coating, making it less prone to cracking and crazing.[2]

COMMON TYPES OF EPOXY RESINS

The most common type of epoxy resin is the diglycidyl ether that is formed by condensing epichlorohydrin (ECH) with diphenylolpropane (DPP), also known as Bisphenol-A (Fig. 3).

If one looks closely at the structure of the higher molecular weight DGEBPA resin, the structure-property relationships can be summarized as shown in Table 2.

Table 3 illustrates how the physical properties of standard DGEBPA resins change as their molecular weight increases.

Many critical coating properties vary depending upon the molecular weights in the final resin product, due to differing backbone chain lengths and hydroxyl-functionality (Table

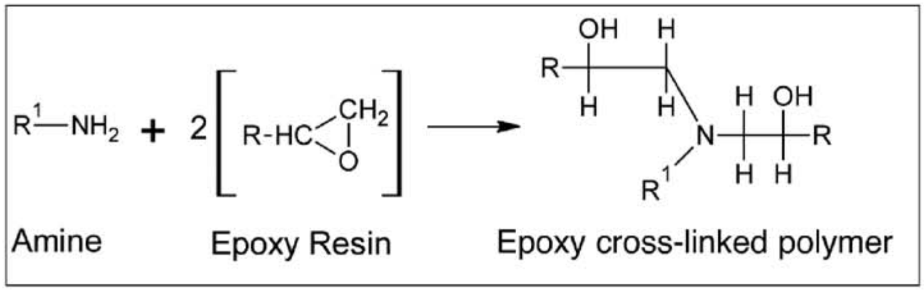


Fig. 2: Amine hardener reacts with a resin's epoxy groups to form a cross-linked polymer matrix

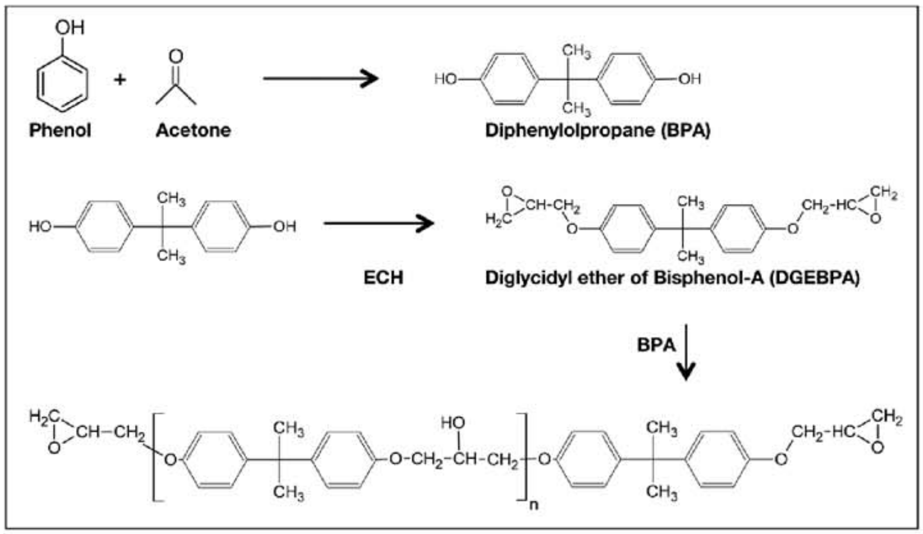


Fig. 3: Diphenylolpropane is reacted with epichlorohydrin to form a diglycidyl ether resin; further reaction with BPA forms higher molecular weight analogues

Table 2: Relationship Between Resin Structure and Properties

Multiple aromatic rings	Strong chemical resistance
Oxirane group (epoxide ring) attached to aromatic group	Good reactivity to form tight crosslinking in the final cured network
Hydroxy functionality (-OH)	Strong adhesion, good substrate wetting
Diphenylolpropane (BPA) backbone	Rigid structure that provides toughness and improved heat resistance
Only ether (-O-) and carbon-to-carbon (C-C) linkages	Strong resistance to water, bases and acids, and other strong chemicals

Table 3: Physical Properties of DGEBPA Resins, in Relation to Molecular Weight

Resin Type	n	Molecular Weight	Epoxy Equivalent Weight[1]	Hydroxyl Functionality	Melting Point (C)	Viscosity cP (25 C)
Standard Liquid	<1	380	185–192	2	8–12	11–14
Type 1	2	900	450–525	6	64–76	0.8–1.7[2]
Type 4	3.7	1400	905–985	7+	95–105	4.3–6.3[2]
Type 7	8.8	2900	1600–1900	13	125–132	17.5–27[2]
Type 9	12	3800+	2400–4000	17+	140–155	36.2–98.5[2]

[1]*Grams of resin containing 1 equivalent of epoxy* [2]*Forty percent solution in diethylene glycol monobutyl ether*

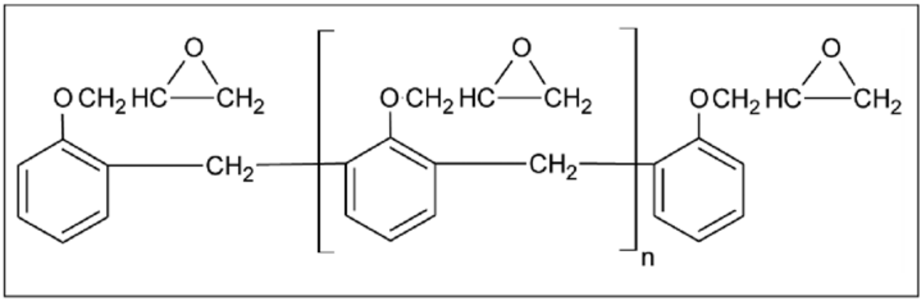


Fig. 4: General structure of an epoxy phenolic novolac resin

4). When used with a polyamide curing agent, a Type 1 epoxy resin is the sixty-year standard for the protective and marine coatings market. Epoxy polyamide coatings offer fast dry, good flexibility, chemical resistance, and long-term corrosion resistance. Type 4 resins are used for resin manufacture (i.e., epoxy esters) and for powder coatings. Type 7 and 9 resins are used for bake coatings.

Another type of epoxy resin is made by the reaction of epichlorohydrin with diphenylolmethane (DPM or Bisphenol- F), which is manufactured by the reaction of phenol and formaldehyde. The low molecular weight Bis-F epoxy resin (diglycidyl ether of bisphenol-F) is lower in viscosity (6,500 cP vs. 10,000 cP) than the standard liquid epoxy resin, DGEBPA. Another advantage of the Bis-F epoxy resin is improved, low-temperature crystallization resistance, which is a limitation of standard DGEBPA resins. One way to further improve crystallization resistance is to use a combination of Bis-A and Bis-F epoxy resins in a blend of the two resins.

Bis-F epoxy resins have a functionality slightly greater than two and offer better chemical resistance and higher glass transition temperatures than DGEBPA liquid resins. For these reasons, Bis-F epoxies are often used in solvent-free (100%-solids) coating formulations for tanks, secondary containment, chemical processing plants, etc.

Epoxy novolacs, which are formed by reacting a novolac resin with epichlorohydrin, are used with various amine curing agents to yield coatings with superior chemical resistance. Two common examples are epoxy phenolic novolac and epoxy cresyl novolac resins.[3] Epoxy novolac resins have a significantly higher functionality and higher proportion of aromatic rings, which increase chemical resistance and glass transition temperature. These resins have very high viscosity or are semi-solid resins with functionalities ranging from 2.2 to 3.6 (Fig. 4). Alternative highly-functional epoxy resins are available, but due to their high viscosity and high costs, these specialty epoxy resins are not typically used in marine or protective coatings.

Other specialty resins feature many other types of polymers attached to their epoxy groups, achieving a variety of results. Examples include epoxy esters, polyglycol- and cardanol-epoxidized resins for flexibility, hydrocarbon-modified and acrylate-modified resins, and epoxy-functional modifier resins, as well as epoxy-functional silanes and siloxanes. Blends of more than one type of resin are also possible. Crosslinking joins these resin types together and creates coatings with a wide variety of properties.

Table 4: Performance versus Molecular Weight of Epoxy Resin

	Low M.W. Epoxy (e.g., Liquid)		High M.W. Epoxy (e.g., 9-type)	
	Advantage	**Limitation**	**Advantage**	**Limitation**
Viscosity	Low			High
Pot Life	Short		Long	
Curing Agent Demand		High	Low	
Dry Times	Slow		Fast	
Crosslink Density		High	Low	
Toughness	Low		High	
Flexibility	Low		High	
Chemical Resistance	High			Low
Corrosion Resistance	High			Low

CURING AGENTS

The type of curing agent selected for a formulation has a dominant impact on the performance of an epoxy coating. The resin's major reactive groups—epoxide and hydroxyl—are capable of reacting with many cross-linking groups. Consequently, a wide variety of reactive chemistries can be used as curing agents. Some curing agents will work at ambient temperatures while others require heat. Curing agents that require heat to cure are not summarized here but can be found in the technical literature.

- Aliphatic polyamines are curing agents with multiple amine hydrogen (–NH) reaction sites per molecule. This wealth of reaction sites results in a high cross-link potential. Aliphatic amines are used for hard, tough coatings that are very resistant to acids or alkali. These coatings can be brittle if not formulated or mixed properly. High volatility and reactivity mean shorter working pot life and fast cure times. Aliphatic polyamines are prone to reaction with ambient moisture, resulting in "amine blush" or "carbamation."

- Polyamine adducts are manufactured by pre-reacting an epoxy resin with excess aliphatic polyamine. The advantage of this approach is enhanced compatibility with lower blushing. Longer working time with improved mixing ratio tolerance and higher flexibility are some of the advantages of

In practice, a simple mixture of resin and curing agent rarely provides a coating formulation with each of the desired properties for a specific application. A variety of formulating components are needed to improve processing, optimize performance, or to reduce cost.

these curing agents. The limitation is higher mix viscosities.

- Polyamides and amidoamines are prepared by reacting aliphatic polyamines with either dimer fatty acids or with monomer fatty acids, respectively. These curing agents produce more flexible epoxy coatings with better weather and alkali-resistance, longer pot lives, and more tolerant mixing ratios. These systems resist acid and solvents only moderately. Resultant coatings are more viscous and require an induction time before being applied. Lower molecular weight, lower viscosity versions can yield higher solids, allowing the development of lower volatile organic compounds (VOC) epoxy polyamide coatings.
- Cycloaliphatic amines contain a saturated ring structure with multiple amine hydrogen (–NH) reaction sites per molecule. These amines provide coatings with properties that are between those of coatings based on aliphatic amines and those based on polyamides. Cycloaliphatic amines provide low viscosity coatings with good chemical resistance. To improve the coatings' moisture resistance and increase reactivity, pure cycloaliphatic amines are typically supplied as formulated commercial products designed to meet specific requirements.
- Aromatic amines are curing agents wherein the amine functional group is attached to an aromatic ring. Increased ring content with amine groups attached provides greater chemical resistance but lower UV stability. Aromatic amines are typically solid at room temperature and require heat cure (unless adducted). Accelerators are used to achieve acceptable cure rates.
- Other specialty curing agents include Mannich bases, flexible curing agents based on polyglycol, and phenalkamines. Each type offers specific performance and application characteristics that may be important for certain applications in the protective and marine coatings markets.

COATING FORMULATION

In practice, a simple mixture of resin and curing agent rarely provides a coating formulation with each of the desired properties for a specific application. A variety of formulating components are needed to improve processing, optimize performance, or to reduce cost. The major types of components used in coatings formulations are

- cure accelerators,
- plasticizers and toughening agents,
- diluents,
- fillers and pigments,
- solvents, and
- reinforcements, particularly fibers.

Examples of materials that modify coating properties are cure accelerators, flexibilizers, plasticizers, and toughening agents. Accelerators are chemicals such as alcohols or phenolic materials that help the epoxy/amine reaction to proceed more quickly. Plasticizers improve the crack resistance of an epoxy coating when bent slowly around a mandrel or during mechanical bending to form an article. Toughening agents help the coating to be less brittle under rapid deformation (such as what occurs during direct or reverse impact).

Diluents are used to lower viscosity and improve handling at room temperature. Two types of diluents can be used—either non-reactive or reactive. Non-reactive diluents, such as certain types of solvents and plasticizers, do not cure into the system. They can migrate, or evaporate, from the film after use. In some cases, the evaporation is fast (minutes or hours), but in other cases, this migration can take days, months, or years.

Reactive diluents usually contain epoxide groups, and include mono- and diglycidyl

Table 5: Conventional Two-Component Epoxy Maintenance Coating

Part A Component	**Pounds**	**U.S. Gallons**
Epoxy Resin (1-type, equivalent weight = 500) at 75%wt. solids in xylene	300	35.1
Methyl Isobutyl Ketone	50	7.5
Propylene Glycol Monomethyl Ether (PM)	50	6.5
Xylene	50	6.9
Pigment & Extenders	293	9.6
Anti-settling Agent	8	0.8
Anti-flood Agent	2	0.3
	753	66.7
Part B Component		
Polyamide Curing Agent (equivalent wt. = 150) at 70%wt. solids in xylene	174	22.8
Xylene	52	7.2
Methyl Isobutyl Ketone	22	3.3
	248	33.3
Formulation Constants		
Totals, A+B mixed	1,001	100.0
Density, pounds/gallon	10.0	
Nonvolatiles, %wt.	64.9	
Nonvolatiles, %vol.	50.9	
VOC, calculated, lb./gal (g/L)	3.5	(421)

ethers and monoglycidyl esters. These additives will cure into the system, reducing the number of functional epoxy groups that are available for cross-linking with the amine. Cross-link density will decrease, but flexibility increases. Diluents enable lower viscosity coatings, but they have slower dry times and lower glass transition (T_g) films. Some examples of epoxy-functional, reactive diluents are C12-C14 glycidyl ether, cresyl glycidyl ether (CGE), and neopentyl glycol diglycidyl ether (NPGE). Monoepoxide diluents are excellent viscosity reducers, but they lower cross-link density. Short chain diepoxide diluents like NPGE have less effect on the heat resistance of a cross-linked system.[4]

SOLVENTS

To achieve the desired viscosity and film characteristics for manufacture and application, organic solvents are used in many ambient temperature cure epoxy coatings for protective or marine applications. Important solvent types or classes include ketones, alcohols, esters, aromatics, and hydrocarbons.

In the U.S., some of these solvents are designated as Hazardous Air Pollutants (HAPs) or volatile organic compounds (VOC) by the U.S. Environmental Protection Agency. For application shops, the total emissions and types of emissions for each site location are regulated. In other regions of the world, the boiling point of the solvent is an important criterion for being defined as a VOC.

A two-component epoxy maintenance coating starting formulation is summarized in Table 5. There are two separate components to this epoxy coating: Part A (epoxy) and Part B (curing agent). These components are supplied separately and usually in a volume mix ratio of either 2:1 or 4:1. The formulation contains additives such as an anti-settling agent to prevent the pigments from falling to the bottom of the container and becoming a hard lump; and an anti-flood agent to prevent the lighter colored pigments from separating to the surface as the coating dries, which would cause uneven color development. The formulation contains a combination of fast-, medium-, and slow-evaporating solvents to aid in mixing the components, to facilitate application, and improve the coating's drying characteristics.

SUMMARY

Solvent-borne, conventional solids epoxy systems have a long, successful track record as critical components of medium- to heavy-duty protective and marine coatings. These epoxy coatings are applied to prevent the corrosion of substrates, such as steel or concrete that is subject to chemical, corrosion, mechanical, or weathering exposures.

Epoxy coating systems are typically applied in three separate layers that have distinct functionalities. Epoxies are used for the primer and mid-coat layers. They are also used for the topcoat layer when yellowing or chalking resistance is not critical (e.g. for industrial tanks or railcar tank wagons).

Epoxy coating systems are supplied as two separate components—epoxy and curing agent—which must be mixed before use. Several different types of epoxy resins, curing agents, and specialty additives are available to adjust the coatings' formulation properties as needed. Manufacturers' instructions and recommendations must be carefully followed for these coatings to perform as designed.

Some of the industrial solvents used in protective and marine epoxy coatings are designated as HAPs and VOCs, and these are regulated at the local, state, and federal level in the U.S. market. VOC reduction can be achieved by increasing the solids content (remove solvent), or by moving to waterborne epoxy alternatives. These optional routes to environmentally-friendly coatings will be treated separately in future articles on this topic.

REFERENCES

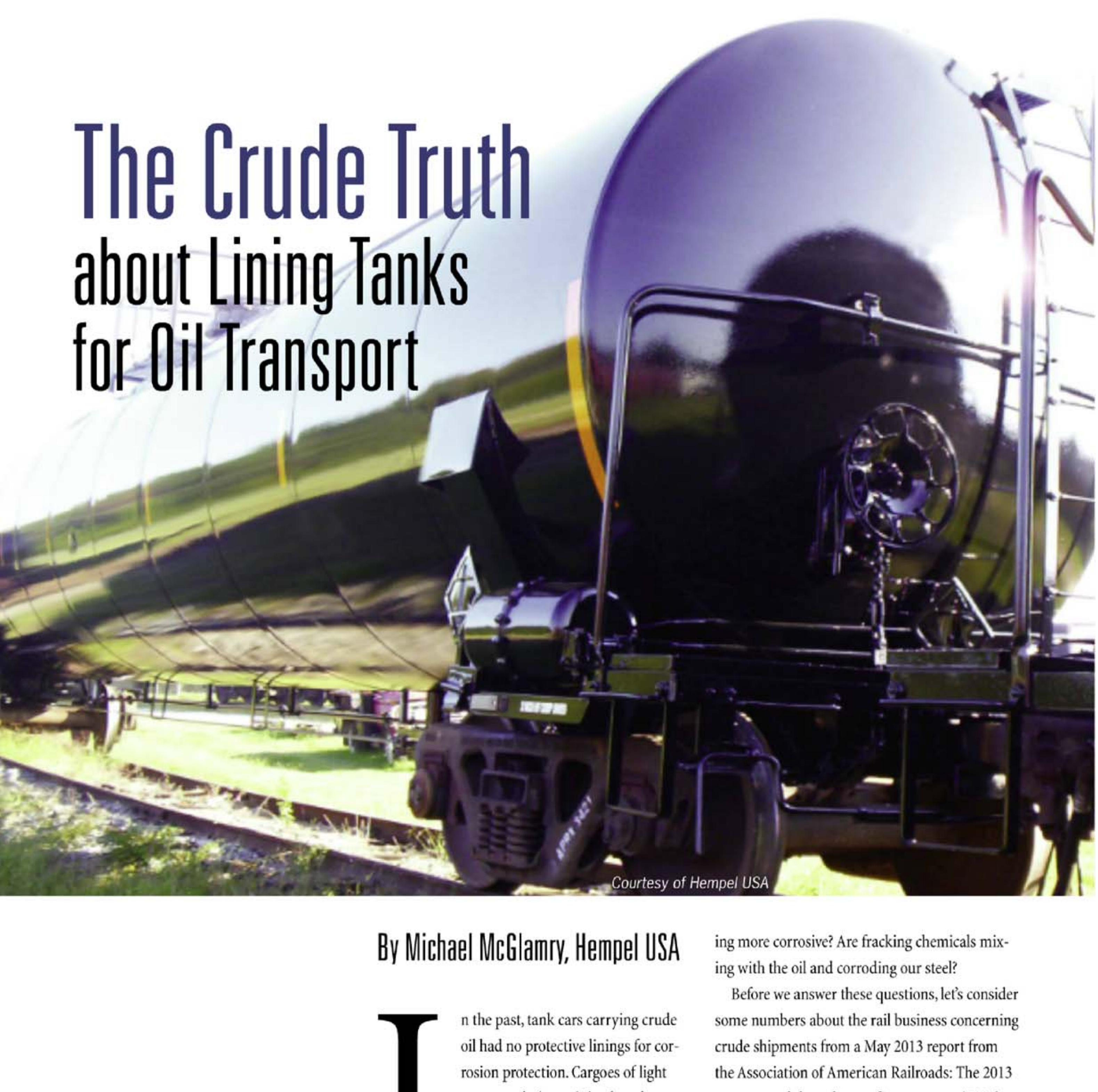
1. http://www.sspc.org/standards/standards_using_SSPC_standards/ to download the first chapter of *SSPC Volume 2, Systems and Specifications*, entitled "About SSPC Standards and Guides."
2. Hare, Clive H., *Protective Coatings—Fundamentals of Chemistry and Composition*, Technology Publishing Company, Pittsburgh, PA; 1994, p. 190.
3. Lee, Henry, Nevelle, Kris, "Handbook of Epoxy Resins," McGraw-Hill Book Company, New York, 1967, p, 4-44.
4. Momentive Specialty Chemicals, "HELOXY™ Modifier Selector Guide," MSC-158, April 2012, http://www.momentive.com/, available by request.

Daniel J. Weinmann, Ph.D., is the Global Market Segment Leader—Coatings & Civ. Eng. for Momentive Specialty Chemicals Inc. in Stafford, TX.

He earned his B.S. in Chemistry from the University of Oklahoma and his Ph.D. from the University of North Dakota in Grand Forks. Since joining the epoxy resins business, Dr. Weinmann has worked in various technical roles with primary focus on the coatings and civil engineering industry. He currently serves as the global segment leader for Coatings, Civil Engineering, and Adhesives markets.

Dr. Weinmann is the coauthor of two U.S. patents. He has published numerous technical articles and has presented talks on high-solids, solvent-free, and waterborne epoxy coating technology to industry groups around the world. He is a member of the American Coatings Association, NACE International, and SSPC: The Society for Protective Coatings. JPCL

The Crude Truth about Lining Tanks for Oil Transport



Courtesy of Hempel USA

By Michael McGlamry, Hempel USA

In the past, tank cars carrying crude oil had no protective linings for corrosion protection. Cargoes of light sweet crude (containing less than 0.5% sulfur) have a passivating effect on the steel of the cars, and very little corrosion was ever identified during routine inspections. Why is there now significant concern about corrosion in rail cars, when the industry has a track record (pun intended) of over 100 years with very low corrosion rates in unlined cars? What has changed? Is crude becoming more corrosive? Are fracking chemicals mixing with the oil and corroding our steel?

Before we answer these questions, let's consider some numbers about the rail business concerning crude shipments from a May 2013 report from the Association of American Railroads: The 2013 report noted that whereas five years ago (2008), "U.S. Class I railroads originated just 9,500 carloads of crude oil,"[1] the number of carloads originated had increased to 234,000 in 2012, and in the first quarter of 2013, the number was 97,000. Given the 2013 first quarter number, the report predicted another large increase in carloads of crude originated by U.S. Class I railroads.[1]

Given the above numbers, maybe we are seeing more corrosion on tanker cars just because we have a whole lot more steel exposed. Or maybe we are carrying crude that's not only crude. The answer to our problem can be found by understanding oil production and the constituents in crude. For this discussion, we are focusing on the developments in the unconventional onshore oil market in North America, which is pushing the overall rail crude oil tank requirement capacity.

We must understand that there are several advanced completion techniques within the unconventional market, including, to name a few, traditional welling/fracking, in situ mining, steam-assisted gravity drainage (SAGD), and cyclic steam stimulation (CSS). For this article, we will focus specifically on the fracking completion technique.

There has been a lot of discussion in the unconventional oil and gas market and in the media about fracking, so we won't go into great detail here, but the fact is, there are corrosive chemicals used in the fracking process.

The presence of corrosive chemicals in fracking raises a question about transporting oil: When those chemicals are pumped into the formation, do they return to the surface with the oil extracted and with enough corrosion potential to cause problems? The answer is "No." While the chemicals can be found in the produced crude, the concentrations are so low that they are not seen as problematic. It's important to note that with traditional extraction methods, crude oil also contains water, chlorides, oxygen, and up to 0.5% sulfur for sweet crude or higher for sour crude.

What about bitumen produced from mining oil sands? Oil sands are a naturally occurring mixture that typically contains 10–12% bitumen, 80–85% minerals (clays and sands), and 4–6% water. Bitumen is a mixture of large hydrocarbon molecules containing sulfur compounds (equivalent to up to 5% elemental sulfur by weight), small amounts of oxygen, heavy metals, and other materials.

Now that we are starting to get a clear picture of the composition of the cargo, we should take a closer look at the water, sulfur, and oxygen. When we do, the "ah-hah" moment comes. Bitumen is extremely viscous at ambient temperatures, but crude can be just as viscous in extremely cold temperatures, such as those occurring in North Dakota winters. In an effort to make the bitumen or crude flow into the tank cars, it is heated. This heating causes the water, sometimes with high levels of chloride, to naturally separate from the oil and sink to the heel, or bottom, of the rail car. So, we've created an environment that contains sulfur, high chloride levels, and hot water, an environment ideal for supporting corrosion. To put this environment into perspective, even at ambient temperatures, wet elemental sulfur has been shown to corrode mild steel up to 1 mm/yr (0.04 in./yr), with localized pitting rates of up to 7 mm/yr (0.27 in./year). With the addition of chlorides, the corrosion rates have been shown to double and even triple, in research conducted by Fang, Young, and Nešic´.[2]

Now that we have a better idea of what we're fighting, another question arises: How do we protect the interiors of tank cars carrying crude oil or bitumen from oil sands? We'll need an interior lining that must be resistant to high temperatures, and, since high-pressure steam is often used during the cleaning of the tank cars, with steam temperatures that can be as high as 330 F (166 C), the lining also must be resistant to thermal shock. In addition, during crude loading in the winter, the steel temperature could be -40 F (-40 C), while the crude temperature will be around 160 F (71 C). This condition leads to an immediate 200-degree F (111-degree C) temperature swing, resulting in thermal expansion of the steel as well as the lining material. So the lining will also need to have some level of flexibility to cope with the flexing of the tank car during loading and unloading operations, as well as the general movement associated with transportation. This is a tall order, even before adding the chemical resistance requirements of hot chloride water and the low pH environment associated with sulfur compounds.

The good news is that advanced technology phenolics and thick-film epoxy novolac linings on the market can withstand the environment. Coating manufacturers focused on the rail industry have long, successful track records for this type of service. The real question becomes, should you risk an unscheduled release and loss of an asset because the tank car wasn't lined?

References

1. Association of American Railroads, "Moving Crude Oil by Rail," May 2013, https://www.aar.org/keyissues/Documents/Background-Papers/Crude-oil-by-rail.pdf
2. Haitau Fang, David Young, and Srdjan Nešic´, "Elemental Sulfur Corrosion of Mild Steel at High Concentrations of Sodium Chloride," 17th International Corrosion Congress, Paper #2592, Las Vegas, NV, October 6–10, 2008.

Michael McGlamry is the Americas Protective Product Manager for Hempel, USA. McGlamry is highly experienced in the coatings world, with almost 20 years in the Protective and Lining Segments. He has worked in a variety of roles including Product Manager, Lining Technical Manager, Technical Service Manager, and Upstream Offshore Engineering Sales. He is NACE Level 1 certified and also holds an international certification for Project Management. JPCL

OSHA'S Proposed Rule for Silica Hits the Streets

By Alison B. Kaelin, CQA, ABKaelin, LLC

On August 23, 2013, the U.S. Occupational Safety and Health Administration (OSHA) unveiled its long-expected proposed rule for protecting workers against respirable crystalline silica. OSHA issued two versions of the proposed rule, one for general industry and shipyards (1910/1915) and one specific to construction (1926).

The proposed rule reduces the current permissible exposure limit (PEL) for general industry, shipyards, and construction to 50 micrograms per cubic meter of air ($\mu g/m^3$). The current PEL for general industry and shipyards is 100 $\mu g/m^3$, and the current PEL for construction is 250 $\mu g/m^3$.

Once published in the *Federal Register*, OSHA will accept comments for 90 days, as part of a rulemaking process. A hearing will be held in early March 2014, and the final rule will be issued sometime after. The proposal and related information can be read on https://www.osha.gov/silica/index.html.

While no conclusions on the actual requirements should be drawn based on a proposed rule, the proposed provisions do provide insight into likely approaches that will be considered by OSHA when the final rule is issued. Employers should consider the requirements of the proposed rule as they apply to their operations, and plan how to implement the requirements when the rule is final. Background on respirable crystalline silica, including its health effects, and a summary of the proposal follow.

Background

Silica is a compound composed of the elements silicon and oxygen (chemical formula SiO_2). Respirable crystalline silica means airborne particles that contain quartz, cristobalite, and/or tridymite. The respirable portion is determined by a respirable-particle-size-selective sampling device.

The proposed rule estimates that exposures to crystalline silica can occur in more than 30 major industries and operations. Silica can be present in the following materials and in others discussed in the proposal: abrasives such as mineral slags as well as sand, paints, concrete, portland cement, silicates, and soil.

As part of the rulemaking, OSHA performed an extensive analysis entitled "Respirable Crystalline Silica—Health Effects Literature Review and Preliminary Quantitative Risk Assessment." The available evidence indicated that employees exposed to respirable crystalline silica at concentrations well below the current PELs (of 100 and 250 $\mu g/m^3$) have an increased risk of lung cancer and silicosis. Occupational exposures to respirable crystalline silica also may result in the development of kidney and autoimmune diseases and in death from other nonmalignant respiratory diseases, including chronic obstructive pulmonary disease (COPD).

Summary of the Proposed Rules

Among the aspects of the proposed rule that may be of interest to the coatings industry are the following.

- Requirements to comply with applicable ventilation standards (e.g., 29CFR1926.57) for abrasive blast cleaning. While the ventilation standards have long been in place, they have not been fully implemented in many containment systems.
- Requirements for laboratory analysis of respirable silica samples by an ISO 17025-accredited laboratory.
- Construction industry exemption from exposure monitoring for specific operations if engineering and work practice controls and respiratory protection are implemented.
- Options for establishing regulated areas or developing a written access plan (which appears to be very similar to the worker protection plan required by the Lead Standard).
- Addressing training requirements via the Hazard Communication Standard.

The paragraphs in the proposed rule address similar topics (e.g., methods of compliance) of other comprehensive health standards.

The box on p. 53 gives a brief summary of the proposals for General Industry and Shipyards and for Construction. The box highlights some similarities and differences between the two proposals.

Alison B. Kaelin, CQA, has more than 25 years of public health, environmental, transportation, and construction management experience in the coatings industry. She is the owner of ABKaelin, LLC, a Pittsburgh, PA-based provider of outsourced quality assurance, auditing, training, consulting, and related services to the protective coatings, construction, fabrication, and nuclear industries. She is a certified quality auditor, a member of SSPC, and a NACE-certified coating inspector. She was a 2012 *JPCL* Top Thinker, a 2012 *JPCL* Editor's Award Winner, and an SSPC Technical Achievement Award winner in 2005.

<table>
<tr><th colspan="5">OSHA's Proposed Rules for Protection against Crystalline Silica</th></tr>
<tr><th colspan="3">PARAGRAPHS</th><th>GENERAL INDUSTRY/SHIPYARDS</th><th>CONSTRUCTION 1926.1053</th></tr>
<tr><td>A</td><td colspan="2">Scope</td><td>All exposures to silica except construction and agriculture</td><td>1910.12(d) and 1926</td></tr>
<tr><td>B</td><td colspan="2">Definitions</td><td colspan="2">Same</td></tr>
<tr><td>C</td><td colspan="2">PEL</td><td colspan="2">50 μg/m3</td></tr>
<tr><td>D</td><td colspan="2">Exposure Assessment</td><td colspan="2">• Rely on existing data (within 1 year) or objective data that the Action Level can't be exceeded or monitoring must be performed
• Periodic reassessment
• Collection samples using cyclone and analysis per OSHA ID-142, NMAM 7500, 7602, 7603, MSHA P-2 or P-7
• Analysis by ISO 17025 accredited laboratory participating in round robin testing</td></tr>
<tr><td></td><td colspan="2"></td><td></td><td>Not required for Specific Operations if engineering controls, work practices and respiratory protection are implemented per Table 1</td></tr>
<tr><td>E</td><td colspan="2">Regulated Area and Access Control</td><td colspan="2">Establish a regulated area and provide PPE and respirators for all entrants OR develop a written Access Plan</td></tr>
<tr><td rowspan="3">F</td><td rowspan="3">Methods of Compliance</td><td>Engineering Controls and Work Practices</td><td>• Required to reduce exposures to below the PEL using
Wet methods
Ventilation
Enclosures</td><td>Use engineering controls, work practices, and respiratory protection for Specific Operations in Table 1—implement engineering controls and work practices to reduce exposures below the PEL for other operations</td></tr>
<tr><td>Abrasive Blasting</td><td>Implementation of ventilation standards (1910.94, 1915.34 and 1915, Subpart I), as applicable</td><td>In addition to the above, implement ventilation per 1926.57</td></tr>
<tr><td>Cleaning Methods</td><td colspan="2">HEPA or wet cleaning
Prohibition on compressed air without ventilation</td></tr>
<tr><td>G</td><td colspan="2">Respiratory Protection</td><td colspan="2">Per 1910.134 and when exposures are greater than PEL, installation or implementation of engineering controls, when in a regulated area or required by access plan</td></tr>
<tr><td>H</td><td colspan="2">Medical Surveillance</td><td colspan="2">• Required when 30 days above PEL
• PLHCP (Physician or other Licensed Health Care Professional)
• Initial exam within 30 days of exposure
Medical and work history
Physical exam/chest x-ray
Pulmonary Function Test (PFT)
Periodic exams every 3 years or sooner</td></tr>
<tr><td>I</td><td colspan="2">Communication of Hazards to Employees</td><td colspan="2">Include respirable crystalline silica in the Hazard Communication Standard training (29 CFR 1910.1200). Training must
• include access to labels on containers of crystalline silica and safety data sheets;
• discuss hazards, including the following health effects at minimum: cancer, lung effects, immune system effects, and kidney effects;
• ensure affected employees can demonstrate knowledge of exposure producing operations; specific procedures implemented to protect employees, including work practices and respirators and protective clothing; and
• include the contents of the standard; and the purpose and a description of the medical surveillance program.</td></tr>
<tr><td>J</td><td colspan="2">Recordkeeping</td><td colspan="2">• Maintain air monitoring data or objective data and medical surveillance per 1910.1020</td></tr>
<tr><td>K</td><td colspan="2">Dates</td><td colspan="2">Effective dates are expected to be 180 days after the effective date for everything except engineering controls (required within one year of the effective date) and laboratory requirements, which commence two years after the effective dates.</td></tr>
</table>

Photo: Dreamstime

SSPC 2014 Technical Program Unveiled

SSPC's annual conference and exhibition, SSPC 2014 featuring GreenCOAT, will be held Feb. 10–13, 2014, at Disney's Coronado Springs Resort in Lake Buena Vista, FL. This yearly event is the only conference and exhibition dedicated 100% to protective, marine, industrial, and commercial coatings. SSPC 2014 offers a full schedule of training courses, workshops, technical programs, exhibitors, special events, award ceremonies, and networking opportunities. SSPC will also expand its technical program this year with the offering of seven new hour-long "Mini Sessions," which will be held on Wednesday and Thursday mornings.

The following is a list of the technical presentations and workshops that will make up SSPC 2014's Technical Program. For updates, please visit sspc2014.com. Upcoming issues of *JPCL* will continue to preview the conference and exhibition.

Monday, February 10

Afternoon: 1:30–4:30 p.m.

Session 1: Workshop

- "Proper Use of Coatings Inspection Instruments and Visual Guides," by Matt Fajt and Richard Burgess, PCS, KTA-Tator, Inc., 1:30–4:30 p.m.

Session 2: Development and Performance of Complex Coatings

- "Two Coat vs. Three Coat Paint Systems," by Shameem A. Khan, Maryland State Highway Administration, 1:30–2:00 p.m.
- "Industrial Protective Coating Tradeoffs: Understanding Why Industrial Coatings Can Be Complicated," by J. Peter Ault, PCS, Elzly Technology Corporation, 2:00–2:30 p.m.
- "Evaluation of Various Coating Chemistries Using High Temperature Cathodic Disbondmental Testing," by Surojit B. Mukherjee, AkzoNobel, 2:30–3:00 p.m.
- "Development of Linings for High Temperature, High Pressure Applications for Petrochemical Applications," by Ted Moore, PCS, and Mark M. Morrison, The Sherwin-Williams Company, 3:00–3:30 p.m.
- "Anticorrosive Zn Free Pigments: Their Performance," by Dr. Richard March, Nubiola, 3:30–4:00 p.m.

Session 3: Workshop

- "An In-Depth Look at Standards Most Frequently Used by Industrial Painters," by L. Skip Vernon, PCS, MCI, Coating and Lining Technologies, Inc.; and Michael

Damiano, PCS, SSPC: The Society for Protective Coatings, 1:30–4:30 p.m.

Tuesday, February 11

Morning: 8:30–10:00 a.m.

Session 1: Coatings for Ships and Marine Structures, Part I

- "Cavitation Erosion Comparison Between Commercial Paint Coatings and Polyurethane Coatings Containing Nano-Carbon," by Se-Woong Kim, Samsung Heavy Industries Co., Ltd., 8:30–9:00 a.m.
- "DDG 1000: Challenges Associated with Painting the U.S. Navy's State of the Art Destroyer," by Robert Cloutier, Bath Iron Works (BIW), 9:00–9:30 a.m.
- "The Case Study of Foul Release Coating Application and Its Key Issues for the Shipbuilding Industry," by Sang-ki Chi, Samsung Heavy Industries Co., Ltd., 9:30–10:00 a.m.

Session 2: Coating Technology for the Aerospace Industry

- "NASA STD 5008A Qualification of Coatings for NASA's Qualified Products List," by Dr. Mark R. Kolody, NASA Corrosion Technology Laboratory, 8:30–9:00 a.m.
- "Silicones as Protective Coatings," by Brian Burkitt, NuSil Technology, LLC, 9:00–9:30 a.m.
- "Aviation Painting in a Green World" (GreenCOAT), by Terry W. Perry, Florida State College at Jacksonville, 9:30–10:00 a.m.

Session 3: Pipeline Coatings Performance

- "Field and Laboratory Experience with Polyurethane Pipe Linings," by Allen Skaja, Ph.D., PCS, U.S. Bureau of Reclamation, 8:30–9:00 a.m.
- "Finite Element Analysis to Locate Maximum Values of the First and Second Principal Strains in the Tensile Pull-Off Test for Coating Adhesion on Large Pipes," by Stuart Croll, North Dakota State University; and Brent Keil, Northwest Pipe Company, 9:00–9:30 a.m.
- Efficient Polyurethane Pipe Coatings for Harsh Conditions," by Dr. Matthias Wintermantel and Andreas aus der Wieschen, Bayer MaterialScience AG, 9:30–10:00 a.m.

Session 4: Coating Failure Investigations

- "Failure Investigation: Field Sampling and Communication to Maximize the Effectiveness of the Laboratory Analysis," by Rick Huntley, PCS, KTA-Tator, Inc., 8:30–9:00 a.m.
- "The Curse of the Mummy: Mysterious Tank Lining Failures in WAC Vessels," by Mike O'Donoghue, Ph.D., International Paint LLC, 9:00–9:30 a.m.
- "Tank Lining of 3 New Concrete Storage

Tanks: How €350.000 Worth of Tank Lining Turned Into a €1.5 Mio+ Nightmare," by Gunnar Ackx, PCS, Scicon Worldwide, 9:30–10:00 a.m.

Mid-Morning
10:30 a.m.–12:30 p.m.

Session 1: Coatings for Ships and Marine Structures, Part II

• "NSRP Surface Preparation and Coatings Update: Specs to Decks," by Stephen Cogswell, BAE Systems Southeast Shipyards, 10:30–11:00 a.m.

• "A Low VOC and Sprayable Nonskid/Nonslip Coating for the U.S. Navy and Non-Military Markets" (GreenCOAT), by Eric B. Iezzi, Ph. D., Naval Research Lab, 11:00–11:30 a.m.

• "Changing the Corrosion Culture Through Education and Training," by Dan Dunmire, Office of Under Secretary of Defense Acquisition, Technology & Logistics, 11:30 a.m.–12:30 p.m.

Session 2: Assessing and Treating Building Components, Part I
***Sponsored by* Durability + Design**

• "Rules of Removal: Chemical Paint Stripping on Historic Masonry," by Al Morris, PROSOCO, Inc., 10:30–11:00 a.m.

• "Selecting Appropriate Protective Treatments for Finished Concrete Flooring," by Joe Reardon, PROSOCO, Inc., 11:00–11:30 a.m.

• "Increasing Weathering Test Acceleration Through Higher Irradiance," by Allen Zielnik, Atlas Material Testing Technology, 11:30 a.m.–12:00 p.m.

• "Case History—Site Applied Decorative Polyaspartic Flooring in a Residential Garage Floor Application," by Steven Reinstadtler, Bayer MaterialScience LLC, 12:00–12:30 p.m.

Session 3: Concrete Floor Protection

• "Concrete Moisture & Testing: It's All About Keeping Your Floors Above Water!" by Roland A. Vierra, Flooring Forensics, Inc., 10:30–11:30 a.m.

• "Dimensional Profiling: Providing Sustainable Slip Resistance with a Known Approximate Static Co-Efficient of Sliding Friction Value," by Mike Houx, West Coast Industrial Flooring, Inc., 11:30 a.m.–12:00 p.m.

• "Understanding Testing as it Relates to Product Evaluation and Selection in the Polymeric Flooring and Coatings Industry," by Steven Schroeder, Crossfield Products Corporation, 12:00–12:30 p.m.

Session 4: Bridge Protection & Repair

• "FDOT—Metalizing Existing Bridge Structures: Lessons Learned," By Greg Richards, KTA-Tator, Inc.; and Don Buwalda, Florida DOT, 10:30 a.m.–11:00 a.m.

• "When Size Does Matter: An In-Depth Analysis of Brooklyn Bridge Project Data to Determine the Most Efficient Size of

Abrasive Blast Containment Units and the Workforce," by Guerman Vainblat, P.E., Greenman-Pedersen, Inc.; and Timur Kolchinsky, E.I.T., Hirani Group, 11:00–11:30 a.m.

- "Rapid Installation of Replacement Connection Plates on the County of Placer/Foresthill Road Bridge—A Novel Engineered Approach to a Unique Set of Challenges," by Raymond S. Tombaugh, KTA-Tator, Inc., 11:30 a.m.–12:00 p.m.
- "Experimental Beam End Treatment," by Bobby Meade, Greenman-Pedersen, Inc., 12:00–12:30 p.m.
- "Weathering of High Performance Coatings on Florida Bridges," by Paul Vinik, Florida DOT, 12:30–1:00 p.m.

Afternoon
1:30–4:30 p.m.

Session 1: Workshop

- "Failure Analysis of Paints & Coatings," by Dwight G. Weldon, PCS, Weldon Laboratories, Inc.; and Gary L. Tinklenburg, PCS, Tinklenburg Consulting Group, 1:30–4:30 p.m.

Session 2: Assessing and Treating Building Components, Part II
***Sponsored by* Durability + Design**

- "Building Wall and Coating Condition Evaluation," by Kevin Brown and Ken Trimber, PCS, KTA-Tator, Inc., 1:30–2:00 p.m.
- "Commercial Contractor and Applicator Certifications," by Jeff Theo, PCS, Vulcan Painters, Inc., 2:00–2:30 p.m.
- "Preparation of Concrete for Rapid Coating Application," by Fred Goodwin, BASF Construction Chemicals, 2:30–3:00 p.m.
- "Durability of Paint/Coatings on the Exterior of Building Enclosures," by Kevin Knight, Edifice Tutorial, Inc., 3:00–3:30 p.m.
- "Tiffany Metalwork Relies on High-Performance, Environmentally Safe Coating System," by Kurt Wood, Arkema, Inc., 3:30–4:00 p.m.

Session 3: Workshop

- "Confined Space Safety Training," by Charles Brown, Greenman-Pedersen, Inc., 1:30–4:30 p.m.

Session 4: Tools of the Trade: Application and Inspection of Coatings

- "Psymplified Psychometrics," by Robert Ikenberry, PCS, California Engineering Contractors, Inc.; and Don Schnell, DRYCO, 1:30–2:00 p.m.
- "Speed Up Your Dry Film Thickness Measurements Using a Scanning Probe," by John F. Fletcher, Elcometer Limited, 2:00–2:30 p.m.
- "Equipment Factors That Affect Spray Performance," by Eric Rennerfeldt, Graco, Inc., 2:30–3:00 p.m.
- "Robotic Sprayed-in-Place Pipelining: The Polyurea Goes Round & Round," by Dudley J. Primeaux, II, PCS, and Todd Gomez, PCS, VersaFlex Inc., 3:00–3:30 p.m.
- "Flexible Measurement Solutions for Industrial Painting and Inspection

Applications," by Paul Lomax, Fischer Technology, 3:30–4:00 p.m.

• "Specifying Dehumidification for a Blasting and Coating Project," by Brian Battle, Dehumidification Technologies, LP, 4:00–4:30 p.m.

• "Advancements in Intumescent Epoxy Rapid Rise Passive Fire Protection Reduce Labor and Installation Costs," by Gordon Walker, Jotun Paints, Inc., 4:30–5:00 p.m.

Wednesday, February 12

Morning

8:30–9:30 a.m.

Mini Session 1

• "Tank Lining Selection and Application: Old and New Wisdom," by Mike O'Donoghue, Ph.D., International Paint, LLC, 8:30–9:30 a.m.

Mini Session 2

• "Regulatory Update: Current and Emerging Trends in Occupational and Environmental Health," by Alison Kaelin, ABKaelin, LLC, 8:30–9:30 a.m.

Mini Session 3

• "The Gas Fracking Boom: Expanded Opportunities for the Protective Coatings Industry," by E. Bud Senkowski, P.E., PCS, KTA-Tator, Inc., 8:30–9:30 a.m.

Mini Session 4

• "Safe Application of High-Performance Polyurethane Coatings," by Barbara Cummins, Bayer MaterialScience LLC, 8:30–9:30 a.m.

Mid-Morning

10:00 a.m.–12:00 p.m.

Session 1: Surface Preparation Foundations and Methods

• "Lowering the Total Cost of Surface Preparation," by Brad Gooden and Jerry Gooden, Blast-One International, 10:00 a.m.–12:00 p.m.

• "Replica Tape—A Source of New Surface Profile Information," by David Beamish, DeFelsko Corporation, 10:30–11:00 a.m.

• "Educating Customers on the Difference Between Wet Abrasive Blasting and Water Jetting," by Duane Hough, Champion Painting Speciality Services Corp.; and Wade Hannon, Geoblaster Equipment, 11:00–11:30 a.m.

• "Air Balancing is More than a Building Science," by David Simkins, Polygon US Corporation, 11:30 a.m.–12:00 p.m.

Session 2: Perspectives of Women in Business

• "Understanding Your Customer/Client," by Joyce Wright, Newport News Shipbuilding, 10:00–11:00 a.m.

• "Women in Business," by Sarah Huckabee Sanders, Tsamoutales Strategies, 11:00 a.m.–12:00 p.m.

Session 3: Panel Discussion

• Panel Discussion: "Agree to Disagree: Exploring Differing Views on Causes of Coating Failures," 10:00 a.m.–12:00 p.m.

Session 4: Leadership Network Program

• Leadership Network Program, 10:00 a.m.–12:00 p.m.

Afternoon
3:00–5:00 p.m.

Session 1: Workshop

• "Coating Inspector Forum," by Earl Bowry, PCS, Jotun Paints, Inc.; and J. Peter Ault, PCS, Elzly Technology Corporation, 3:00–5:00 p.m.

Session 2: Panel Discussion

• Panel Discussion: "Women in Coatings: The Coatings Industry Impact Awards Panel," moderated by Cynthia O'Malley, PCS, KTA-Tator, Inc.; and Joyce Wright, Newport News Shipbuilding, 3:00–5:00 p.m.

Session 3: Paperless QA (GreenCOAT)

• "Electronic Management of Paint Records—Paperless QA," by James Taylor, Newport News Shipbuilding, 3:00–4:00 p.m.

• "SSPC-PA 2, New Digital Data Collection Solutions," by Joseph Walker, Elcometer Limited, 4:00–4:30 p.m.

• "Robust Functional Paperless Paint," by Ross Boyd, TruQC LLC, 4:30–5:00 p.m.

Session 4: Workshop (GreenCOAT)

• "Waterborne Protective Coatings," by Leo Procopio, The Dow Chemical Company, 3:00–5:00 p.m.

Thursday, February 14
Morning
8:30–9:30 a.m.

Mini Session 1

• "Unique Rigging Application for Suspended Scaffolding," by Clint Ramberg, Spider, 8:30–9:30 a.m.

Mini Session 2

• "Effects of Heat Treatment on the Corrosion Protection Performance of Thermal Sprayed Aluminum Coating," by KyungJin Park, Hyundai Heavy Industries Co. Ltd., 8:30–9:00 a.m.

• "Polyaspartic Coated Galvanized Steel—A Novel and Cost Effective Alternative to Traditionally Coated Steel Structures," by Richard Schertzer, Madison Chemical Industries, Inc., 9:00–9:30 a.m.

Mini Session 3

• "The Benefits of Enhanced Air Quality During Installation of Coatings and Linings," by Matthew M. Barwick, Sunbelt Rentals, Inc.; and Charles B. Summerlin, Carboline Company, 8:30–9:30 a.m.

Mid-Morning
10:00 a.m.–12:00 p.m.

Session 1: Workshop

• "Painting Over Hot Galvanizing with Live Adhesion Testing," by Kevin Irving, AZZ Galvanizing Services; Dee McNeill, The Sherwin-Williams Company; Ted Hopwood, PCS, Kentucky Transportation Center, Univ. of Kentucky; and Todd Williams and Ahren Olson, Bayer MaterialScience LLC, 10:00 a.m.–12:00 p.m.

Session 2: Multifaceted Green Coatings (GreenCOAT)

• "Looking Past the Reflection—Conservation of Energy through Insulation Coatings," by David Hunter, Hunter Engineering Consulting, Inc., 10:00–10:30 a.m.

• "Development of Supercritical CO2 Spray Coating System for VOC Reduction," by EunHa Song, Hyundai Heavy Industries Co. Ltd., 10:30–11:00 a.m.

• "Is Your Waterborne 2K Epoxy Formulation Giving You a Headache? Here is the Cure!" by Dr. Florian Lunzer, Allnex USA, Inc., 11:00–11:30 a.m.

• "Waterborne Coatings with Increased Cross Link Performance," by Dr. Steffen Pilotek, Buhler Group, 11:30 a.m.–12:00 p.m.

Session 3: Business Development and Planning

• "Double Your Business in the Next 12 Months," by Richard Bueckert, KDC Enterprises, Inc., 10:00–11:00 a.m.

• "Basics of Decision—Models in the Making," by Doug Sawyer, CDS Group, LLC, 11:00 a.m.–12:00 p.m.

Session 4: Workshop

• "Protective Coatings—An Overview," by Christopher Farschon, PCS, Tony Serdenes, Kirk Shields, and Ron Queensbury, Greenman-Pedersen, Inc., 10:00 a.m.–12:00 p.m.

Afternoon 3:00–5:00 p.m.

Session 1: Field and Laboratory Testing

• "Volatile Organic Compound (VOC) Content: Are Regulations Beyond What Can Be Accurately Measured?" (GreenCOAT), by Cynthia L. O'Malley, PCS, KTA-Tator, Inc., 3:00–3:30 p.m.

• "Setting the Color Straight," by John W. Winfrey, VersaFlex Incorporated, 3:30–4:00 p.m.

• "Re-Evaluating Electrochemical Impedance Spectroscopy (EIS) for the Field Inspector's Toolbox: A Theoretical Approach," by Bobbi Jo Merten, Ph.D., U.S. Bureau of Reclamation, 4:00–4:30 p.m.

• "Soluble Salt Determination Using the Saturated Filter Paper Extraction Method," by John F. Fletcher, Elcometer Limited, 4:30–5:00 p.m.

Session 2: Coatings for Water and Wastewater

• "Triangle of Trust—Client Driven Coatings Specifications for Wastewater Facilities," by Joe Cesarek and Dan Zienty, PCS, SEH, Inc., 3:00–3:30 p.m.

• "Development of an ASTM Standard for Erosion Testing of Protective Coatings Systems," by David Tordonato, U.S. Bureau of Reclamation, 3:30–4:00 p.m.

• "Adhesion Measurements of Coatings on Cylindrical Steel Pipes: Variablitity and Significance," by Stuart Kroll, North Dakota

State University; and Brent Keil, Northwest Pipe Company, 4:00–4:30 p.m.

• "Galvanic Corrosion in Water & Wastewater Structures: Coupling Stainless and Carbon Metals Leads to Accelerated Corrosion," by Travis C. Tatum, P.E., Dunham Engineering, Inc.; and Vaughn O'Dea, PCS, Tnemec Company, Inc., 4:30–5:00 p.m.

Session 3: Workshop

• "Writing Effective Corrective Actions," by Cory Allen, PCS, Vulcan Painters, Inc., 3:00–5:00 p.m.

JPCL

SSPC 2014 Exhibitors

The following is a current list of companies planning on exhibiting at SSPC 2014 featuring GreenCOAT, current as of press time. For information on exhibiting, please contact Kate Jurik, SSPC Event Manager & Exhibit Sales Specialist, at jurik@sspc.org, or 877-281-7772, ext. 2211.

Abrasives Inc.
Aggreko
AIR Systems International
Allnex
ARID-DRY
ARS Systems
Atlantic Design
Barton International
Belzona Inc.
Benjamin Moore/Corotech
Binks Devilbiss Ransburg BGK
Bullard Co.
Carboline Company
CESCO / Aqua Miser
Chlor*Rid International Inc.
Church & Dwight
Clemco Industries Corp.
CoatingsPro Magazine
Dampney Co. Inc.
DeFelsko Corporation
Dehumidification Technologies, LP
Denso NA
DESCO Manufacturing Co., Inc.
Detroit Tarp
Dex-O-Tex, div. of Crossfield Products Corp.
DoD Office of Corrosion Policy and Oversight
Doosan Portable Power
Dow
DRYCO, LLC
DUSTNET
Eagle Industries
Elcometer
EnTech Industries
Fischer Technology Inc.
FS Solutions Group
Geoblaster Equipment

GMA Garnet (USA) Corp.
Graco Inc.
Green Diamond Sand Products
Greener Blast Technologies
Greenman-Pedersen, Inc.
Harsco Minerals
HippWrap Containment
HoldTight Solutions Inc.
HRV Conformance Verification Associates
IBIX North America
Indian Valley Industries
Industrial Vacuum Equipment Corp.
International Marine & Industrial Applicators
International Paint
JAD Equipment Co.
Jotun Paints, Inc.
Kennametal, Inc.
KTA-Tator, Inc.
Marco
Mascoat
MMLJ
Mohawk Garnet, Inc.
Moisture Control Company
Monarflex by Siplast
Montipower, Inc.
Mosebach Manufacturing Co.
NACE International
National Equipment
Nelson Industrial Services
Novatek Corp.
Olimag Sand
OPTA Minerals, Inc.
Painters & Allied Trades LMCI
Pinnacle Central
Polygon
PPG Protective & Marine Coatings
Pretox Systems/NexTec, Inc.
PTQ Safety Goggles LLC
Rhino Linings Corporation
Ring Power
Rototexx
Royce International
SAFE Systems
Safety Lamp of Houston
SAFWAY Services
Sand Express
SAUEREISEN
Schmidt Engineered Abrasive Systems
The Sherwin-Williams Company
Spider
Sponge-Jet Inc.
SSPC
Sulzer Mixpac USA, Inc.
Surface Prep Solutions
Tank Industry Consultants
Tarps Manufacturing
TDJ Group
Technology Publishing/PaintSquare
Tesla NanoCoatings
The Warehouse Rentals & Supply
Tnemec Company
Trace Industrial Supply, LLC
Tractel Inc., Griphoist Division
TruQC
U.S. Minerals
Van Air Systems
VersaFlex Inc.
Wagner Systems Inc.

SSPC Revises Paint 36, Guide 15

As part of its five-year periodic review, SSPC C.1.3.D, Polyurethane Coatings, chaired by Michael J. Masciale, has recently completed revisions to its Coating Specification No. 36, Two-Component Weatherable Aliphatic Polyurethane Topcoat, Performance-Based, commonly referred to as SSPC-Paint 36.

This performance-based standard sets minimum performance requirements for the specifier to use when selecting a weatherable aliphatic polyurethane topcoat for atmospheric service. It can also be used by coating manufacturers as a benchmark against which to test their coatings.

The technical revisions to the standard are described as follows.

- The requirement for minimum 17% polyisocyanate content in the standard has been eliminated. The AASHTO test method for determining isocyanate content in structural steel coatings is referenced as an optional quality assurance test in note 12.4.2.
- Tables 1, 2, and 3 from the 2006 version have been combined into a single table that contains all of the requirements for weathering performance testing. The requirements themselves have not changed from the 2006 version of Paint 36.
- A table summarizing physical performance test requirements has been created, containing requirements for adhesion testing, direct impact resistance, MEK resistance, and degree of chalking that appeared in the 2006 version of the standard. These requirements have not changed.
- Commentary and explanatory material has been moved out of the body of the standard into the notes section. The organization of the standard is now parallel to that of the 2012 revision of SSPC-Paint 38, Single-

Component Moisture-Cure Weatherable Aliphatic Polyurethane Topcoat, Performance-Based.

SSPC's Technical Committee C.2.15, Guide 15 Revision, chaired by Dr. Lisa Detter-Hoskin of the Georgia Tech Research Institute, also issued revisions to SSPC-Guide 15, Field Methods for Extraction and Analysis of Soluble Salts on Steel and Other Nonporous Substrates. The value of Guide 15 is that it compares the requirements and operating principles of the various methods of extracting soluble salts from steel and nonporous substrates and analyzing the extraction liquid. This Guide allows the specifier to compare the methods and analysis techniques in order to specify the best method to use on a given project.

The technical revisions to Guide 15 are as follows.

- The Guide has been completely reorganized for this revision. The field methods are arranged by the process used for obtaining measurements, with fully automated extraction/calculation methods listed first, followed by multi-step measurement techniques. Multi-step field methods are grouped together, followed by laboratory reference extraction procedures.
- Descriptions of equipment for single-step extraction and analysis have been added, with summary tables describing the generic techniques and analysis methods.
- The 1995 appendix (B.1 in 1995 version) that described calculation of equivalent surface concentration of chloride from conductivity of chloride solution has been deleted. The committee chair has been unable to find published research papers that substantiate use of this conversion practice. The committee accepted the proposed deletion.
- A reference to sonic enhancement of the laboratory boiling extraction method has been added.

To purchase and download the full revised versions of Paint 36 and Guide 15, please visit the SSPC Marketplace at sspc.org/market-place/standards.

Industry Vet Earns SSPC's MCI Status

Kevin Schweikhart of Protective Coating Solutions, Inc., has become just the sixth coatings professional to achieve SSPC's prestigious Master Coatings Inspector (MCI) status. The MCI program recognizes and honors individuals whose experience and training has afforded them the prestige of multiple inspector certifications.

Kevin Schweikhart

To reach the MCI level, one must qualify for certification as a Concrete Coating Inspector (CCI), as well as two of the three other SSPC inspector programs: Bridge Coatings Inspector (BCI), Protective Coatings Inspector (PCI), and the NAVSEA Basic Paint Inspector course (NBPI), which SSPC administers on behalf of Naval Sea Systems Command. Schweikhart is qualified as a CCI Level II, BCI Level II, and PCI Level II inspector.

Schweikhart has over 20 years of experience in the protective coatings industry, working the last 15 years as a construction and materials consultant. His expertise includes technical consulting services for commercial paints, high-performance coatings, and waterproofing wall systems, including elastomeric sealants.

He began his career in the coatings industry as a pot and brush painter, which led to an opportunity at Porter Paints in Tampa, FL. After holding multiple positions from inside sales to outside sales, Schweikhart began his consulting career at a small engineering firm. In 2003, he formed Protective Coating Solutions, Inc., and continued to provide coating consulting services to multiple industries.

Schweikhart has extensive experience in specification preparation for all types of industrial and commercial paint and coating applications. He was President of the Florida West Coast Chapter of the Construction Specifications Institute (CSI) from 1997 to 2000, during which time he attained the status of Construction Documents Technologist (CDT). Schweikhart is also a NACE Level 3 Coatings Inspector, an SSPC Protective Coatings Specialist (PCS), and an approved lead instructor for the BCI, CCI and PCI certification programs.

For more information on how to become a Master Coatings Inspector, please contact Terry Sowers at 877-281-7772, ext. 2219; or e-mail sowers@sspc.org.

JPCL

Seas Water Treatment Facility, Thorn Creek Basin Sanitary District, and the city of Chicago's Jardine Water Purification Plant.

For further information on WEFTEC, please visit the official conference website, www.weftec.org.

Exhibitors

The following is a list of exhibitors known to *JPCL* that may be of interest to protective coatings professionals. The list is current as of press time.

3F Chimica Americas/US Polymers Inc. 2913
A.W. Chesterton Company 2473
American Water Works Association....5054
AP/M Permaform/ConShield Technologies 4423
Arizona Instrument....1005
BASF Corporation....2613
C.I.M. Industries Inc. 4822
Caldwell Tanks Inc. 304
Carboline Company 2317
Containment Solutions Inc. 3216
Denso....3402
Gardner Denver, Inc. 1412
Induron Coatings Inc. 2662
Insituform Technologies Inc. 2633
International Paint....4001
Jack Doheny Rentals 3853
Kerneos Inc. 3953
LaMotte Co. 1008
MPC Containment....3673
MSA, The Safety Company....4746
NACE International....5158
Nelson Environmental Inc. 4018
PPG Protective & Marine Coatings....4172
Quadex Inc....4274
ResinTech, Inc. 5277
RLS Raven Lining Systems....604
Sauereisen, Inc. 3550
Sherwin-Williams Co. 3314
Spectrashield Liner Systems....860
SprayRoq, Inc. 1843
SSPC: The Society for Protective Coatings 3918
Sulzer Pumps....2362
Sunbelt Rentals 3705
Superior Tank Co., Inc. 3151
Terre Hill Composites, Inc. 809
Thermion Inc. 142
Thermo Fisher Scientific 4159
Tnemec Company, Inc. 1437
U.S. Environmental Protection Agency 3078
Vulcan Industries, Inc. 2639

JPCL

Photo courtesy of McCormick Place

Chicago Welcomes 86th WEFTEC

The 86th Annual Water Environment Federation's Technical Exhibition and Conference (WEFTEC) will be held at McCormick Place South in Chicago, IL, October 5–9. Hosted by the Water Environment Federation (WEF), the conference and exhibition is the largest annual water quality event in the world, with this year's event comprising 26 workshops, over 148 technical sessions, an exhibit hall featuring almost 1,000 exhibitors, and more.

Focus areas for the technical sessions and workshops include: Collection Systems and Distribution; Disinfection and Public Health; Energy/Residuals and Biosolids Management; Industrial Issues and Treatment Technologies; Facility Operations and Maintenance; Future Insights and Global Issues; Municipal Wastewater Treatment Process and Design; Research and Innovation; Stormwater Management; Small Communities; Utility Management and Leadership; Water Reclamation and Reuse; and Watershed Resources Management and Sustainability.

Attendees can also observe active projects and site operations during WEFTEC's scheduled facility tours, which include the Cermak Road-Blue Island Avenue Sustainable Streetscape Project, behind-the-scenes tours of the John G. Shedd Aquarium, the Metropolitan Water Reclamation District of Greater Chicago's (MWRDGC) TARP–Thornton Reservoir Project, MWRDGC's Stickney Water Reclamation Plant, Brookfield Zoo's Seven

Photo courtesy of Wikimedia Commons

Citizens Bridge Rehab Contract Awarded

Advanced Painting Systems, Inc. (Allison Park, PA), SSPC-QP 1 and -QP 2 certified, and the Pennsylvania Department of Transportation have reached an agreement on a $4,706,071 contract to rehabilitate the Citizens Bridge. Opened in 1932, this historic 949-foot-long by 30.5-foot-wide steel through truss bridge crosses the Allegheny River, connecting Kittanning and West Kittanning, PA. The bridge was last rehabilitated in 2010.

The contract includes cleaning and recoating approximately 295,000 square feet of structural steel surfaces. The steel will be abrasive blast-cleaned to a Near White finish (SSPC-SP 10), tested for soluble salt with as-needed chloride remediation, and recoated with a three-coat organic zinc-epoxy-urethane system selected from NEPCOAT List B. Containment according to SSPC-Guide 6 and waste disposal according to SSPC-Guide 7 are required to dispose of the bridge's existing lead-based coatings. Approximately 180 square feet of top flange steel surfaces will also be Commercial power tool-cleaned (SSPC-SP 15), vacuum-shrouded power tool-cleaned to SSPC-SP 3, and spot-coated with an organic zinc-rich primer. The contract also includes additional spot and maintenance coating application, as well as 3,165 square yards of epoxy-based surface treatment for bridge deck surfaces.

Water Tank Quick Hits

- New England Pipe Cleaning Co. (Watertown, CT) won a $1,220,000 contract from the Town of Weymouth, MA, to clean and recoat interior and exterior surfaces of the 1.29 MG Ash Street water storage tank and the 2 MG Pleasant Street water storage tank. Containment is required to capture the tanks' existing lead-based coatings.
- The City of Monticello, IN, and V & T Painting, LLC (Farmington Hills, MI) reached an agreement on an $884,600 contract to clean and recoat interior and exterior surfaces of three 500,000-gallon elevated water storage tanks and one standpipe water storage tank. The interiors will be abrasive blast cleaned and recoated with a three-coat system, while the exteriors will be pressure washed, spot-power tool-cleaned, and recoated with a four-coat system. The existing coatings contain lead; containment is required.

Western Industrial to Recoat Dam Piping

The California Department of Water Resources awarded an $888,631 contract to Western Industrial, Inc. (Mukilteo, WA), SSPC-QP 1 and -QP 2 certified, to clean and recoat 525 feet of 70-inch-diameter outlet works piping at the Los Baños Creek Detention Dam. Opened in 1965 and located in California's Central Valley, the dam and reservoir collect water sourced from the slopes of the Diablo Range mountains.

The contract includes cleaning and recoating the interior and exterior of the piping with a 100%-solids elastomeric polyurethane coating system. The contract also includes recoating a downstream side emergency release slide gate, the upstream sides of two discharge slide gates, expansion joints, ladders, handrails, exterior surfaces of a bypass line, air inlet piping, ventilation piping, an HP gate cylinder, and HPU control piping inside the gate chamber, as well as recoating a 9-foot-diameter drop intake bulkhead gate (plug). Lead abatement and containment are required to dispose of the existing lead-based coatings.