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The Society for Protective Coatings

FEATURES

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SSPC 2020 STRUCTURE AWARDS SERIES

THE GOVERNOR MARIO CUOMO BRIDGE AND THE BAYONNE BRIDGE

The final installment covering the 2020 SSPC Structure Award-winning coating projects, this article describes the work on two New York City-area bridge projects that received honors: the Governor Mario Cuomo Bridge, which won the Eric S. Kline Award for an outstanding project involving coating in the shop, and the Bayonne Bridge, winner of the George Campbell Award for a difficult or complex project.

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HOW TO PREQUALIFY A CUI COATING CHOICE

By Simon Daly, Hempel A/S

One of the major challenges facing equipment operators in the process industries is corrosion under insulation, and choosing the optimal coating for protection against CUI is a complex affair. This article will discuss different coating tests with the aim of defining which methods can be used to simulate CUI conditions in the laboratory, and how to evaluate a coating material's performance under related conditions.

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UHP WATERJETTING

THE OLDEST NEW SURFACE PREP METHOD

By Brady DeRoche, Innovative Surface Prep

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The JPCL Coating Systems Buying Guide for Concrete provides details about high-performance coating systems suitable for concrete substrates for bridges and highways, in chemical and petrochemical plants, food and pharmaceutical plants, power plants, pipelines, wastewater facilities, waterfront locks and dams, and water works, as well as specialty-function applications.

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Thermal Spray Inspection Basics

BY MICHAEL DAMIANO, SENIOR TECHNICAL ADVISOR, SSPC

The best practices described herein are taken from SSPC's thermal spray inspection training course, designed for the experienced coating inspector who has little or no experience inspecting industrial thermal spray applications on steel.

THERMAL SPRAY PROCESS

Thermal spraying is a group of processes where the thermal spray feedstock (aluminum, zinc or a combination of alloys developed in the form of a wire or powder) is heated, atomized and propelled by a conveying gas stream and deposited to form a thermal spray metallic coating (TSC) on the cleaned steel. Electric arc spraying is the most common application method, although flame spray is sometimes used. This article focuses on arc spraying.

While the inspector does not have to be an expert on arc spray equipment operation, they should become familiar with the equipment the contractor is going to use to ensure that the spray gun is clean and operating properly. TSC spray equipment, whether it is a handheld nozzle unit or a robotic unit, is not at all like airless or conventional spray pumps used to spray liquid coatings.

SURFACE PREPARATION

As with any coating application, surface preparation is critical. Before beginning surface preparation, it is important for the inspector to check ambient conditions and surface temperature, as is done with any coating application, to ensure that the steel temperature is at least 5 F (3 C) above the dew point and not falling. Oftentimes, this differential is mandated by contract.

Relative humidity should not exceed 85%, and the surface temperature cannot fall below 50 F (10 C). For optimal adhesion, it is important that thermal spray be done on a clean and dry surface.

While the inspector does not have to be an expert on arc spray equipment operation, they should become familiar with the equipment the contractor is going to use.

SSPC-SP 1

TSC can only be applied on abrasive blast-cleaned surfaces where a deeper-than-usual, angular surface profile is imparted. The first step in the blast-cleaning process (once the condition of the steel is accepted for TSC application) is to remove all visible grease, oil, lubricants and cutting compounds using an approved solvent. While SSPC-SP 1, Solvent Cleaning, only requires visible inspection, for TSC applications it is recommended that an additional test or combination of tests such as the Cloth Wipe, Black Light or Water Break (ASTM F22) Tests be performed to supplement any visual inspection.

In addition to checking for oil and grease, the air used for abrasive blasting and blow-down should be checked using the ASTM D4285 Blotter Test for oil and water contamination to ensure clean, dry air. The inspector should document date, time and test result. Some inspectors mark and keep the blotter paper, while some simply take a photo.

The blasting abrasive should also be checked to ensure that it is the correct mesh size and shape to generate the angular profile specified. The abrasive material must also be tested for contamination per the field-testing requirements (oil and water and conductivity) of SSPC-AB 1, 2 and 3. Many specifications will also require chemical testing of the steel for conductivity or specific soluble salts such as chloride, sulfate or nitrate prior to abrasive blast-cleaning.

Once the above testing is satisfactory, blast-cleaning to either SSPC-SP 10/NACE No. 2 or SSPC-SP 5/NACE No. 1 can be completed immediately prior to TSC application, unless the use of dehumidification is allowed to preserve the blast-cleaned surface for a longer period.

SURFACE PROFILE

The surface profile depth required for TSC coating is usually higher than the profile required for liquid coatings application. Industry standard SSPC-CS 23.00/AWS C.2.23/NACE 12 calls for a minimum profile of 2.5–5 mils (64–127 microns). For special TSC applications such as those for nonskid flight decks, NAVSEA Standard item 009-124 calls for the surface profile to be between 5–10 mils (127–254 microns).

The TSC inspector will normally check the profile using either ASTM D4417, Method B or Method C. Method B is more appropriate for higher profiles. NAVSEA Standard item 009-124 requires profile to be measured using the stylus method (ASTM D7127 or D4417 Method D), which reads profile and peak count. The number and location of measurements taken will be in accordance with SSPC PA-17 or specification requirements.

After blow-down, some specifications will call for checking the surface for dust, which can be done using a clear tape test or a more formal process such as ISO 8502-3.

APPLICATION

Besides checking to make sure the specified surface preparation and profile is acceptable, it's important for the inspector to verify that the specified wire alloy is going to be sprayed, as well as adhere to the following processes.

Thermal spray coating typically requires several pre-application processes to help ensure the success of the application. SSPC-CS 23.00 describes the Job Reference Standard used in TSC applications. The JRS is a pass/fail representative test panel of the entire project or major sections of the job. The JRS is essentially a steel plate that's prepared for each application by a qualified thermal spray operator. Both the contractor and the inspector use the JRS as a "comparator" to evaluate the quality of the application as work progresses.

The JRS is made with actual field equipment following surface preparation and TSC applicator parameters. The JRS should be retained until the project is completed.

INSPECTING APPLIED TSC BEND TEST

The bend test is a qualitative test (180-degree bend on a mandrel) that is used to determine if proper surface preparation, equipment set-up and spray parameters have been put into place. After being sprayed, the coupons are bent in the mandrel. The test is successful if there is no cracking or spalling, or only minor cracking that cannot be lifted with a knife blade. CS 23.00 provides a diagram that illustrates what pass/fail looks like after each bend.

The bend test is a qualitative test that is used to determine if proper surface preparation, equipment set-up and thermal spray parameters have been put into place. COURTESY OF SSPC

CUT TEST

Some specifications require the contractor or inspector to conduct a cut test. The TSC cut test, which tests for bonding, consists of a single 1 ½-inch-long cut, using a chisel or other cutting tool, through the coating to the steel without cutting the steel. The bond is considered unsatisfactory if any part of the TSC along the cut lifts from the steel

HOLD POINTS

The TSC inspector should write an inspection plan with hold points to ensure that the TSC application remains compliant throughout the process. Typical hold points, depending on contract requirements, include:

- Pre-Surface Preparation—Proper Feedstock, Ambient Conditions, Abrasive Cleanliness, Size and Shape, Compressed Air Cleanliness;
- Surface Preparation—Surface Cleanliness, Soluble Salt Contamination, Surface Profile and Peak Count; and
- Application—Compare Coating Thickness, TSC Appearance and Tensile Adhesion with JRS, Bend Tests.

Best practice requires the inspector to check or witness the initial check of the TSC for the specified film thickness and ability to pass the bend tests before proceeding with any work.

Bend tests and film thickness tests are always recommended at the beginning of a shift or a crew change and periodically thereafter.

The inspector should use an SSPC-PA 2 Type 2 gage, designed to measure TSC, to measure film thickness. The inspector should check with the gage manufacturer to make sure that they have the correct probe for measuring thick-film TSC.

Film thickness should be measured in accordance with SSPC-PA 2, Level 4. This means that acceptable measurements are between 80% of the minimum specified FT and 150% of the maximum DFT range—as long as the area average is within the specified DFT range.

> The TSC inspector should write an inspection plan with hold points to ensure that the TSC application remains compliant throughout the process.

If the film thickness is too high, adhesion testing in accordance with ASTM D4541 may be required to assess whether adhesion is adequate. Do not measure TSC on a typical high spot or irregularities, such as splatter. A non-conformance report should be written, followed by a discussion with the facility owner to decide how the high thickness should be handled. The specification may provide a repair procedure if it is decided that any high spots should be repaired.

Adhesion testing is often required for TSC applications in accordance with ASTM D4541, Type III, IV, V or VI. This testing can be done on the JRS. The specification should provide acceptance criteria for adhesion testing (e.g., 700 psi [4.83MPa] or 1,000 psi [6.89 MPa]), depending on the kind of wire sprayed.

To provide stronger barrier protection, some specifications will require the contractor to apply a sealer to penetrate the porosity of the TSC. The TSC may also be top coated with a liquid coating for identification purposes such as markings on a flight deck. **JPCL**

CYNRAIN / GETTY IMAGES

SSPC Expands Global Outreach Through Translations

BY PAMELA GROFF, TECHNICAL MATERIALS DEVELOPMENT SPECIALIST AND MELISSA PINOLINI, TRAINING AND CERTIFICATION SPECIALIST, SSPC

SSPC continues to expand its international reach by offering many courses, exams and standards in a variety of languages. This initiative began almost eight years ago when the organization developed Spanish and Portuguese versions of its Coating Application Specialist exams, primarily for contractors in the U.S. Since then, SSPC has partnered with a number of subject matter experts and professional translators across the world to further widen the range of technical materials available in Chinese, Japanese, European and South American Spanish, Brazilian Portuguese, French Canadian, Greek, Arabic, Turkish and Bahasa (Malay).

Assembling the right team to create an accurate translation requires bringing together project managers, technical subject matter experts and bilingual translators who are not only fluent in reading and writing in English and the target language, but also familiar with the technical content. Project managers ferry comments back-and-forth between translators and SMEs in search of the perfect words as the translation evolves. Some English words have no equivalent in other languages. Others do, but regional nuances impact understanding. Mediating these discussions is one of the most important aspects of the project manager's job in shepherding the translation toward success.

Project managers also oversee the correct transfer of the layout and illustrations from English into the target language. This involves ensuring that every table, footnote, caption and callout have been translated and are in the proper places, as well as checking that all mathematical equations are complete when the document is typeset. The ultimate goal is to create a mirror of the original English SSPC document in another language and to have every foreign translation of that document match each other in the clarity of the explanations and instructions provided.

Many of SSPC's exams, including the Abrasive Blaster Certification (C7) and Spray Application Certification (C12), have been translated into Arabic, Bahasa, Japanese, Portuguese and Spanish. These are available to students upon request at registration. An SSPC exam will pass through multiple quality checkpoints to ensure the formatting is readable. Placing the English language copy in one column and the target language in another is a tremendous aid in helping students understand the exam material while improving their language skills for the coatings industry. It also helps instructors reinforce key concepts in the classroom.

> SSPC translations reach the international membership in many ways.

Thus, the work doesn't end once the translation is completed. SSPC pilots translated exams, course materials and standards with focus groups of students and other member stakeholders. Watching and assisting students as they work through the course materials under the guidance of bilingual instructors is just one additional control put in place to be certain that SSPC is providing the best educational tools possible. Roundtable discussions after courses and exam testing also supply helpful feedback that may improve translation quality.

SSPC's international chapters frequently provide the impetus for translating a course, exam or standard. There may be a demand for fireproofing training in China or wet abrasive blasting standards in Brazil or Argentina. According to Jim Kunkle, Manager of SSPC Business Development, "International members of SSPC have chartered eight new chapters over the past five years, seven of which are in Central and South America. Those chapters have been instrumental in identifying certifications, training programs, standards and other materials that needed to be translated in additional languages." SSPC also relies on the international chapters to review translated documents and generate feedback for improving them.

SSPC translations reach the international membership in many ways. Three key SSPC courses—Fundamentals of Protective Coatings (C1), Planning and Specifying Industrial Coating Projects (C2) and Quality Control Supervisor (QCS)—are now available online in Spanish for students to work through at their own pace. Likewise, the PCI Level 2 and Level 3 Recertification Exams are available online in Chinese and Turkish, giving those students a quick way to keep their certifications current.

The SSPC surface preparation standards, plus SP 5 (WAB), SP 10 (WAB), QP 1, QP 3, PA 2, and AB 1, 2, 3, and 4 are among those standards recently translated into Spanish and Portuguese. SSPC-VIS 3 was released as an English, Spanish, Portuguese combination in January 2020 and VIS 1, 4, and 5 will be released in the same format soon. The SSPC Argentina Chapter is also in discussions about what additional materials they would like to have translated.

During the pandemic, a PCI Spanish class was held as live instructor-led virtual training while C1 and C2 in English were also held virtually. Technology and translations are expected to continue the growing global scope of coatings training into the future.

For more information on SSPC translations, visit the FAQ page on sspc.org. JPCL

SSPC COURSES (Course information available at sspc.org)

Nov. 2–6	CCI Conc Ctgs Insp, Gibsonia, PA
Nov. 9–12	C3 Lead Pt Removal, Peachtree Corners, GA
Nov. 9–13	NBPI NAVSEA Basic Pt Insp, Portland, OR
Nov. 9–13	PCI Prot Ctgs Insp, Rotterdam, Netherlands
Nov. 9–15	PCI Prot Ctgs Insp, Pattaya, Thailand
Nov. 10–12	CAS Coating App Spclst, Zephyrhills, FL
Nov. 11–12	C7 Abrasive Blast, Theodore, AL
Nov. 11–12	C12 Spray App (Spanish), San Diego, CA
Nov. 13	C6 Lead Pt Refresher, Peachtree Corners, GA
Nov. 13–14	C14 Marine Plural Comp App, San Diego, CA
Nov. 13–14	C12 Spray App, Theodore, AL
Nov. 13–15	CA5 Ctg App Spclst, Apache Junction, AZ
Nov. 14	Lead Pt Worker Safety, Duluth, GA
Nov. 16–18	CAS Ctg App Spclst, Portland, OR
Nov. 16–20	NBPI NAVSEA Basic Pt Insp, Vallejo, CA
Nov. 16–22	PCI Prot Ctgs Insp, Newington, NH; Petaling Jaya, Malaysia
Nov. 16–28	PCI Prot Ctgs Insp, Singapore
Nov. 30–Dec. 3	C3 Lead Pt Removal, San Diego, CA
Nov. 30–Dec. 4	NBPI NAVSEA Basic Pt Insp, Norfolk, VA
Nov. 30–Dec. 6	PCI Prot Ctgs Insp, Saskatoon, SK Canada

CONFERENCES & MEETINGS

Nov. 8–12	ESWP 2020 Virtual International Water Conf, eswp.com/water
Nov. 9–13	AASHTO Virtual Annual Mtg/Trade Fair, transportation.org
Nov. 10–12	PaintSquare Connect, paintsquare.com/psc
Nov. 10–12	Greenbuild Virtual 2020, greenbuildexpo.com

"No Objection"

SAYS PA AG TO SSPC/NACE COMBINATION

ANTONIOM / GETTY IMAGES

SSPC: The Society for Protective Coatings and NACE International, The Worldwide Corrosion Authority, announced in late September that the Pennsylvania Office of Attorney General issued a statement of no objection to the combination of the two organizations. This represents the last approval needed to combine the associations.

In April, the members of SSPC and NACE voted affirmatively to move forward with the proposed combination of the two organizations. By the end of May, 13 integration teams were established to build out recommendations for how to integrate the various aspects of each organization. The official transition to one organization is expected to take place on Jan. 1, 2021, with complete integration of the organizations expected to occur in intervals beyond that date.

One of these integration teams, the "NewOrg" Certifications Integration Team, is focused on integrating the existing certifications for inspectors, applicators and specialists, and its recommendations are intended to be completed by January 2021. The Combination Proposal, approved by the members of both organizations, outlines a few guiding principles, which the Certification Team will continue using as it makes its recommendations, including:

- All current SSPC and NACE certification and accreditation programs will continue to be recognized and supported through the combination process.
- Existing certification holders will be provided with a path to recertify into the continuing program, when their certification comes due. Until the "NewOrg" certification program is launched, the cardholder will recertify under their respective program.
- Financial burden or economic impact to certified and accredited parties should be minimized.

The "NewOrg" Certifications Integration Team (the member task force mentioned above) is currently focused on the following certifications:

- Inspector Certifications such as NACE CIP and SSPC PCI;
- Applicator Certifications such as SSPC CAS and NACE CCA; and
- Specialist Certifications such as NACE PCS and SSPC PCS.

For each set of certifications, the team is conducting program evaluations including a broad gap analysis and examination of all aspects of each program. Once this evaluation is complete, the team will begin developing recommendations for approval by the Transition Team. These recommendations are intended to be completed by the end of January 2021.

Existing certification programs will continue to be supported until a new process is approved and an implementation schedule is created and shared with certification holders. In the meantime, all certification holders should keep their certifications current.

If you have comments/feedback for the "NewOrg" Certifications Integration Team, please email cooperation@sspc.org or cooperation@nace.org, or register and attend one of the upcoming online Town Hall meetings at sspc.org:

- Tuesday, Nov. 10, 6 a.m. Central;
- Thursday, Nov. 12, 1 p.m. Central;
- Monday, Dec. 14 10:30 a.m. Central; and
- Thursday, Dec. 17, 6 a.m. Central.

BEEKEEPING IN THE TIME OF COVID-19

BY ALISON B. KAELIN, CQA, ABKAELIN, LLC

Bet you expected another boring regulatory article, huh?

Ken Tator told me back in 2010 that we should start keeping bees. We read a few articles on the topic, but ultimately, I shelved the idea away until that time when you "have time." I opened my business in 2013 and have not had time to think of much besides building my business.

In 2019, though, I started trying to do some of the things I wanted to, like gardening, hydroponics, worm composting and growing milkweeds to try to help stem the inevitable effects of climate change.

Then, Stacy got me a hive box for Christmas. She said, "It was time" and "now or never," and I took the plunge. I bought beekeeping books, more "basic" equipment and enrolled in bee websites and classes. I joined a local beekeeping group and ordered my bees for delivery in the spring.

From January through March and the beginning of the COVID-19 pandemic, we built and painted bee boxes, stands, supers and frames. My dining room and garage were full of equipment. I completed online beekeeping courses instead of the one-on-one training and mentorship I had planned. I converted part of my urban backyard into an apiary.

In April, I took delivery of my bees and fed the bees until "nectar" flow was achieved. Since then, I have planned, performed and documented biweekly hive inspections. These are necessary to monitor the healthy progress in colony growth, to check and treat them for parasites and the many illnesses that plague today's honeybees. As the hive grew, I added capacity (or supers) for the bees to expand and to use to store the nectar and pollen that would eventually become honey.

The process of beekeeping presents many similarities to protective coatings work.
PHOTOS COURTESY OF ABKAELIN, LLC

Boxes (left) house multiple honeycomb-filled frames and serve as the "containment" system. Beekeeping requires its own set of PPE (right).

There have been stings (earlier today, I got stung on the eyebrow), weird bee behavior and issues that were not covered in my online classes or books. I have had to reach out to various subject matter experts and master beekeepers to mentor and guide me through potential loss of one of my queens, the excessively hot weather and other newbie questions.

This new adventure in beekeeping has made me think about its many similarities to my work in asset protection and coatings projects. I'll explain some of these similarities, and we can see what lessons we might be able to apply from one situation to another.

DRAWINGS AND SPECIFICATIONS

Langstroth beehives are generally two deep boxes (where the bees live) and multiple supers (where extra honey is stored). In each box

are 8–10 frames that the bees draw out to create honeycombs to lay eggs and store honey. They must be built to standard specifications and painted to protect them from weather. These boxes are like the containment system used in protective coatings projects; they both provide an environment where the work can take place, while simultaneously protecting the workers and the surrounding environment.

The bee books and manuals are like our industry's technical standards and specifications. They provide guidance for every step of the process, from the construction of the boxes to the sequence and steps of inspection and asset management.

TRAINING AND MENTORSHIP

I consider myself to be a pretty smart person, so when my in-person classes were cancelled due to COVID-19, I figured I could read and watch enough videos to replace in-person and hands-on training with an experienced beekeeper.

When it came to having 60,000 mad bees flying around my head, though, I knew the words and lingo, but did not have the experience or craft skills to go with it. For example, on every inspection, you want to see the queen or evidence that there is a queen through eggs and larvae. For the first few weeks, I could not see anything during the inspections except bees. I had to record video of everything and look at it later to confirm that things were okay.

There have been countless other conditions in the hive that I needed experience to manage. For example, is that weirdly shaped "thingy" a queen cup (which is like an isolated drip of paint and would be no biggie), or is it a queen cell, which means your queen is dead (such as serious corrosion of a critical member).

Fortunately, I found a neighbor with four years of beekeeping experience, who has been mentoring me. Similarly, we in the coatings community should seek advice from those who have more experience than us—or be willing to mentor newbies alike.

Each bee in the "workforce" plays a role. Developing and following a plan will lead to a satisfactory final product.

WORKFORCE

Most new hives are started with a package (bees with a random queen) or a "nuc" (five frames of bees, with a queen, that have survived the winter). Just like a work crew, a bee colony is all about the team (the worker bees) and good leadership (the queen). A good-laying queen keeps the hive productive and growing. A weak or damaged queen cannot lay enough eggs to maintain a healthy colony.

I have seen both scenarios in the field on coatings projects. Good leadership is the key to successful project completion and growth. Conversely, bad leadership affects the entire team and can drive a project in a negative direction.

SCHEDULE/LIFE CYCLE

Beekeeping, like asset protection, has both schedules and cycles to it. Asset protection starts with initial fabrication, surface preparation and coating application, followed by a maintenance schedule and life cycle.

INSPECTIONS/CORRECTIVE ACTIONS

Like coating inspection, bee inspections are programmatic. You need to plan what you need to do; before you open that hive of 60,000 mad bees. You must understand what exactly you are looking for, how much time you can devote to it, what the conditions will be and what tools you will need. When things go wrong—and they will in both—you need know what to do when things are not as expected or specified.

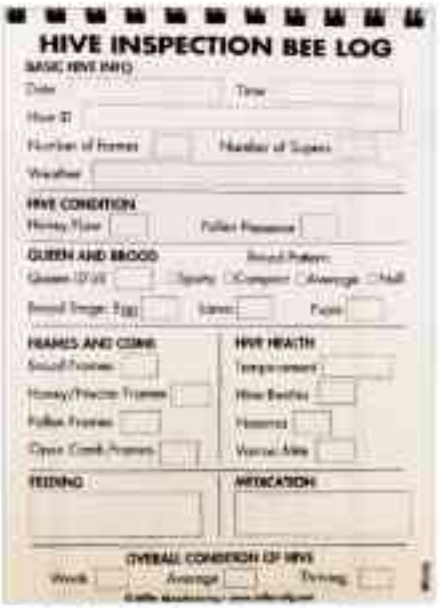
Before every inspection, I go through an inspection plan to make sure I remember to do everything that needs to be done. I must

BEEKEEPING LIFE CYCLE	ASSET PROTECTION LIFE CYCLE
Obtain plans and materials	Develop specifications/drawings
Build the hive	Fabricate
Paint the hive	Surface preparation and coatings
Install the bee	Workers
Inspect the bees	Coating inspection
Maintain hive books of inspections/results	Coating inspection documentation
Corrective actions	Corrective action
Treat the bees	Touch-up
Maintain the hive throughout each season	Preventive maintenance
Inspect the bees	Coating inspection
Corrective actions	Corrective action

BEE INSPECTION	COATINGS INSPECTION
Plan inspection	Inspection plan
Wear a bee suit, hood and gloves	Wear appropriate PPE
Remove boxes/frames for inspection	Adequate lighting, access, etc. for inspection
Use smoker, hive tool visual examinations and test kits to evaluate condition of hives	Use coating inspection equipment to verify hold points have been met
Respond to adverse conditions	Respond to non-conforming conditions
Document inspection	Document inspection
Repeat based on season, weather, bees, etc.	Repeat based on schedule, hold point, etc.

gather and prepare my equipment, hive tool, smoker, tests, medicines and feeders or new boxes. I have put on my PPE, consisting of a bee jacket, gloves and veil. Once equipped, you need to approach and remove the boxes from the hive in a specific order, then remove a couple of frames to provide space and to inspect the bees, and then repeat.

This is like doing planned and focused coating inspections. Well before the actual inspection, you need to don equipment, access the work area, make sure you have your tools and then get it done. When something is wrong, you need to fix it as soon as possible and document it.



"Beehive Logs" mirror coating inspection reports.

DOCUMENTATION

Records are essential. I have a formal "Beehive Log" to complete for each hive inspection, not unlike a NACE inspection logbook or coating inspection report. I use it to plan my next inspection and make sure I have any tools, equipment or treatments needed. I am constantly taking photos and videos of my bees and inspections to make sure I do not miss anything and to show to my mentors when I encounter problems and successes.

CONCLUSIONS

Beekeeping in the time of COVID-19 has reminded me of the keys to coatings project management and asset protection:

- Good standards and specifications;
- Quality workforce and leadership;
- Schedule and life cycle;
- Planned inspection and corrective actions; and
- Documentation.

Even then, the best prepared beekeeper may encounter unexpected problems that require corrective actions or change in management to maintain a successful hive. But when all of the right factors are in place and applied properly, it can be a success.

Just last week, I harvested multiple pounds of honey from one of my two hives and am now happily eating the fruits of my bees' labor. Hope you are staying safe! **JPCL**

SSPC 2020 STRUCTURE AWARDS SERIES

The Governor Mario Cuomo Bridge and The Bayonne Bridge

EDITOR'S NOTE: The annual SSPC Structure Awards recognize the work of teams of contractors, designers, end users and coating manufacturers for excellence on protective coatings projects. The 2020 Structure Awards were presented Feb. 3 during the annual awards luncheon at SSPC Coatings+ 2020 in Long Beach, California. This is the final installment of the 2020 series, which has profiled each award-winning project in detail.

GOVERNOR MARIO CUOMO BRIDGE

GOV. MARIO CUOMO BRIDGE PROJECT AT A GLANCE
Structure Owner: NY State Thruway Authority
Contractor/Applicator: W&W/AFCO Steel, Canam-Bridges
Touch-Up Applicator: Jag'd Construction
Coating Material Supplier: Sherwin-Williams Protective and Marine
Consultant: HDR Inc.
Engineer: American Bridge Co.

The Eric S. Kline Award, given for outstanding achievement in industrial coatings work performed in a fixed shop facility, was awarded for work on the Governor Mario M. Cuomo Bridge, also known as the New Tappan Zee Bridge, spanning the Hudson River between the Tarrytown and Nyack, New York.

This new twin cable-stayed bridge was designed to replace the original Tappan Zee Bridge, which was built in 1955 and had outlived its intended service life. With a span of more than three miles, the new bridge—the longest in the state of New York—presented a large amount of steel for construction, which in turn required protection from corrosion.

Protective coatings were provided for numerous steel girders, with each member ranging in typical size between 12–14 feet wide by 90–120 feet long. Before application, steel was abrasive blast-cleaned to an SSPC-SP 10/NACE No. 2, Near White Metal finish. A three-coat system composed of an organic zinc-rich epoxy primer, a polyamide epoxy intermediate and an acrylic polyurethane topcoat was applied at 3–5 mils DFT per coat—except on the exteriors of the fascia girders and in designated high-corrosion areas, where the intermediate coat was increased to 6–10 mils DFT for added durability.

Those involved in the project said that blasting and coating the steel in the shop, rather than after it was erected, enabled more uniform applications and thorough inspections, providing efficiency, quality and safety benefits. They also said that because most coatings were applied offsite, minimal onsite application was needed, except for touching up connection points and any potential coatings damage incurred during construction.

In addition, they said that the selection of an organic zinc primer over inorganic zinc improved dry and recoat times, reduced stripe coat times and accelerated inspections. In particular, the choice of the intermediate coat enabled wet-on-wet applications following stripe coating to enhance efficiencies, as well as the ability to apply higher DFTs in a single coat. The system, which complied with New York State Department of Transportation specifications, is expected to have a service life of 25 years or more.

The Governor Mario Cuomo Bridge, also known as the New Tappan Zee Bridge, is the longest bridge in the state of New York.

Below: Individual steel sections for the new bridge were prepared and coated in the shop before being sent to the field for erection. The coating system chosen allowed for shorter recoat windows.
PHOTOS COURTESY OF SHERWIN-WILLIAMS PROTECTIVE & MARINE

The coating system chosen allowed for shorter recoat windows, which added to the ease of the shop application.

SSPC 2020 STRUCTURE AWARDS SERIES

BAYONNE BRIDGE

BAYONNE BRIDGE PROJECT AT A GLANCE
Structure Owner: The Port Authority of New York and New Jersey
Contractor/Applicator: Ahern Painting Contractors Inc.
Coating Material Supplier: PPG and Carboline
Engineer/Consultant: Greenman-Pedersen, Inc.
General Contractor: Skanska Koch Kiewit JV

The George Campbell Award honors outstanding achievement in the completion of a difficult or complex industrial or commercial coatings project. One of this year's Campbell Awards was presented to those involved in rehabilitation work on the Bayonne Bridge, which connects Bayonne, New Jersey, and the New York City borough of Staten Island. Opened in 1931, the 5,780-foot-long bridge is currently the fifth-longest steel arch bridge in the world. In addition to providing cross-state traffic in and out of New York City, it also allows clearance for cargo ships seeking passage underneath into the NYC metro area's numerous ports.

The roadway of the Bayonne Bridge had to be lifted in order to accommodate larger shipping vessels passing underneath. PHOTOS COURTESY OF AHERN PAINTING CONTRACTORS INC.

After a highly complex six-year rehabilitation project, the Bayonne Bridge's new roadway, protective coatings and related improvements were complete.

SSPC 2020 STRUCTURE AWARDS SERIES

Pictured, from left: SSPC President Joe Walker; Jeff Anderson, Carboline; Marty Kittle, Ahern Painting Contractors Inc.; and Dale Zarcone, PPG Protective & Marine Coatings. COURTESY OF SSPC

Around 2006, plans for the widening of the Panama Canal were put into motion to accommodate for the larger, new generation of "Panamax" shipping vessels. Unfortunately, the typical height of these ships exceeded clearance levels of the Bayonne—threatening to cut off port access for commerce into the area. After a U.S. Army Corps of Engineers study determined that raising the roadway of the Bayonne Bridge from its original 155 feet to 215 feet above water was the best solution to allow clearance of Panamax vessels, bridge improvement work commenced in 2013—including extensive cleaning and repainting.

The project required that the bridge remain open to both road and maritime traffic during construction to minimize the local economic impacts. On top of new roadway construction, steel repairs, new railings, lighting and other components, and community enhancements including a pedestrian walkway and bike path over the bridge were also part of the contract.

The existing arch was contained and the existing lead-based coatings were removed and abated using recycled steel grit in 2014. Much of the original primer was intentionally left intact to facilitate structural steel repairs. New steel towers, bearings, suspender ropes and an entirely new roadway and bearings were constructed, coated and touched up from 2014 through 2018.

In 2018, the arch structure below the roadway was re-contained and prepared in accordance with SSPC-SP 7/NACE No. 4, Brush-Off Blast Cleaning, using expendable abrasive, before the finish coats were applied. During this phase, an epoxy intumescent fire protection coating was also applied to further protect critical elements of the arch structure.

The contractors noted the complexity of this project, which presented a score of industrial painting challenges involving heavy duty construction platforms and large containments, lead abatement with recycled steel grit, sweep blasting with expendable abrasive, shop application over blasted galvanizing, new steel components from domestic and overseas fabricators, and the installation of epoxy intumescent fire protection during day and night shifts on a complicated architectural structure.

The contractor also noted the human factor of the workforce during the project, as the size of the project workforce fluctuated through periods of relative quiet and several extremely resource intensive periods where multiple crews coordinated several complex installations. Extensive coordination and communication was highlighted as a key factor for completion of this six-year project. **JPCL**

HOW TO PRE-QUALIFY A CUI COATING CHOICE

BY SIMON DALY, HEMPEL A/S

One of the major challenges that equipment operators in the process industries are facing today is corrosion under insulation, which can lead to injuries, loss of containment, and damage to brand reputation as well as significant lost revenue from downtime, and maintenance and replacement of corroded parts. Choosing the optimal coating for protection against CUI is a complex affair.

Many operators in the protective coatings business have heard the horror stories about corrosion under insulation and appreciate that coatings can form one of the barriers that helps protect their asset integrity from the problem. This has been known for many years, but despite this, the methods for selecting the optimum coatings remain often misunderstood. Increased confidence in coating selection can be beneficial when considering risk-based inspection, which, in turn, can assist in driving confidence around inspection intervals and ultimately reducing inspection costs—a major financial contributor in the corrosion management of CUI.

But what makes a coating system not provide the level of resistance expected in an insulated environment? And how can you make sure that you choose the right coating for a specific purpose? In order to choose the right coating for the right situation, it is necessary to look at which test protocols can be used to predict a coating material's behavior when placed in a CUI environment, and also how knowledge about the candidate coating's behavior toward heat will help assist in correct material selection.

While, of course, real-life experience offers the best "proof" of performance, some of the challenges associated with gathering and comparing CUI coating performance data from the field make it exceptionally difficult to draw conclusions around performance and therefore predict future behavior. Hopefully, as corrosion and coating inspection becomes increasingly digitalized, more effective comparisons will be able to be drawn between different coating types. Until

that time, however, accelerated testing remains one of the key ways to select the correct CUI coating.

This article will discuss different coating tests, with the aim of defining which methods can be used to simulate CUI conditions in the laboratory, and how to evaluate a coating material's performance under related conditions. A closer look at which tests can be used shows that it can be appropriate to look beyond test methods related specifically to CUI when considering protective coatings for insulated pipework and process equipment. The article will also detail the requirements as laid down in the recent ISO 19277 standard, which specifically addresses these issues.

CHALLENGES IN FINDING THE RIGHT CUI COATING

When a coating for CUI is found unsatisfactory, many factors play a role. Did the coating not perform as expected due to poor application? Was the product incorrectly specified? Or was the product defective itself? Above all, it is crucial to determine if a coating is suitable or not for an environment in which CUI can occur, in order to avoid specifying the wrong material.

While, of course, the ability to prevent CUI is of paramount importance, often when considering protective coatings to be used under insulation—particularly at the new construction stage—designers must consider them in the context of a wider painting specification.

In recent years, much focus has been placed on the ability of protective coatings to be used across a wider variety of temperature ranges, including cryogenic in both insulated and uninsulated service. The benefits of such systems can be significant and include:

- Simplified coating specifications for pipework and process equipment;
- Reduced number of coating systems to approve for construction;
- Eliminated need for separation of bulk items, such as piping and valves prior to painting;
- Simplified paint inventories for applications; and
- Streamlined coating and inspection procedures.

While there is a tendency to assume that corrosion under insulation conditions are the most aggressive, this is not always the case. It may depend on the generic type of the coating.

Life Cycle of a CUI Coating

ISO 19277, "Petroleum, petrochemical and natural gas industries – Qualification testing and acceptance criteria for protective coating systems under insulation," was introduced in December 2018 to try and address some of these additional considerations when selecting a CUI coating. This document mandates a series of tests in an attempt to capture the exposure cycle a typical CUI coating might encounter during the construction, transport and operational phases. Before looking at these tests, it is important to understand what these key phases might look like.

Transportation: During transportation from the fabrication yard or shop and prior to insulation, the coating may be exposed to typical atmospheric corrosion across a range of corrosive environments, all the way up to CX in the case of modular transport by sea.

Construction: During construction the coating may continue to be exposed to atmospheric corrosion at its final location and prior to insulation being installed. In both cases the coating has yet to be exposed to significant heat, only ambient temperatures.

Operational Phase, No CUI: During this part of its life, the coating is exposed to heat but not to the presence of moisture, assuming all insulation is correctly installed, but will be exposed to the operational temperature of the equipment.

Operational Phase, CUI: As the barrier properties of the insulation/cladding degrade over time the coating will be exposed to both heat and moisture as water penetrates the insulation system.

Operational Phase, Thermal Cycling: For some severe cases the coating may also be subjected to changes in temperature through thermal cycling.

Shutdown/Insulation Removal: Finally, if the insulation is removed, either as part of protracted shutdowns or change of service,

Fig. 1: An example of corrosion under insulation, showing severly deteriorated steel underneath the insulation material.

Fig. 2: Piping and other insulated process equipment can be subject to CUI at high temperatures.

the coating may once again be exposed to heat and atmospheric corrosion only.

Thermal Conditions Play a Role

CUI is widely described as occurring in the temperature range of 122–347 F (50–175 C). However, in the case of environments with high relative humidity—the so-called "sweating" pipe syndrome—corrosion beneath insulation can occur below this temperature.

Of course, in the case of a modern paint specification, this temperature range is only one of many, which generally results in the specification of a variety of different paint systems. It is also fair to say that when specifying coating systems for new construction projects, protecting against CUI is simply one of many coating uses to be considered—albeit an important one.

Temperature is the key selection factor when selecting a protective coating for use within process industries, and it is also imperative that it is described accurately in terms of which temperature is being considered; minimum, peak, design, cycling temperature limits can all play a role when selecting the correct coating type, and may lead to the selection of different coating types depending upon which temperature condition is used.

An example of this is pipework coated with an epoxy novolac coating. Routinely operating at a "temperature" of 320 F (160 C) beneath insulation, this temperature is not expected to pose any issues for this material. However, subject it to regular steaming out or process cycles to a peak operating temperature above 392 F (200 C), and it would not be unreasonable to expect to see degradation of the coating over a period of time, ultimately manifesting itself as coating failure. In the absence of a protective coating, CUI can then start to work its destructive cycle while operating in the lower temperature zone.

It is also important to consider the accuracy of predicted temperatures when specifying coating systems since calculated temperatures at the design stage may not always play out in practice. While the changes may seem minor where these limits coincide with a change in recommended coating type, they may result in an incorrect specification being made. As such, it is useful to establish safety margins when considering the maximum temperature for which a coating may be specified.

ISO 19277 attempts to create a series of CUI environments in a similar way to the corrosive categories referred to in ISO 12944 for atmospheric corrosion. These CUI environments are aligned with different temperatures and can be found in Table 1. By creating a consistent framework of CUI environments, a clear understanding of the environment and the pre-qualification tests associated with it can be established.

Here, it is also essential to be aware that the same coating does not necessarily work equally well at high and low temperatures. Many protective coatings undergo an improvement in properties when exposed to heat. An example of this is the conversion of organic silicone resins to a more heat-resistant silicone matrix, a feature of many high-temperature paints. They will show different performance characteristics depending on the thermal conditions they have previously been exposed to.

ISO 19277 refers to this by not permitting cross over of requirements. So, for example,

a coating that meets the requirements of CUI-3 is not automatically assumed to be suitable for category CUI-1, although by consolidating testing, some tests may be used for more than one category. Care should be taken, since this improvement is only part of the story. Expose a coating beyond its temperature limits, and degradation of the coating film will commence, usually via cracking and subsequent corrosion. The maximum temperature limit is highly dependent upon the coating binder type.

RELEVANT COATING TESTS

Construction/Transportation Phase

In order to establish a baseline of adequate atmospheric corrosion resistance, ISO 19277 mandates an artificial aging test consisting of neutral salt spray (ISO 9227) and water immersion (ISO 2812-2). Test panels are scribed and exposed for the same duration, regardless of the CUI environment classification, since at this stage CUI conditions are deemed not to exist. Evaluation is carried out according to ISO 4628-2 (Blistering), ISO 4628-3 (Rusting), ISO 4628-4 (Cracking) and ISO 4628-5 (Flaking). This assessment is common throughout the other test methods used in the standard. Adhesion tests and acceptance criteria are listed for both pre- and post-aging resistance.

Table 1: CUI Classification Environments

Classification	Minimum Temperature	Peak Temperature
CUI-1	-49 F (-45 C)	Up to 140 F (60 C)
CUI-2	-49 F (-45 C)	140 F (60 C) to 302 F (150 C)
CUI-3	-49 F (-45 C)	302 F (150 C) to 400 F (204 C)
CUI-1-Cryo	-320 F (-196 C)	Up to 140 F (60 C)
CUI-2-Cryo	-320 F (-196 C)	140 F (60 C) to 302 F (150 C)
CUI-3-Cryo	-320 F (-196 C)	302 F (150 C) to 400 F (204 C)

Operational Phase, No CUI

In order to recognize that moisture ingress into the insulation does not commence immediately, ISO 19277 permits for coating systems to be heat-conditioned to replicate the effect of where the coating is exposed to heat, but prior to the presence of moisture within the insulation. Heat conditioning is carried out for five cycles consisting of 20 hours at the maximum temperature for which the CUI classification is applicable (so 140 F [60 C], 302 F [150 C] or 400 F [204 C]) followed by a 4-hour cooling period (24 hours total). One of the drawbacks of the standard is that it does not provide for any long-term thermal

Fig. 3: A small-scale test rig adopted from ASTM G-189.

exposure. One test that could be used to supplement the standard is ASTM D 2485, which is used to determine a coating's resistance to heat. This test exposes coated panels to a variety of different increasing temperatures, where they are left for a period. They are then allowed to cool off and inspected visually for any signs of blistering, cracking, flaking and delamination from the metal surface.

Following this, panels are exposed to a corrosive environment via accelerated corrosion testing for a set time, or a real-life atmospheric corrosion test. The purpose here is to identify any areas where heating of the coating has caused cracking, which might ultimately penetrate to the substrate and subsequently be a site for corrosion. In this case, microcracks and CUI are very similar—what you cannot see can definitely hurt you.

A more detailed analysis by optical microscopy in lieu of the visual inspection can also be used. This allows more thorough inspection of microcracking and characterization of crack width and crack length.

Operational Phase, CUI

Once moisture has been able to penetrate the jacketing and insulation in sufficient quantity, then the conditions exist for coating breakdown and subsequent corrosion under insulation.

Historically, immersion test data has in many instances been presented as being a worst-case scenario, and thereby used as a standalone method for testing whether a coating can provide adequate protection in CUI conditions. While in some cases this may be true, it has some failings as a test method.

First, it may discount some coating systems, which would work quite satisfactorily in real life. Additionally, it does not consider the interaction between the insulation material and the coating itself. The passage of water through some insulation types may result in a change in composition of the corrosive medium, which is not automatically factored into immersion testing. Test methods such as NACE TM0174, Method B, can provide some additional information in this area; however, it is suggested that immersion testing is always supplemented with actual testing of insulated samples. Generally, this immersion testing is carried out at elevated temperature.

ISO 19277 describes two separate tests for evaluating the coating performance in a CUI environment, namely:

- Multi-phase CUI cyclic corrosion test, the so-called CUI condensation chamber (this test is mandatory); and
- Vertical pipe test, the so-called Houston pipe test (this test is optional).

Each of the tests consists of exposing the coating to a heating cycle, along with the addition of a corrosive medium. The key difference between the two is that in the case of the CUI cyclic corrosion test, there is no insulation present. This is one of the reasons why this test method and the standard have not been more widely adopted.

It is worth emphasizing that the ASTM G189 test is essentially isothermal. A constant test temperature is maintained (within a predetermined range). This is unlike the Houston pipe test, where the temperature at any given point varies along the length of the pipe and the level of saturation of the insulation, which is dependent upon the duration of exposure.

Several operators and laboratories have carried out testing that involves taking the basic principle of ASTM G189 and scaling it up to a larger test apparatus. Instead of a single pipe, numerous small-diameter pipe spools are coated and bolted together. Each pipe spool is electrically isolated from the next. The pipe is then insulated. A heated medium (either air or oil) is then passed through the pipe, heating the substrate, and a corrosive medium is passed into the insulation. This test can be carried out using a pump-type arrangement or by lowering the whole assembly into a water trough and raising the level of the corrosive medium up and down on a cycle to saturate the insulation and then allow it to dry out. The performance of the coating can then be evaluated both visually and using electrochemical measurements.

Operational Phase, Thermal Cycling

ISO 19277 also contains testing for thermal cycling. This consists of exposing test panels to an elevated temperature and then cooling. The temperature is determined according to the maximum temperature of the CUI category concerned. The panel is then placed into ice water. This is repeated for 20 cycles. Inspection of the panels is then carried out. Where the CUI-1/2/3-Cryo categories are being used, there is an additional cryogenic cycling test required.

Shutdown/Insulation Removal

To cover this eventuality, the aging resistance testing previously described also

Fig. 4: Equipment used for multi-phase CUI cyclic corrosion testing.

covers a section where the test panels have been heat conditioned prior to exposure.

SUPPLEMENTAL TESTING

The methods described are the key elements of the ISO 19277 standard; however, supplemental tests may also be useful and can essentially be broken down into the three following categories:

1. Physical properties such as impact resistance, hardness, etc., which are important to understand the coating's ability to be installed with minimal damage and therefore its ability to offer subsequent protection;
2. Thermal properties, which help characterize the suitability of the coating for the thermal conditions to which it will be exposed; and
3. Corrosion resistance properties, which help to understand the properties of the coating when exposed to other corrosive environments not characterised here.

CONCLUSIONS

In summary, the selection of test methods for ensuring the suitability of a coating under CUI conditions is extremely critical and depends upon several different factors. ISO 19277 provides guidance in this area and will almost certainly be further developed. Additionally, other bodies such as SSPC and NACE are also seeking to develop guidance in this area.

By selecting better and more appropriate test methodologies, it is possible to identify better performing coating candidates for CUI environments, thus providing higher probabilities of success—which, in turn, can result in reducing the costs associated with insualtion removal and detection of CUI, as well as preventing unexpected failure and the associated consequences. **JPCL**

ABOUT THE AUTHOR

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UHP WATERJETTING
THE OLDEST NEW METHOD FOR SURFACE PREPARATION

BY BRADY DEROCHE, INNOVATIVE SURFACE PREP

With growing concerns over changes in Federal regulations, and the increase in waste disposal costs, the oil and gas maintenance industry has sought alternative approaches to traditional surface preparation methods to fit their project specifications. Surface prep operators seek a method that is controlled, safe, predictable and, most importantly, able to provide a clean surface that meets the set performance standards.

One solution for the industry—the use of water pressure to remove contaminants and various materials—was created in the early 1800s, and used by coal miners as a method to remove loose debris and coal. This method has evolved since then to now use ultra-high-pressure water to remove existing coatings and contaminants from surfaces on maintenance projects. Now known as UHP waterjetting, the U.S. Navy embraced this method in 1994 as an additional method, where appropriate, to reduce waste streams and provide a solution to corrosion-related damage to ships at sea.

Surface preparation techniques have evolved with the increased acceptance of UHP waterjetting, which can provide benefits not only in workflow, but also in the overall project's bottom line. With quality requirements rising and budgets for maintenance activities decreasing, UHP WJ has become a surface preparation option to consider.

This article aims to provide knowledge surrounding the topic and more details on one popular method of utilizing this solution: remote-controlled robotics.

WHAT IS UHP WATERJETTING?

Ultra-high-pressure waterjetting uses ultra-high-pressure water (greater than 30,000 psi, 2,000 bar or 200 MPa) to remove various levels of coatings, contamination, chlorides (salts) and corrosion. The process uses water that meets a standardized level of cleanliness to remove unwanted materials and leave behind a clean, rust-free surface according to the SSPC/NACE joint WJ standards, SSPC-SP WJ-1/NACE WJ-1 through SP-WJ 4/WJ 4. The four WJ standards range from the highest degree of cleaning (WJ 1), in which all visible rust, coatings, mill scale and foreign matter are removed, to the lowest degree of cleaning (WJ 4), in which only loose material is removed.

UHP waterjetting is best used in maintenance projects when removing heavy rust, elastomeric coatings, urethanes, fiberglass-filled paints, salts, lead-based paint and icebreaker coatings. Unlike abrasive blasting, which creates a new surface profile for coating adhesion, UHP waterjetting leaves the original profile intact. While this ability to create a profile is a benefit of abrasive blasting, improper abrasive blasting can harm the original surface profile and cause material to be embedded into the profile. Water pressure at this rate simply shears off coatings and contaminants, revealing an optimal surface for coating performance.

However, there are some concerns that continue to limit the acceptance of UHP waterjetting prior to protective coatings application. On steel surfaces, UHP waterjetting typically leaves a duller, matte finish than the shiny, bright finish imparted by processes such as abrasive blasting to near-white metal. Some in the industry may view this difference in appearance as indicative of a less clean surface, but the SSPC/NACE WJ standards dictate acceptable appearance of UHP waterjetted steel, and as long as the coatings and contaminants are removed in accordance with the specified standard, this appearance is generally acceptable for subsequent coating application.

In addition, waterjetting can leave a damp surface that may not be practical to adequately dry during operations, and thus, flash rusting is likely when not using an inhibitor. While manageable levels of flash rust are generally allowed by inspectors, the use of damp-surface-tolerant and flash-rush-tolerant coating systems may be a consideration when UHP waterjetting is chosen for surface prep.

UHP WJ ROBOTICS

Driven by the benefits seen on maintenance projects employing UHP waterjetting, service providers have begun to specialize in bringing new UHP methods to contractors

and owners worldwide. One solution that is becoming more and more common is the use of remote-controlled robotics for UHP waterjetting surface preparation. The industry has accepted remote-controlled equipment as a safe and efficient way to provide users an ultra-clean surface with the following benefits.

Safety: UHP waterjetting robotics put technicians further out of harm's way, and safely planted on the ground. UHP waterjetting can also reduce the amount of dust that is typicaly generated by abrasive blasting, which can be harmful for workers to inhale if not properly protected. While hazardous waste such as existing lead coating residue still requires proper disposal

Cost Savings: Because only water is used to remove coatings with UHP waterjetting, the cost of purchasing, collecting and disposing of abrasive is eliminated. Spent coatings that contain hazardous material will still need to be collected, filtered and disposed of properly after UHP waterjetting. Less waste generated and less clean-up means a smaller budget.

Reduced Project Time: Utilizing UHP robotics, service providers can remove coatings at a rate of up to 750 square feet per hour, depending on the coating thickness. Removal of coatings with UHP robotics can also allow for other work to be completed during surface prep operations. Steel and mechanical welding, electrical and painting applications are able to be performed concurrently right behind the robotic crawler. This means projects can be completed in less time.

Clean Surface: A properly cleaned surface means that the applied coatings will meet its intended service life. UHP waterjetting robotics can remove coatings and contaminants, cleaning the surface to the SSPC/NACE joint WJ-1 to WJ-4 standards, with the original profile intact. If, for example, WJ 1 is specified, corrosion products can be removed from deep into the profile pits and leave the surface free of soluble salts, chlorides and other contaminants to provide a clean surface for the new coatings.

Environmental Benefits: Starting in the 1970s, environmental compliance has been gaining more and more attention. Abrasive blasting's potential to have detrimental impacts to the environment if not operations and materials are not properly contained and disposed of, have positioned UHP waterjetting to be recognized as a method that can produce minimal waste and environmental impact. With advancements in filtration systems, service providers can test the used water according to standards and return the water from UHP WJ production back to clean water that in most cases can be disposed into ditches, sewers and other outlets.

USES OF UHP WJ ROBOTICS

Secondary surface preparation utilizing UHP waterjetting robotics is currently being used across many different industries in maintenance or rehabilitation. Whether preparing the surface of an above-ground storage terminal inland or a helipad offshore, UHP waterjetting has proven to be an alternative to other surface preparation methods that is worth considering.

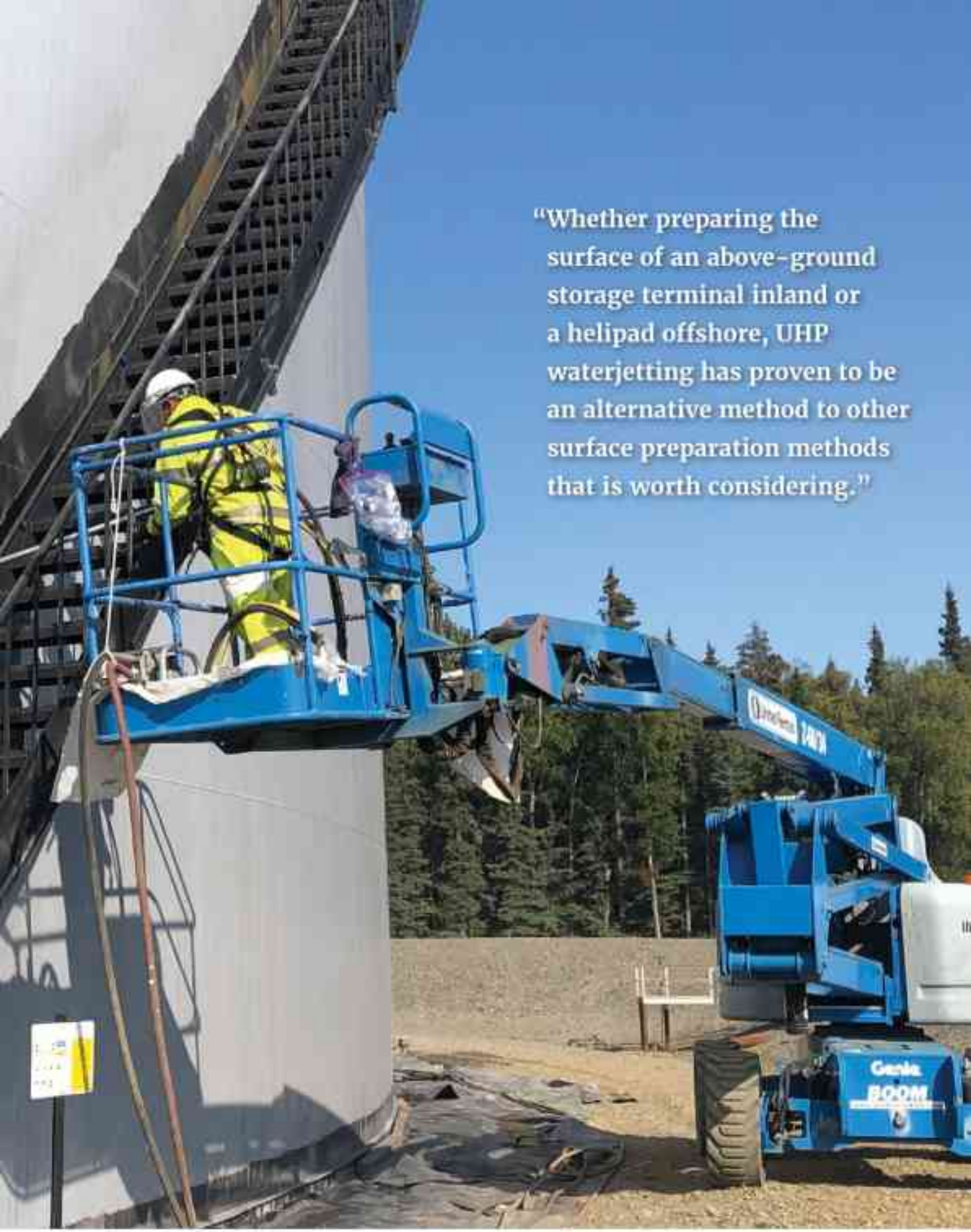
Petrochemical Plants, Storage Terminals & Refineries

A common use for these industries is for above-ground storage tank maintenance (interior and exterior) to remove coatings, specialty liners, rubber lining and fiberglass. A UHP waterjetting robot's ability to move efficiently around most of the internal and exterior surfaces of tanks can reduce overall project time and reduce the need for confined space entry. Robotic systems that utilize vacuum systems contain all the waste from production.

Offshore Platforms & Drilling

A common use for offshore industries is the maintenance of rigs, ships and helipads. Not having to bring abrasive equipment to offshore sites can significantly reduce the total job footprint, allowing more room for other operations. Use of vacuum-assisted UHP robotics can also eliminate the need for containment, as the robot is capable of capturing all debris. Concurrent work can

Fig. 1: Ultra-high-pressure waterjetting is becoming an increasingly acceptable method of surface preparation in the protective coatings industry. PHOTOS COURTESY OF THE AUTHOR



"Whether preparing the surface of an above-ground storage terminal inland or a helipad offshore, UHP waterjetting has proven to be an alternative method to other surface preparation methods that is worth considering."

also continue during UHP waterjetting, keeping other operations moving forward. The need for fresh water supply can restrict the use of UHP waterjetting in these situations, although there are equipment options such as reverse osmosis watermakers, which can filter contaminants out of raw water for use in UHP operations.

Shipyards

For maintenance of ship decks and hulls, service providers offer robotic crawlers that carry themselves around the hull and deck using a vacuum system. This eliminates the need for man lifts or scaffolding and helps keep shipyards clean, as the system calls for little to no cleanup or waste disposal after operations are completed. With much other work needed to maintain a ship while in dry dock, contractors using UHP waterjetting robotics can continue tasks such as hot work and painting while the system is still in operation.

UHP WJ IN ACTION

This method of surface preparation has years of experience and numerous success stories conquering difficult tasks. Let's take a look at a few instances where UHP waterjetting was able to solve a unique surface preparation hurdle.

Asbestos and Lead-Based Coating Removal

One project's scope of work was to abate lead-based and asbestos coatings on the shell of a 150-foot diameter by 48-foot-tall storage tank for a major refiner in the Midwest. The tank had been insulated with spray foam, which had already been removed by the coatings contractor, leaving an asbestos-filled mastic and lead-based paint on the surface. Initial efforts to remove the coatings by scraping the heavier mastic and then utilizing a chemical remover to remove the remaining coatings were taking too long. Also, the additional cost of containment and disposal were of concern.

The contractor decided to use a remote-operated robotic waterjetting crawler. This particular robot used a vacuum system to attach itself to the surface for waterjetting operations. After surface prep, the water was pulled back into the system, utilizing the same vacuum, and run through a filtration system. The water discharged from the system was able to be disposed of into nearby drainage systems, free of lead and asbestos, and the spent coatings were disposed of safely and separately.

The remote-operated robotic waterjetting crawler was able to complete the job at 325 square feet per hour, and provide an SSPC-SP-WJ 1/NACE WJ-1 surface with zero chlorides. The surface behind the crawler was immediately ready for coatings application, which enabled the contractor to clean and cover more surface each day. Hazardous waste was significantly reduced, leaving behind only four 55-gallon drums of paint chips that were to be disposed of. The return-to-service schedule was shortened by weeks, which in turn provided tremendous cost savings for the refinery.

Coating Removal on LNG Tank

This job involved stripping and repainting the exterior of a 14 million gallon, double-walled liquefied natural gas tank. The tank was 125 feet tall and had a diameter of 180 feet; therefore, the contractor needed to prep 85,000 square feet for application of a 12–18-mil coating system. Because the tank was double-walled with a pressurized interior tank, the project had no tolerance for "hot work" to avoid the danger of explosions. The existing coating system was 15 years old and had light rust breakthrough covering about 80–90% of the surface. The overarching goal of the project was to provide a recoated surface that would last the owner 20 years.

Because of safety and environmental concerns and the nature of the project, the contractor selected UHP waterjetting as their surface preparation solution. The contractor used one remote-controlled robotics system, four UHP waterjetting pumps, eight hand lance guns, assorted hoses, one vacuum truck, one 20-yard vacuum box, three man lifts and one 250 cfm air compressor. The robotics system was used on the large flat areas on the tank, and the hand lances took care of the areas of the tank not accessible by the robot. The two equipment systems were able to work concurrently to increase production rates.

The job went off without a hitch, as the contractor was able to waterjet an estimated four to five hours per day, with around three to five hours per day spent moving lines, inspecting progress and performing other housekeeping duties. The contractor

Fig. 2: Robotic UHP waterjetting systems are capable of cleaning surfaces to specified standards, with the potential for added safety and other benefits.

was able to clean as much as 3,500 square feet per day but averaged around 2,000 square feet within the four to five hours of production time. Around 100,000 gallons of water was used for the project, which was then filtered and released back to the utility company. The project was initially scoped to be done in two phases, but after the utility company recognized how efficiently the project was being completed, they authorized the completion of the entire tank in one season.

Coatings Repair on Thames Barrier

A ship had struck the Thames Barrier flood control gates located in London. These gates protect the metropolitan London area from dangerous surge tides that threaten the area. The ship caused significant damage to the coatings, which needed to be fixed quickly before the risk of permanent corrosion damage occurred. The contractor needed to be able to provide a fast solution that was able to work while the gate stayed in operation. Because the gate was over water, the solution needed to have no environmental pollution or potential release into the waterways.

The contractor elected to use a robotic UHP waterjetting system using a vacuum crawler that contained all cleaning waste. The robot used 40,000 psi (2,750 bar, 280 MPa) water provided by the UHP pump to remove the coatings from the surface. Then, the attached vacuum was able to collect all waste from the surface prep and deliver it into a remote vacuum skid. The effluent water would then be filtered and prepared for disposal. Because the project could not interfere with gate operation, minimal equipment was loaded onto a barge and moored at the base of the gate. The complete system consisted of a UHP pump, vacuum skid, remote crawler, generator, air compressor and tankage. A filter system was also used for effluent water so that it could then be returned to the water system. All operations were done from the deck of the barge so that the flood gates could stay in operation.

The UHP waterjetting system provided an environmentally safe surface preparation method. Being in a high-salt environment, the system was still able to remove all contaminants and provide a clean surface for coating application. The job was completed quickly and without having to take the flood gates out of service.

Fig. 3: UHP robotics can allow different work to take place concurrently, such as coating application taking place side-by-side with UHP waterjetting.

CONCLUSION

With proven cases of success and industry standards put in place, UHP waterjetting is becoming an increasingly acceptable option for surface preparation in maintenance projects.

The goal of any surface preparation project is to provide a surface that is cleaned to the specified standard for coatings to be applied, and UHP waterjetting's ability to remove contaminants from the surface without affecting the original surface profile—plus the environmental and safety benefits, along with potential savings in project time and costs—can assist contractors and owners striving for success in their surface preparation operations. **JPCL**

ABOUT THE AUTHOR

Brady DeRoche is the Business Manager for Innovative Surface Prep, based in Gray, Louisiana. He joined ISP in 2019 and was previously the company's Marketing Director. He holds a bachelor's degree in advertising design from the University of Houston.

ACKNOWLEDGEMENT

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2020 ANNUAL COATING SYSTEMS BUYING GUIDE FOR CONCRETE

The 2020 JPCL Annual Coating Systems Buying Guide for Concrete provides details about high-performance coating systems suitable for concrete substrates for bridges and highways, in chemical and petrochemical plants, food and pharmaceutical plants, power plants, pipelines, wastewater facilities, water works, and waterfront, locks and dams, as well as specialty-function applications. The Guide is published as a resource for facility owners, third-party specifiers, contractors and anyone engaged in a coatings project. It allows the user to identify systems that companies recommend for specific applications, exposures and specialty functions.

EDITOR'S NOTE: The following listings in this print edition of the 2020 JPCL Coatings Buying Guide for Concrete are sponsored listings. As always, the complete Buying Guide can be found online at paintsquare.com/supersizers, along with the Coatings Buying Guide for Steel, Annual Contractor Directory and other resources from JPCL.

Bridges

EXTERIOR WEATHERING – MILD/MODERATE

Carboline Company
Carboguard/Carbothane
Epoxy (1-2 Coats)/Urethane

ErgonArmor
Ertech
Coal Tar/Asphalt
(101-250 g/L)

Induron Coatings, LLC
Indurethane 6600 Plus
Epoxy (1-2 coats) Urethane (101-250 g/L)

PPG
Pitt Tech
Other

Sherwin-Williams
Acrylic Texture Coatings, Stains or Solvent Stains
Other

Tnemec Company, Inc.
Epoxoline/Enviro-Crete
Epoxy (1-2 Coats)/Acrylic (1-2 Coats)

EXTERIOR WEATHERING – SEVERE

Carboline Company
Carboguard
Epoxy/Epoxy/Epoxy

ErgonArmor
Novocoat SP2410
Epoxy/Epoxy/Epoxy (Less than 100 g/L)

Induron Coatings, LLC
Perma-Gloss Epoxy (1-2 coats)
Fluorourethane (101-250 g/L)

PPG
Amerlock/Amercoat 450H
Epoxy (1-2 Coats)/Urethane

Sherwin-Williams
Kem Cati-Coat HS/Hi-Solids Polyurethane 250
Epoxy (1-2 Coats)/Urethane

Tnemec Company, Inc.
Epoxoline/Enviro-Crete
Epoxy (1-2 Coats)/Acrylic (1-2 Coats)

Chemical & Petrochemical Plants

EXTERIOR PLANT EXPOSURE – MODERATE TO SEVERE CHEMICAL, WEATHERING & UV

Carboline Company
Carboguard/Carbothane
Epoxy (1-2 Coats)/Urethane

ErgonArmor
Novocoat SC3300 Series
Epoxy Novolac (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Gloss
Epoxy (1-2 coats)/Fluoropolymer
(251-340 g/L)

PPG
Amerlock/Durethane DTM
Epoxy (1-2 Coats)/Urethane

Sherwin-Williams
Macropoxy 646/Hi-Solids Polyurethane
Epoxy (1-2 Coats)/Urethane

Tnemec Company, Inc.
Epoxoline/Enviro-Crete
Epoxy (1-2 Coats)/Acrylic (1-2 Coats)

SECONDARY CONTAINMENT

Carboline Company
Semstone
Epoxy 100% Solids (1 or 2 Coats)

ErgonArmor
Novocoat ER2000 Series
Epoxy Novolac (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
PetroChem 100
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy Phenolic/Epoxy Phenolic/Epoxy Phenolic

Sherwin-Williams
Cor-Cote VEN, Magnalux 304
Vinyl Ester/Vinyl Ester/Vinyl Ester

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
Epoxoprime/ChemBloc/ChemBloc
Epoxy/Epoxy Novolac/Epoxy Novolac

Food/Beverage & Pharmaceutical Plants

INTERIOR PROCESS AREAS

Walls, Ceilings

Carboline Company
Sanitile
Epoxy/Epoxy Novolac/Epoxy Novolac

ErgonArmor
Novocoat SP2000
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Clean II
Epoxy/Epoxy/Epoxy (101-250 g/L)

PPG
Sanishield 3000/5000
Polyurea Pure (1, 2, or 3 Coats)

Sherwin-Williams
Sherloxane 800
Siloxane/Siloxane

Tnemec Company, Inc.
Epoxoprime/Stranlok
Epoxy 100% Solids (1 or 2 Coats)

INTERIOR PROCESS AREAS

Floors

Carboline Company
Carbocrete
Urethane/Urethane

ErgonArmor
PennChem Mortar
Brick and Tile, Acid-Resistant
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Tuff SL
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
PPG Flooring
Urethane/Urethane

Sherwin-Williams
FasTop Multi Systems
Urethane/Urethane

Tnemec Company, Inc.
Epoxoprime/Power-Tread
Epoxy 100% Solids (1 or 2 Coats)

Power Plants

CHEMICAL/WATER EXPOSURE – CAUSTIC OR ACID

Carboline Company
Semstone/Plastite
Epoxy/Epoxy Novolac/Epoxy Novolac

ErgonArmor
Novocoat SC1300 Series
Epoxy Novolac (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
PermaSafe 100 Ceramic Epoxy
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy 100% Solids (1 or 2 Coats)

Sherwin-Williams
Corobond 100/Nova-Plate 325
Epoxy/Epoxy 100% solids

Tnemec Company, Inc.
Tneme-Liner/Tank Armor
Epoxy/Epoxy 100% solids

CHEMICAL/WATER EXPOSURE – WET FLY ASH

Carboline Company
Reactamine
Polyurea Hybrid (1, 2, or 3 Coats)

ErgonArmor
Novocoat SP3300 Series
Epoxy Novolac (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
PermaSafe 100 Ceramic Epoxy
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy 100% Solids (1 or 2 Coats)

REMA Corrosion Control, Inc.
Coroflake, Coroflake MR
Vinyl Ester/Vinyl Ester/Vinyl Ester

Sherwin-Williams
Cor-Cote VEN TF
Vinyl Ester/Vinyl Ester/Vinyl Ester

CIRCULATING WATER PIPE

Carboline Company
Plastite/Phenoline
Epoxy 100% Solids (1 or 2 Coats)

ErgonArmor
Novocoat SP2000
Epoxy/Epoxy 100% solids
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Clean 100 Ceramic Epoxy
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy 100% Solids (1 or 2 Coats)

Sherwin-Williams
Dura-Plate UHS
Epoxy/Epoxy 100% solids

Tnemec Company, Inc.
MortarClad/Epoxoline
Epoxy/Epoxy 100% solids

SECONDARY CONTAINMENT

Carboline Company
Semstone
Epoxy Novolac (1 or 2 Coats)

ErgonArmor
Novocoat ER2000 Flexible Lining
Epoxy/Epoxy 100% solids
(Less than 100 g/L)

Induron Coatings, LLC
PetroChem 100
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy/Epoxy/Epoxy

Sherwin-Williams
Corobond 100/Nova-Plate 325
Epoxy/Epoxy 100% solids

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
Epoxoprime/ChemBloc/ChemBloc
Epoxy/Epoxy Novolac/Epoxy Novolac

Transmission Pipeline

EXTERNAL OF BURIED PIPE

Carboline Company
Polyclad/SPC
Urethane/Urethane

ErgonArmor
Novocoat SP2000
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Sigmashield
Epoxy/Epoxy

Sherwin-Williams
Poly-Cote 110/115
Urethane Elastomeric (1 Coat)

Sprayroq
SprayShield Green 2
Urethane/Urethane

INTERNAL OF BURIED PIPE

Carboline Company
Reactamine
Urethane Elastomeric (1 Coat)

ErgonArmor
Novocoat SP2000
Epoxy/Epoxy 100% solids
(Less than 100 g/L)

PPG
Novaguard
Epoxy/Epoxy 100% solids

Sherwin-Williams
Poly-Cote 110/115
Epoxy 100% Solids (1 or 2 Coats)

Sprayroq
SprayWall
Urethane/Urethane

FIELD JOINT COATING OF BURIED PIPE

Carboline Company
Polyclad/SPC
Urethane/Urethane

ErgonArmor
Novocoat ER2000, Flexible
Epoxy Lining
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy 100% Solids (1 or 2 Coats)

Sherwin-Williams
Poly-Cote 115FR
Urethane Elastomeric (1 Coat)

Sprayroq
SprayShield Green 2
Urethane/Urethane

ABOVE GROUND PIPE EXTERIORS

Carboline Company
Carboguard
Epoxy/Epoxy/Epoxy

ErgonArmor
Novocoat SP2000 Series
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Amercoat/Durethane
Epoxy (1–2 Coats)/Urethane

Sherwin-Williams
Macropoxy 646 FC Epoxy/
Acrolon Ultra
Epoxy (1–2 Coats)/Urethane

Wastewater Treatment Plants, Municipal

EXTERIOR WEATHERING, UV, AND MILD CHEMICAL

Carboline Company
Carboguard/Phenoline/Plaste
Epoxy/Epoxy/Epoxy

ErgonArmor
Novocoat SP2410 Series
Epoxy/Epoxy 100% solids
(Less than 100 g/L)

Induron Coatings, LLC
Indurethane 6600 Plus
Epoxy (1-2 coats)/Urethane (101-250 g/L)

PPG
Amercoat/Durethane
Epoxy (1-2Coats)/Urethane

Sherwin-Williams
Macropoxy 5500/Acrolon Ultra
Epoxy (1-2 Coats)/Urethane

Tnemec Company, Inc.
Epoxoline/Endura-Shield
Epoxy (1-2 Coats)/Urethane

INTERIOR EXPOSURE ENVIRONMENT

Walls, Ceilings

Carboline Company
Sanitile
Epoxy/Epoxy 100% solids

ErgonArmor
Novocoat SP2410 Series
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Clean II
Epoxy/Epoxy/Epoxy (101-250 g/L)

PPG
Amercoat
Epoxy/Epoxy/Epoxy

Sherwin-Williams
Cementplex 875/Dura-Plate 235
Epoxy/Epoxy

Sprayroq
SprayShield Green 2
Urethane Elastomeric (1 Coat)

Tnemec Company, Inc.
Epoxoline
Epoxy/Epoxy/Epoxy

INTERIOR EXPOSURE ENVIRONMENT

Floors

Carboline Company
Carboseal/Semstone
Epoxy/Epoxy 100% solids

ErgonArmor
Novocoat 1500 Series Flooring
Epoxy/Epoxy 100% solids
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Tuff SL
Epoxy/Epoxy 100% solids
(Less than 100 g/L)

PPG
Amerlock
Epoxy/Epoxy

Sherwin-Williams
Armorseal 1000HS/Armorseal 1000HS
Epoxy/Epoxy

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
Epoxoprime/Tneme-Glaze
Epoxy/Epoxy 100% solids

IMMERSION – WASTEWATER COLLECTION, PRIMARY TREATMENT, SECONDARY TREATMENT

Carboline Company
Reactamine
Urethane Elastomeric (1 Coat)

ErgonArmor
Novocoat SG2500 Highbuild Novolac
Epoxy Novolac (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
PermaSafe 100 Ceramic Epoxy
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy/Epoxy/Epoxy

Sherwin-Williams
Poly-Cote 110
Urethane Elastomeric (1 Coat)

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
MortarClad/Perma-Shield
Epoxy/Epoxy 100% solids

IMMERSION – TERTIARY TREATMENT

Carboline Company
Reactamine
Urethane Elastomeric (1 Coat)

ErgonArmor
Novocoat SP2000 Series
Epoxy/Epoxy Novolac/Epoxy Novolac
(Less than 100 g/L)

Induron Coatings, LLC
PermaSafe 100 Ceramic Epoxy
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

PPG
Novaguard
Epoxy Phenolic/Epoxy Phenolic/
Epoxy Phenolic

Sherwin-Williams
Poly-Cote 110
Urethane Elastomeric (1 Coat)

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
Epoxoline
Epoxy/Epoxy/Epoxy

SECONDARY CONTAINMENT

Carboline Company
Semstone
Epoxy/Epoxy 100% solids

ErgonArmor
Novocoat SP2000 Series
Epoxy/Epoxy Novolac/Epoxy Novolac
(Less than 100 g/L)

Induron Coatings, LLC
PermaSafe 100 Ceramic Epoxy
Epoxy/Epoxy 100% solids (Less than 100 g/L)

PPG
Novaguard
Epoxy Phenolic/Epoxy Phenolic/
Epoxy Phenolic

Sherwin-Williams
Corobond VE Primer/Cor-Cote VEN/
Cor-Cote VEN
Vinyl Ester/Vinyl Ester/Vinyl Ester

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
Epoxoprime/ChemBloc/ChemBloc
Epoxy/Epoxy Novolac/Epoxy Novolac

Waterfront, Lock, and Dam Industry

ONSHORE ATMOSPHERIC EXPOSURE – WEATHERING, UV, & AIRBORNE SALT

Carboline Company
Carboguard
Epoxy/Epoxy/Epoxy

ErgonArmor
Novocoat SP1510
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
Indurethane 6600 Plus
Epoxy (1-2 coats)/Urethane
(251-340 g/L)

PPG
Amercoat/Durethane
Epoxy/Epoxy/Siloxane

Sherwin-Williams
Macropoxy 646/Hi-Solids Polyurethane
Epoxy (1-2 Coats)/Urethane

SPLASH ZONE EXPOSURE – WEATHERING, UV, FRESH OR SALTWATER SPLASH, & ABRASION

Carboline Company
Bitumastic
Coal Tar/Asphalt

ErgonArmor
Novocoat SG2500 HB Epoxy
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
Indurethane 6600 Plus
Epoxy (1-2 coats)/Urethane
(251-340 g/L)

PPG
Sigmashield
Epoxy/Epoxy

Sherwin-Williams
Dura-Plate 154
Epoxy/Epoxy/Epoxy

IMMERSION EXPOSURE – SEAWATER

Carboline Company
Reactamine
Urethane Elastomeric (1 Coat)

ErgonArmor
Novocoat SP2000 Series
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
PermaSafe 100 Ceramic Epoxy
Epoxy/Epoxy 100% solids (Less than
100 g/L)

PPG
Sigmashield
Epoxy/Epoxy

Sherwin-Williams
Dura-Plate 235/Dura-Plate 235
Epoxy/Epoxy

IMMERSION EXPOSURE – FRESHWATER

Carboline Company
Reactamine
Urethane Elastomeric (1 Coat)

ErgonArmor
Novocoat SP2410
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
PermaSafe 100 Ceramic Epoxy
Epoxy/Epoxy 100% solids (Less than
100 g/L)

PPG
Sigmashield
Epoxy/Epoxy

Sherwin-Williams
Dura-Plate 235/Dura-Plate 235
Epoxy/Epoxy

Water Works

EXTERIOR EXPOSURE – WEATHERING AND UV

Carboline Company
Carboguard
Epoxy/Epoxy/Epoxy

ErgonArmor
Novocoat SP2410
Epoxy 100% Solids (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
AC403 Elastomeric Coatin
Other (Less than 100 g/L)

PPG
Durethane
Urethane/Urethane

Sherwin-Williams
Macropoxy 646/Acrolon 218/
Fluorokem HS
Other

Tnemec Company, Inc.
EpoxoBlock WB/Enviro-Crete
Epoxy (1-2 Coats)/Acrylic (1-2 Coats)

IMMERSION EXPOSURE – POTABLE WATER APPROVED

Carboline Company
Reactamine
Urethane Elastomeric (1 Coat)

ErgonArmor
Novocoat SP2000 Series
Epoxy Novolac (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Clean 100 Ceramic Epoxy
Epoxy 100% Solids (1 or 2 Coats) (less
than 100 g/L)

PPG
Novaguard
Epoxy 100% Solids (1 or 2 Coats)

Sherwin-Williams
Poly-Cote 110
Urethane Elastomeric (1 Coat)

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
Pota-Pox
Epoxy/Epoxy/Epoxy

IMMERSION EXPOSURE – NON-POTABLE WATER

Carboline Company
Reactamine
Urethane Elastomeric (1 Coat)

ErgonArmor
Novocoat SP2000 Series
Epoxy Novolac (1 or 2 Coats)
(Less than 100 g/L)

Induron Coatings, LLC
Perma-Clean 100 Ceramic Epoxy
Epoxy 100% Solids (1 or 2 Coats) (less
than 100 g/L)

PPG
Amercoat
Epoxy/Epoxy/Epoxy

Sherwin-Williams
Poly-Cote 110
Urethane Elastomeric (1 Coat)

Sprayroq
SprayWall
Urethane/Urethane

Tnemec Company, Inc.
Epoxoline
Epoxy/Epoxy/Epoxy

Specialty Functions

ANTI-GRAFFITI

Induron Coatings, LLC
Indurethane AG
Epoxy/Urethane (color)/Urethane (clear)
(251-340 g/L)

PPG
Amerlock/Durethane
Epoxy/Urethane (Color)/Urethane (Clear)

Sherwin-Williams
Kem Cati-Coat/2K WB Urethane
Antigraffiti
Epoxy/Urethane (Color)/Urethane (Clear)

Tnemec Company, Inc.
Epoxoline/Fluoronar
Epoxy (1-2 Coats)/Fluoropolymer

CONCRETE SURFACING MATERIALS

Carboline Company
Sanitile
Epoxy Blockfiller (2-part)

PPG
Amercoat 100A
Epoxy Surfacer (two-part)

Sherwin-Williams
Dura-Plate 2300
Epoxy Blockfiller (2-part)

Tnemec Company, Inc.
MortarClad
Cementitious Modified Surfacer/
Patching Compound

ANTIFOULANT AND FOULANT RELEASE COATINGS

Carboline Company
C-Flex
Fouling Release

PPG
ABC
Hydrating (Ablative)

Sherwin-Williams
Seaguard HMF Antifoulant
Fouling Release

PROFILES

CARBOLINE COMPANY

2150 Schuetz Rd.
St. Louis, MO 63146
Contact: Customer Service
Phone: 314-644-1000
carbolineservice@carboline.com
carboline.com

Bridges: Carboguard/Carbothane, Carboguard

Chemical & Petrochemical Plants: Carboguard/Carbothane, Semstone
Food/Beverage & Pharmaceutical Plants: Sanitile, Carbocrete
Power Plants: Semstone/Plasite, Reactamine, Plasite/Phenoline, Semstone
Transmission Pipeline: Polyclad/SPC, Reactamine, Carboguard
Wastewater Treatment Plants, Municipal: Carboguard/Phenoline/Plasite, Sanitile, Carboseal/Semstone, Reactamine, Semstone
Waterfront, Lock, and Dam Industry: Carboguard, Bitumastic, Reactamine
Water Works: Carboguard, Reactamine
Specialty Functions: C-Flex

ErgonArmor
2829 Lakeland Drive
Flowood, MS 39232
Contact: Customer Service
Phone: 877-982-7667
ergonarmorcustserv@ergon.com
ergonarmor.com

INDURON PROTECTIVE COATINGS

INDURON COATINGS, LLC
3333 R. Arrington Jr. Blvd. N.
Birmingham, AL 35234
Contact: Customer Service
Phone: 800-324-9584
info@induron.com
induron.com

Bridges: Indurethane 6600 Plus, Perma-Gloss
Chemical & Petrochemical Plants: PetroChem 100, Perma-Gloss
Food/Beverage & Pharmaceutical Plants: Perma-Clean II, Perma-Tuff SL
Power Plants: PermaSafe 100 Ceramic Epoxy, Perma-Clean 100 Ceramic Epoxy, PetrohChem 100
Wastewater Treatment Plants, Municipal: Indurethane 6600 Plus, Perma-Clean II, Perma-Tuff SL, PermaSafe 100 Ceramic Epoxy
Waterfront, Lock, and Dam Industry: PermaSafe 100 Ceramic Epoxy, Indurethane 6600 Plus
Water Works: AC403 Elastomeric Coating, Perma-Clean 100 Ceramic Epoxy
Specialty Functions: Indurethane AGC

PPG

PPG
One PPG Place
Pittsburgh, PA 15272
Contact: PMC Marketing Team
Phone: 888-977-4762
pmcmarketing@ppg.com
ppgpmc.com

Bridges: Pitt Tech, Amerlock/Amercoat 450H
Chemical & Petrochemical Plants: Amerlock/Durethane DTM, Novaguard
Food/Beverage & Pharmaceutical Plants: Sanishield 3000/5000
Power Plants: Novaguard,
Transmission Pipeline: Sigmashield, Novaguard, Amercoat/Durethane
Wastewater Treatment Plants, Municipal: Amercoat/Durethane, Amercoat, Amerlock, Novaguard
Waterfront, Lock, and Dam Industry: Amercoat/Durethane, Sigmashield,
Water Works: Durethane, Novagaurd, Amercoat
Specialty Functions: Amerlock/Durethane, ABC

SHERWIN WILLIAMS

SHERWIN-WILLIAMS
101 Prospect Avenue NW
Cleveland, OH 44115
Contact: Customer Service
Phone: 800-524-5979
swprotective@sherwin.com
sherwin-williams.com/protective

Bridges: Acrylic Texture Coatings, Stains or Solvent Stains, Kem Cati-Coat HS/ Hi-Solids Polyurethane 250
Chemical & Petrochemical Plants: Macropoxy 646/Hi-Solids Polyurethane, Cor-Cote VEN, Magnalux 304
Food/Beverage & Pharmaceutical Plants: Sherloxane 800, FasTop Multi Systems
Power Plants: Corobond 100/Nova-Plate 325, Cor-Cote VEN TF, Dura-Plate UHS
Transmission Pipeline: Poly-Cote 110/115, Poly-Cote 115FR, Macropoxy 646 FC Epoxy/ Acrolon Ultra
Wastewater Treatment Plants, Municipal: Macropoxy 5500/Acrolon Ultra, Cementplex 875/Dura-Plate 235, Armorseal 1000HS/ Armorseal 1000HS, Poly-Cote 110, Corobond VE Primer/Cor-Cote VEN/Cor-Cote VEN
Waterfront, Lock, and Dam Industry: Macropoxy 646/Hi-Solids Polyurethane, Dura-Plate 154, Dura-Plate 235/Dura-Plate 235
Water Works: Macropoxy 646/Acrolon 218/ Fluorokem HS, Poly-Cote 110
Specialty Functions: Kem Cati-Coat/ 2K WB Urethane Antigraffiti, Seaguard HMF Antifoulant

SPRAYROQ Structural Protective LINING SYSTEMS

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4766 Grantswood Road Suite 150
Irondale, AL 35210
Contact: Jeremy Huckaby
Phone: 205-957-0020
jhuckaby@sprayroq.com
sprayroq.com

Chemical & Petrochemical Plants: SprayWall
Power Plants: SprayWall
Transmission Pipeline: SprayShield Green 2, SprayWall,
Wastewater Treatment Plants, Municipal: SprayShield Green 2, SprayWall
Water Works: SprayWall

TNEMEC

TNEMEC COMPANY, INC.
6800 Corporate Dr.
Kansas City, MO 64120
Contact: Mark Thomas
Phone: 816-483-3400
marketing@tnemec.com
tnemec.com

Bridges: Epoxoline/Enviro-Crete
Chemical & Petrochemical Plants: Epoxoline/ Enviro-Crete, Epoxoprime/ChemBloc/ ChemBloc
Food/Beverage & Pharmaceutical Plants: Epoxoprime/Stranlok, Epoxoprime/Power-Tread
Power Plants: Tneme-Liner/Tank Armor, MortarClad/Epoxoline, Epoxoprime/ ChemBloc/ChemBloc
Wastewater Treatment Plants, Municipal: Epoxoline, Epoxoprime/Tneme-Glaze, MortarClad/Perma-Shield, Epoxoprime/ ChemBloc/ChemBloc, Epoxoline/Endura-Shield
Water Works: Pota-Pox, Epoxoline, EpoxoBlock WB/Enviro-Crete
Specialty Functions: Epoxoline/Fluoronar

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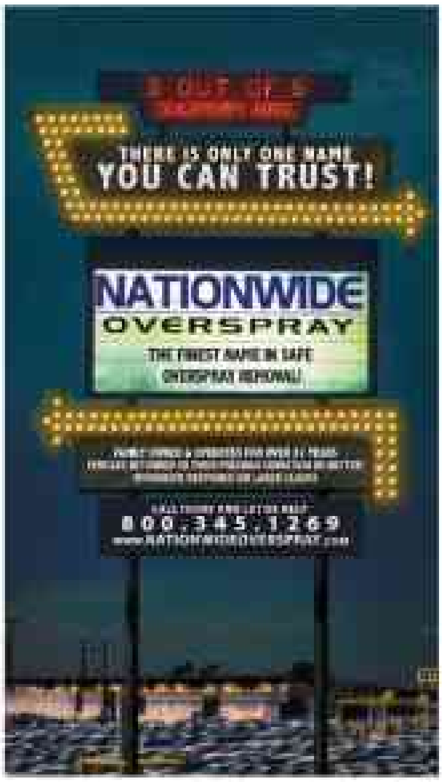

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PAINT BY NUMBERS

10

The number of languages in which translated offerings from SSPC are currently available. *See p. 8*

>4 miles

The combined total length of two New York City-area bridges that were recently repainted and honored with 2020 SSPC Structure Awards: the Governor Mario Cuomo Bridge and the Bayonne Bridge. *See p. 22*

72%

The percentage of PaintSquare Poll respondents who believe that aging infrastructure is the primary culprit in an August gas explosion in Baltimore, which killed two and seriously injured others. *See p. 16*

122-347 F (50-175 C)

The temperature range at which corrosion under insulation is generally thought to occur—although CUI can occur at lower temperatures when in high relative humidity environments. *See p. 28*

9

The number of categories—ranging from bridges to water works to specialty functions—containing listings in the JPCL 2020 Coating Systems Buying Guide for Concrete. *See p. 40*

30,000 psi

The minimum water pressure that constitutes ultra-high-pressure waterjetting, a technique used to remove coatings and contaminants from a surface before coatings application. *See p. 35*