Lou Lyras: 1950-2024

On Jan. 31, longtime painting contractor, JPCL contributor and coatings industry influencer Louis G. Lyras unexpectedly passed away at the age of 73.

In 1976, along with his brother Gus and his father George, Lou founded industrial painting contracting company Corcon, Inc., in his hometown of Youngstown, Ohio. Over the years, Lou and Corcon performed coating work on countless bridges throughout the U.S., including the Verrazzano-Narrows Bridge in New York City, and the Walt Whitman, Ben Franklin, Commodore Barry and Betsy Ross Bridges in the Philadelphia area.

Lou Lyras

In addition, Lou was also heavily involved in developing painting contractor certifications and safety standards with SSPC, serving in over 19 committees, including a seat on the Standards Review Committee and serving as chair of the SSPC PCCP Advisory Committee. He was also author of multiple JPCL articles, including bridge painting project case studies, over the course of his career.

Most recently, Lou was executive producer of the Bridge Brothers documentary, released in 2017, which followed the lives of Corcon's union painters as they worked on the Walt Whitman Bridge.

Outside of his coatings work, Lou had many other passions, including politics and philanthropy. Lou ran for U.S. Congress in Ohio's sixth district twice, in 2018 and in 2022. He was also co-owner of Penguin City Brewing in Youngstown, as well as an avid science-fiction reader and writer.

Technology Publishing Company sends condolences to Lou's surviving wife, children and grandchildren, as well as all of Lou's many coatings industry colleagues. JPCL

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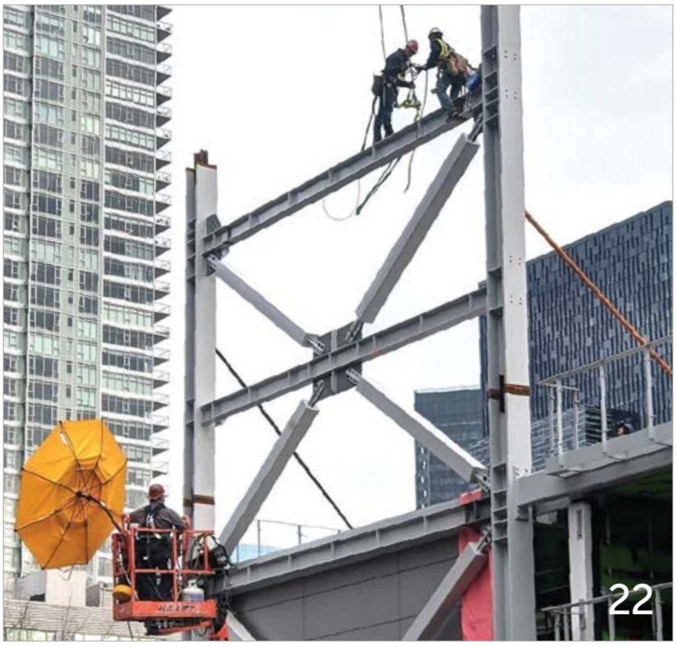

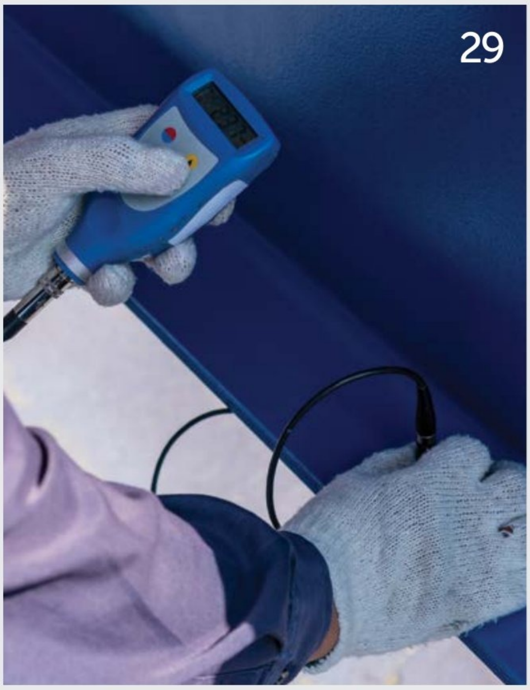

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LEAD FEATURE

10 Black Magic Dispelled? Coal Tar vs. Modified Epoxy Technology

BY VIJAY DATTA AND MIKE O'DONOGHUE, AKZONOBEL; TONY BELK, NUCOR/SKYLINE LLC; AND CORTNEY CHALIFOUX, POND AND COMPANY

For many years, coal tar epoxy coatings were synonymous with a level of performance and corrosion protection not thought possible from emergent light-colored, hazard-diminishing, and inspection-facilitating epoxies. But over time, much has changed. This article briefly compares the pluses and minuses of coal tar epoxy coatings of yesteryear with those of the modified epoxy coating technology that largely replaced them.

COVERAGE

CURRENT EVENTS, CONVERSATION, CALENDAR UPDATES AND MORE FROM THE PEOPLE AT PAINTSQUARE.COM

AMPP Hires New CFO

The Association for Materials Protection and Performance (AMPP) recently announced the appointment of Jennifer Colunga as its new Chief Financial Officer. According to AMPP, Colunga has over 20 years of experience in finance and operations management and will bring her expertise to lead AMPP's financial strategy and drive the association's continued growth.

Colunga is expected to be a major thought partner to the organization's Chief Executive Officer (CEO) and executive leadership team. In this role, she will reportedly oversee every facet of AMPP's financial management. Colunga's responsibilities will reportedly cover several organizational finance functions, including audit, treasury, tax, insurance, operations planning and analysis (OP&A), corporate controllership and business finance and analytics.

"Our organization's continued financial strength is vital for AMPP's capacity to fulfill our mission and generate enduring value for members and customers," said AMPP CEO Alan Thomas.

"Jennifer brings profound financial expertise and a proven track record of accomplishments. With these qualities, she is the ideal leader to guide our talented finance organization and deliver a comprehensive strategic financial vision to propel AMPP toward future growth and success."

Jennifer Colunga

Before this appointment, Colunga reportedly worked as controller at Pioneer Contract Services Inc., managing all aspects, from cash management to audit. In 2021, Colunga worked as the vice president of finance and accounting at Gridiron, LLC, where she reportedly managed the implementation and integration of NetSuite, helping the company's closing and consolidation process. AMPP adds she had successfully integrated a $50 million acquisition into the Enterprise Resource Planning (ERP) system and managed financial policy development, budget planning, risk management and tax compliance.

As a former corporate controller at Pharos Marine Automatic Power, Inc., Colunga reportedly aligned financial policies, established reporting systems and navigated the transition of complex global financial operations. Additionally, in her role as vice president of finance at Microwave Networks Incorporated, Colunga prepared annual budgets, provided quarterly performance updates for the board of directors and managed treasury functions.

"I feel fortunate to be part of AMPP's leadership team and am enthusiastic about guiding its finance organization toward contributing to future success in its evolving strategy," Colunga said.

Colunga holds an MBA and a bachelor's degree in accounting from the University of St. Thomas in Texas. She is also a certified public accountant in the State of Texas.

PHOTO: COURTESY OF AMPP

PPG Announces New Executive Appointments

Global coatings company PPG recently announced two new leadership appointments, effective March 1. According to a release from the company, current Senior Vice President and Chief Growth Officer Irene Tasi will now take on the position of senior vice president of industrial coatings. Additionally, current Vice President of Automotive Coatings Alisha Bellezza will now take on the position of senior vice president of automotive coatings.

PPG states that Tasi was named CGO and a member of the company's Operating Committee in late 2021 and has since helped lead and accelerate PPG's growth agenda. She has reportedly overseen corporate strategy, long-range planning, sustainability, communications and marketing, brand and sales excellence, digital, market-driven innovation and new growth initiatives in her current position. The company adds that she has played a large role in developing the company's Enterprise Growth Strategy.

Irene Tasi

Alisha Bellezza

Bellezza was appointed to her current role last year and has worked on PPG's Operating Committee since joining the company. In her new position, Bellezza will reportedly continue supporting PPG's focus on improving sustainability for automotive customers and driving expansion in the mobility sector and contributing to growth at PPG.

PHOTO: COURTESY OF PPG

Companies Announce Q4, 2023 Financial Results

PPG

On Jan. 18, PPG announced its 2023 fourth-quarter earnings report as well as its year-end report. For the quarter, the company reported net sales of approximately $4.4 billion, up about 4% year-over-year, including organic sales growth of 1%. Full-year 2023 showed net sales from continuing operations at $18.2 billion and was supported by 3% organic sales growth.

Tim Knavish

"Capping off a record year, the PPG team delivered solid year-over-year sales growth, strong adjusted earnings growth and record operating cash flow," said Tim Knavish, PPG Chairman and Chief Executive Officer.

The company's Performance Coating Segment saw net sales of $2.6 million, an increase of 5% from last year's $2.4 million. Segment income rose by 19% compared to the previous year due to higher selling prices and moderating input costs. Segment operating margins reportedly improved by 150 basis points year over year.

Sales of PPG's technology-advantaged aerospace products were reportedly strong, as the business delivered mid-teen percentage organic sales growth year over year. Protective and marine coatings reportedly delivered mid-single-digit percentage organic sales growth driven by strong volume growth in the U.S. and Europe. Automotive refinish coatings organic sales reportedly grew by a low-single-digit percentage, supported by growth in Europe and Asia.

Architectural coatings in Mexico reportedly had a strong quarter, as PPG continued to benefit from a growing Mexican economy and its Comex brand. U.S. and Canada architectural coatings sales were reportedly lower, as growth in the professional contractor channel was offset by continuing softness in do-it-yourself demand.

In the Industrial Coatings segment, Q4 net sales went up to $1.7 million, up 2% from $1.6 million last year. PPG notes that this increase was supported by favorable foreign currency translation. According to the release, automotive OEM coatings organic sales increased by a mid-single-digit percentage with higher selling prices in all regions and higher aggregate sales volumes led by PPG's market share gains in the Asia-Pacific region and Mexico.

Industrial coatings organic sales reportedly dropped by a mid-single-digit percentage with lower volumes in most sub-segments. Packaging coatings organic sales were also reportedly down a low-single-digit percentage from softer customer demand in Europe and Latin America, offset by growth in the U.S. and the Asia-Pacific region. Segment income was higher than last year by $75 million, or 48%, due to input costs moderating from historically high levels and aiding the manufacturing performance.

PPG's full-year 2023 net sales were around $18.2 billion, up about 3% compared to the previous year. Organic sales were reportedly higher by 3% from higher selling prices. Adjusted EPS was also a record, increasing 27% from higher selling prices, moderating input costs, structural cost savings and positive foreign-currency translation. This was reportedly offset by lower sales volumes. Ending the year, input costs and inventory levels reportedly remained above historical levels.

In 2023, PPG paid about $600 million in dividends and capital expenditure came in at around $550 million. The company repurchased $100 million of stock in the fourth quarter and had about $1 billion remaining on its current share repurchase authorization at the end of 2023.

> "Capping off a record year, the PPG team delivered solid year-over-year sales growth, strong adjusted earnings growth and record operating cash flow." — *Tim Knavish, Chairman and CEO, PPG*

"Looking at the full year, in addition to our record financial performance, we successfully implemented various strategic initiatives to strengthen the company, including key actions to position PPG for higher organic growth," said Knavish.

PPG also released projections for the first quarter and full year 2024 based on current global economic activity, soft industrial production, demand stabilization in Europe,

PHOTO: COURTESY OF PPG

continued growth in Mexico and demand improvement in China.

"From a PPG perspective, we plan to deliver volume growth in 2024 by executing on our key strategic growth initiatives and fully capitalizing on continued demand in several areas, including aerospace and Mexico, which will also benefit from cross-selling initiatives through our concessionaire network," said Knavish.

SHERWIN-WILLIAMS

Global coatings firm The Sherwin-Williams Company released its 2023 fourth-quarter and year-end financial results on Jan. 25, reporting consolidated net sales at a 0.4% increase for the quarter and a 4.1% increase for the year. This brought the net sales for the quarter to $5.25 billion and net sales for the year to a record $23.05 billion.

Heidi G. Petz

The company attributes the fourth-quarter growth to an increase in Paint Stores Group net sales volume. This growth was partially offset by lower net sales volumes in the Performance Coatings and Consumer Brands Groups.

"Sherwin-Williams delivered solid fourth-quarter results, with positive sales growth and significant year-over-year gross margin improvement," said President and Chief Executive Officer, Heidi G. Petz. "We continued our accelerated growth investments in the quarter, which we are confident will continue to drive profitable above-market growth in future periods.

"Sales in all three reportable segments were within or better than our guidance. In our architectural businesses, commercial and residential repaint were the strongest performers, while DIY remained challenging. In our industrial businesses, growth varied by division and region, reflecting ongoing choppiness in the market. Paint Stores Group and Performance Coatings Group segment margins expanded year over year."

For the full year, sales reportedly grew to a record $23.05 billion, with gross margin expanded to 46.7%, which Petz notes is well within their current targeted range. Adjusted diluted net income per share also increased 18.6% to a record $10.35 per share.

Net sales in the Paint Stores Group increased 2.3% to $2.9 billion, primarily due to low-single-digit percentage net sales volume growth driven by protective and marine, commercial and residential repaint end markets. PSG segment profit also reportedly increased 14.8% to $567.3 million due to growth in net sales volume and moderating raw material costs, partially offset by continued investments in long-term growth strategies and higher employee-related expenses.

In the Consumer Brands Group, net sales decreased 7.1% to $692.3 million for the quarter, due to a mid-single-digit percentage decrease in net sales volume due to demand softness in North America and the divestiture of the China architectural business which decreased net sales by approximately 3% year-over-year, offset by increases in Latin America and Europe. Segment profit decreased 89.7% to $3.6 million, primarily due to lower net sales volume and higher foreign currency transaction losses driven primarily by the Argentine Devaluation of $30.8 million. These decreases were offset by benefits from moderating raw material costs.

Net sales in the Performance Coatings Group also increased 0.4% year-over-year to $1.614 billion. Sherwin attributes this increase to acquisitions and favorable currency translation, which both increased net sales by a low-single-digit percentage. Growth was reportedly led by the Industrial Wood including acquisitions, Coil and Automotive Refinish businesses, offset by decreases in the Packaging and General Industrial businesses. Segment profit for the fourth quarter increased 40.1% to $220.3 million, as a result of moderating raw material costs, partially offset by lower net sales volume, an increase in selling costs and the Argentine Devaluation of $11.0 million.

In terms of a 2024 outlook, Petz said that the company expects first quarter 2024 consolidated net sales will be up or down a low-single-digit percentage compared to the first quarter of 2023. For the full year 2024, based on the current indicators, they expect consolidated net sales to be up a low to mid-single-digit percentage.

> "Sherwin-Williams delivered solid fourth-quarter results, with positive sales growth and significant year-over-year gross margin improvement."
>
> *— Heidi G. Petz, President and CEO, The Sherwin-Williams Company*

PHOTO: COURTESY OF SHERWIN-WILLIAMS

"We expect to see some recovery in new residential construction, moderation in commercial construction, choppiness in repair and remodel and few catalysts in DIY. We expect Auto Refinish and Protective & Marine demand to remain strong and gradual improvement in Industrial Wood and Packaging, with less clarity in General Industrial," said Petz.

"We enter 2024 with confidence in our team's ability to outperform the market given our customer-focused differentiated services and solutions. These solutions drive customer productivity and profitability and position us to create value in any environment."

GRACO

On Jan. 29, equipment manufacturer Graco Inc. released its fourth-quarter and full-year financial results for 2023, reporting record quarter and annual operating earnings.

According to the release, for the quarter, net sales increased 3% in the Americas and 5% in EMEA, while decreasing 5% in Asia Pacific. Net sales reportedly increased 2% from the same period last year to $566.6 million in 2023. Sales also increased 1% in the Americas and increased by 5% in the EMEA. Additionally, there was a decrease of 4% in Asia Pacific.

"Graco reported record fourth-quarter and annual sales and operating earnings with sales growth in all segments for the quarter," said Mark Sheahan, Graco's President and CEO.

"The Industrial and Process segments achieved record annual sales and operating earnings while Contractor achieved record operating earnings for the year despite a

Mark Sheahan

challenging environment. The Contractor segment saw fourth-quarter sales growth driven by new product introductions and continued strength in both the protective coatings and spray foam product categories. I am proud of the work our teams have done and want to thank our employees, customers and vendors for another great year."

> "Graco reported record fourth-quarter and annual sales and operating earnings, with sales growth in all segments for the quarter."
>
> *— Mark Sheahan, President and CEO, Graco Inc.*

In the Contractor segment, sales increased 2% to $238.8 million for the quarter and decreased 1% to $985.7 for the year. Favorable response to new product offerings was reportedly offset for the quarter and year by slower economic activity in worldwide construction markets. The operating margin rate for this segment improved 4 percentage points for both the quarter and year. Lower product costs and realized pricing combined to drive the operating margin rate higher for the quarter. Realized pricing drove most of the improvement in the operating margin rate for the year.

For the Industrial segment, sales increased 1% to $192 million for the quarter and 2% to $662.8 million for the year as continued end market strength in the Americas was reportedly offset by lower finishing system sales in EMEA and Asia Pacific. The operating margin rate for this segment was flat for the quarter and was lowered by 1 percentage point for the year as realized pricing and lower product costs were affected by unfavorable changes in currency translation rates and higher operating expenses.

In the Process segment, sales increased 4% to $135.9 million for the quarter and increased 11% to $547.1 million for the year. The operating margin rate for this segment increased 3 percentage points for the quarter, primarily due to realized pricing and lower product costs. Expense leverage drove an additional 2 percentage point increase in the operating margin rate for the year.

"As we head into a new year, the business is performing well, and demand levels generally remain steady in an uncertain macroeconomic environment," said Sheahan.

"We are initiating full-year 2024 revenue guidance of low single-digits on an organic, constant currency basis as we will continue to focus on our core strategies of new product development, expanding distribution, entering new markets and targeting strategic acquisitions to drive shareholder value."

AKZONOBEL

Global coatings manufacturer AkzoNobel released its

PHOTO: COURTESY OF GRACO

fourth-quarter and end-of-year financial reports on Feb. 7, indicating a 3% decrease in revenue for Q4 and a 2% decrease for the full year. Additionally, constant currencies were up in both Q4 and the full year, by 4% and 5%, respectively.

Greg Poux-Guillaume

For the company's fourth quarter, revenue was down 3%, and 4% higher in constant currencies, driven by volumes as well as pricing. ROS was at 8.7%, up from 4.8% in 2022. Adjusted operating income was up to 221 million euros (about $237 million) from 2022's 129 million euros; while operating income, up from 2022's 103 million euros, totaled 214 million euros.

Looking at the full fiscal year 2023, revenue was down 2% but 5% higher in constant currencies. ROS was also up to 10.1% compared to 2022's 7.3%. Acquisitions also added 2%, where hyperinflation reduced revenue by 1%. Akzo's 2023 adjusted operating income increased 36% to 1.074 billion euros from last year's 789 million euros. Operating income also increased from 708 million euros in 2022 to 1.029 billion euros.

AkzoNobel adds that several highlights from the quarter included its introduction of an industry-first architectural powder coating, the first bio-based interior coating supplied to KIA motors and a major investment in coatings technology to support the beverage can industry.

The ROS for the company's Decorative Paints segment for the fourth quarter improved to 8.3%, up from last year's 5.2%. For this segment, revenue was 2% lower and up 5% in constant currencies. Revenue growth in constant currencies was mainly due to a combination of higher volumes in all regions, and pricing.

Looking at the full year, reported revenue was down 1% while in constant currencies was up 6%, mainly driven by pricing. Operating income increased 29% to 500 million euros and adjusted operating income increased 27% to 500 million euros. ROS reportedly improved to 11.6% from 9.0% in 2022.

The ROS for the Performance Coatings' fourth quarter was up to 10.7%. The segment's revenue was down 3% (up 4% in constant currencies), driven by higher volumes in all businesses, especially in Powder Coatings and Marine and Protective Coatings, as well as pricing. Adjusted operating income in this segment also increased to 165 million euros, compared to Q4 2022's 98 million euros.

> "We have good momentum heading into 2024 and we expect to resume growing volumes while delivering further margin—and profit—expansion."
>
> — Greg Poux-Guillaume, CEO, AkzoNobel

Looking at the full year, reported revenue was down 2% while in constant currencies was up 4%, mainly driven by pricing. Operating income increased to 698 million euros and adjusted operating income increased to 685 million euros. ROS reportedly improved to 10.8% from 7.6% in 2022.

For the mid-term, AkzoNobel says it is aiming to expand profitability to deliver an adjusted EBITDA margin of above 16% and a return on investment between 16% and 19%, underpinned by organic growth and industrial excellence.

"2023 was a year in which AkzoNobel delivered a clear rebound in performance. Our volumes stabilized, outperforming many of our markets, and our profits rebounded on resilient pricing and the first effects of raw material deflation," said Greg Poux-Guillaume, AkzoNobel CEO.

"In parallel, our efforts to transform our company gathered pace, allowing us to absorb persistent global inflation and unfavorable currency effects to beat the targets we set ourselves at the beginning of the year."

The company also plans to lower its leverage to around two times in the mid-term, while remaining committed to retaining a strong investment grade credit rating.

"We have good momentum heading into 2024 and we expect to resume growing volumes while delivering further margin – and profit – expansion," commented Poux-Guillaume.

On Red Sea shipping disruptions, CFO Maarten de Vries said in a call with Reuters that longer supply lines and increasing costs could impact the company, which sources its raw materials from China. Poux-Guillaume added that carriers' delays were now around 10 to 12 days. "For us it's a working capital impact, but it's manageable," he said.

PHOTO: COURTESY OF AKZONOBEL

PHOTO: DIMASOBKO / GETTY IMAGES

"BLACK MAGIC" DISPELLED?

Coal Tar vs. Modified Epoxy Technology

BY VIJAY DATTA AND MIKE O'DONOGHUE, AKZONOBEL; TONY BELK, NUCOR/SKYLINE LLC; AND CORTNEY CHALIFOUX, POND & COMPANY

How many of us are aware that during the last century, one of the great achievements in the world of corrosion mitigation was to modify the newly invented epoxy resins and coatings of around 1947 with that "black stuff": coal tar pitch? Not unexpectedly, unmodified epoxy coatings were expensive and somewhat limited in their immersion service performance when they first arrived on the scene. Hence, one challenge for pioneering coating formulators in the mid-20th century was how to reasonably lower the overall cost of the epoxy thermoset systems and improve upon their water resistance with an inexpensive extender resin. Moreover, how to do so and yet improve upon their performance in immersion service?

The answer was to add in a high-quality pitch derived from coal tar, a hydrophobic material first produced in the U.S. in 1913, and readily available as a by-product from the production of coke for steelmaking.

With poetic license it was—almost as if, with a wave of a magic wand, and a "hey presto"—the unmodified epoxy coating turned into a magical, black-colored material. That very black

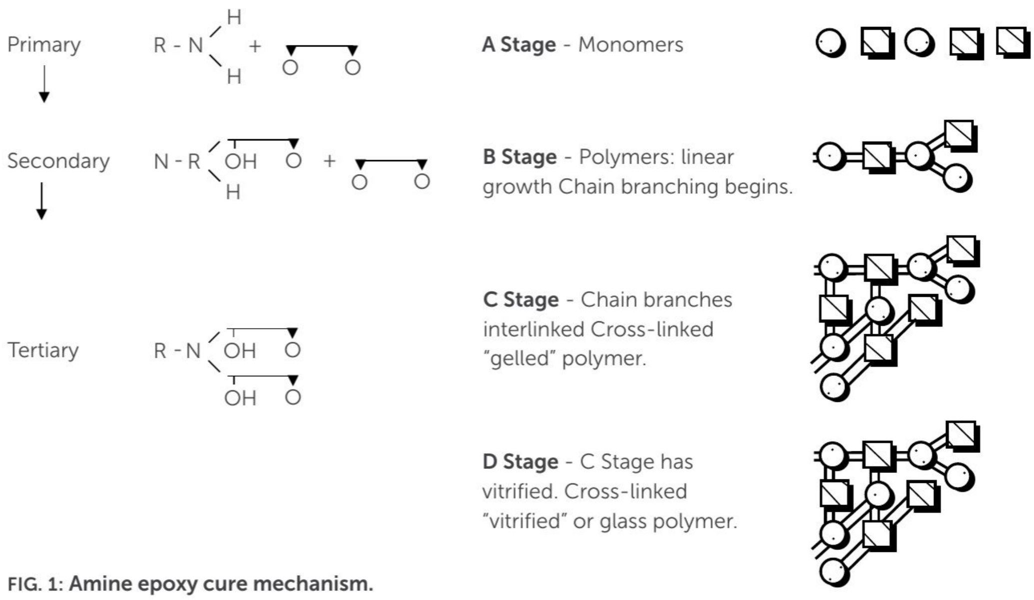

FIG. 1: Amine epoxy cure mechanism.

CONT. FROM P. 11 color was what gave the coating supernatural hydrophobicity, to such an extent that no other colored epoxy coating would do for the engineering community almost a century ago.

These time-honored black knight coal tar epoxy coatings became entrenched in the collective thinking of engineering best practice.

Indeed, many engineers of old for years believed that if an epoxy coating wasn't black, it couldn't be any good. In no time at all they became synonymous with a level of inordinate performance and corrosion protection not thought possible from emergent light-colored, hazard-diminishing, and inspection-facilitating epoxies.

But over time, much has changed. This article briefly compares the pluses and minuses of coal tar epoxy coatings of yesteryear with those of the modified epoxy coating technology that largely replaced them. Nowadays, synthetic hydrocarbon reinforcing resins are preferred to coal tar pitch when used as an extender resin or in epoxy coatings. Comparatively, new epoxy coatings have also been formulated in other ways to afford superior immersion performance, safety, sustainability and aesthetic qualities than their albeit outstanding coal tar-containing predecessors.

Despite coal tar epoxies having been one of the so-called workhorses in the world of protective coatings for many decades, some of the attendant health, saftey and environmental issues inevitably led to a pronounced decline in their use.

The Amine-Epoxy Cure Mechanism

Performance can vary dramatically within the generic classification of two-component epoxies, largely because of the many curing agents to cross-link the bisphenol A (Bis A), Bis F and novolac epoxy resins. A sampling of amine curing agents includes:

- Polyamide;
- Aliphatic amine;
- Aromatic amine;
- Amido amine;
- Cycloaliphatic amine;
- Phenalkamine; and
- Polyamine adduct.

A quick explanation on how epoxy coatings cure can be helpful. Irrespective of whether a coal tar extender resin is present or absent in a two-component amine-cured epoxy, a four-stage curing mechanism identified as A stage through D stage will take place between epoxy groups and the active hydrogen atoms in the curing agent ***(Fig. 1)***.[1]

In the A stage, the epoxy and curing agent monomers are mixed, and cross-linking has not yet begun.

The B stage follows. Polymers are formed as one of the active hydrogens in

GRAPH: COURTESY OF THE AUTHORS

the primary amine (-NH_2) in the curing agent reacts with an epoxy group. This results in formation of a hydroxyl group (-OH) and a secondary amine (-NH). The latter then reacts with another epoxy group to form a tertiary amine (with its autocatalytic influence), and yet another hydroxyl group. Polymer chains thus grow linearly and then entangle.

The C, or gelled stage, progresses somewhat slowly as entangled polymer chains interlink and form a giant cross-linked polymer. The latter becomes vitrified and post-curing leads to an essentially complete cross-linked D stage — the final coating form.

Throughout the cure process, the generation of hydroxyl groups is most important because they are considered by many to help provide or promote adhesion to polar sites on steel surfaces via hydrogen bonding.

Coal Tar Epoxies: The Black Knights

PERFORMANCE

In a typical Bis A epoxy coating where coal tar is an extender, it is theoretically possible that different polar chemical groups on — say, the phenolic compounds in the coal tar can cause further cross-linking, either with the epoxy or curing agent, during the foregoing A- though D-stage epoxy-reactions.

Quite apart from the predominately hydrophobic nature of coal tar providing water resistance, reactive moieties in the tar may also have additive or synergistic effects and can further lower the permeability of the coating (with the proviso that the material is fresh). The aged material together with the moieties on the tar and the cross-linked epoxy may form an interpenetrating network.[2-5]

Today, synthetic hydrocarbon reinforcing resins are preferred to coal tar pitch when used as an extender resin or additives in epoxy coatings.

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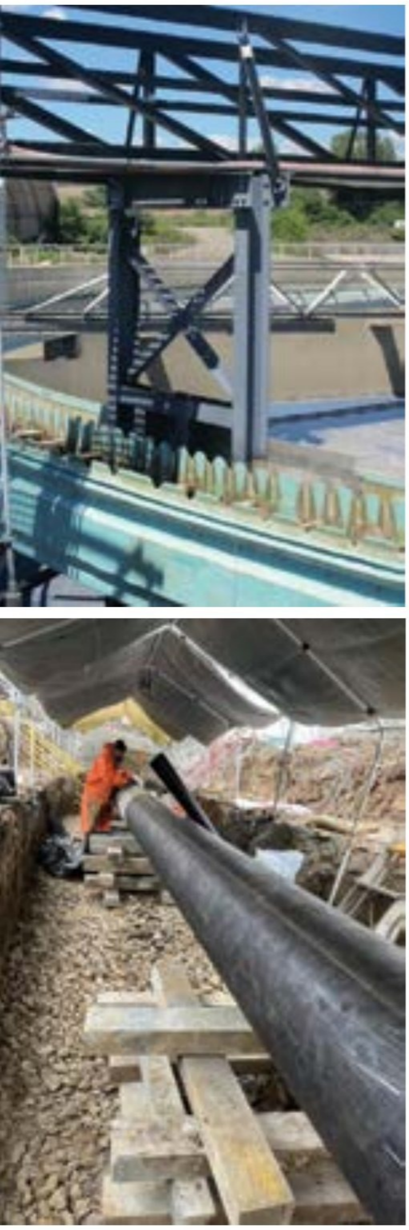

FIG. 2: Examples of the immersion and buried service obtained by steel structures and pipelines coated with coal tar epoxies include (top) coal tar epoxy after 30 years immersion on a wastewater clarifier rake; and (bottom) coal tar epoxy after almost 50 years of buried service.

PHOTO: (FROM TOP) COURTESY OF RANDY NIXON, CORROSION PROBE, INC.; COURTESY OF MARK DROMGOOL, KTA-TATOR AUSTRALIA PTY LTD.

For best results, a coal tar epoxy system is applied to steel free of surface contaminants and blasted to an SSPC-SP 10/NACE No. 2 Near White Metal standard having a sharp, angular profile of 2–3 mils. Spray application of a two-coat system at ca 8 mils dry film thickness per coat is generally carried out for a full system DFT of around 16 mils.

Once in immersion service, aside from their low permeability and good chemical resistance properties, well-formulated coal tar epoxy coatings possess high dielectric strength. They interpose electrical resistance into corrosion cell circuits, filter ions, and serve as a barrier to current flow. Thus, they have exhibited long-life protection to offshore structures and buried pipelines where water resistance and low moisture vapor transmission and cathodic protection is required. This resistance also extends to buried or immersed steel structures that have impressed current external cathodic protection (CP) systems, such as underground and undersea pipelines. Coal tar epoxy coatings have a much higher CP over-voltage capability than almost any other coating type ever developed.

As with most epoxy coatings, the properties of coal tar epoxies are largely a function of the curing agent used to cross-link the epoxy resin. A specific example to differentiate coal tar coatings while illustrating their curing agent dependency is in liquid sewage immersion at water and wastewater treatment facilities where coatings are exposed to fatty acids.

For instance, polyamide epoxy coatings have both fair chemical resistance and excellent water resistance. Their coal tar modified versions, however, and the unmodified polyamide epoxy coatings themselves, have fairly poor chemical resistance against oleic acid or linoleic acid found in sewage. These coal tar polyamide epoxy coatings are prone to chemical attack by organic fatty acids as well as biological attack by bacteria rendering them potential "bug foods."

Properties such as abrasion and temperature resistance, flexibility, and cure-speed vary depending on the type of coal tar epoxy. Apart from flexibility, amine cured coal tar epoxies have some superior properties compared to polyamide cured coal tar epoxies.

Despite the low water and low ionic permeability of well-formulated coal tar epoxies they have a few other drawbacks. The composition and quality of coal tar pitch varies depending upon its source and the coatings made from it invariably have poor shelf lives. Moieties such as polar groups in tar acids may react with either the base epoxy component or curing agent. In some cases, the coal tar epoxy coating needs to be supplied as a three-component kit with the coal tar pitch material kept separate from both the epoxy resin and the curing agent. These reactions can lead to foreshortened recoat windows of the applied coating film and other adverse effects such as the coating becoming brittle upon aging.

Additional downsides of coal tar epoxies are that they are limited to black, aluminum or dark colors, cannot be readily topcoated since the black pitch can bleed through them, and these coatings are susceptible to cracking and "alligatoring" on their upper layers by UV in sunlight.

HEALTH AND SAFETY CONCERNS

Despite coal tar epoxies having been one of the so-called workhorses in the world of protective coatings for many decades ***(Fig. 2)***, some of the attendant health, safety and environmental issues arising from their application, leaching and repair by abrasive blasting and sanding has inevitably led to a pronounced decline in their use.

To understand why let's look first at coal tar and then at coal tar pitch.

Coal tar is produced during the pyrolysis (heating in the absence of oxygen) of metallurgical grade coal as it is heated in a fluidized bed at around 1,000 C to produce coke, used primarily for steel making. The coal tar was originally a waste material or the residue from this process. If coal tar is refined during a distillation process at various temperatures and pressures, a material called coal tar pitch is produced. This is a black or dark brown material that has been found to be an important industrial product. It is used widely in the aluminum smelting industry to make anodes as a rich source of carbon.

However, coal tar pitch contains a mixture of bi- and polycondensed aromatic hydrocarbons. These are collectively known as polycyclic aromatic hydrocarbons (PAHs). PAHs can be separated into three fractions by distillation, viz., light oil, middle oil and heavy oil.

The components making up the "heavy oil" fraction include benzo(a)pyrene, naphthalene, phenols, cresols, pyridines, anthracenes, carbazoles and quinolines. Coal tar contains dozens of compounds which by themselves, or in a mixture, can pose serious health problems.

Some PAHs are readily absorbed through the skin, are mutagenic and toxic, and may cause dermal problems and cancers. In fact, in 2006 coal tar was classified as a Group 1 Carcinogen by the International Agency for Research on Cancer (IARC) and as a Category B Carcinogen by the European Union.[6]

In 2023, the National Institute of Health (NIH) published in its National Toxicology Program's *15th Report on Carcinogens* that numerous studies – mostly case reports – revealed that occupational exposure to coal tars, or coal tar pitches is associated with skin cancer, including scrotal cancer and other several other cancers, e.g., lung, bladder, kidney and digestive tract.[7] Applicators exposed to coal tar by inhalation of fumes, swallowing or skin contact are therefore particularly vulnerable to these health hazards given they atomize coal tar coatings during spray application.

For many years coating manufacturers supplied low-cost coal tar-based anti-corrosive barrier coatings. Applicators have long complained of "coal tar burns" or acute dermal irritation caused by overspray contacting their skin during coal tar epoxy application or from fragmented microfine dust arising from abrasive blasting aged coal tar coatings.

Concerns have been reported for workers exposed to coal tar epoxies (as well as coal tar enamels) in both their application and future repair. Public exposure to deleterious chemicals leaching from coal tar enamels led to it no longer used in potable water service. PAHs are present in coal tar enamels, but a discussion of these coatings is beyond the scope of this paper. Suffice it to say that coal tar enamels have the best long-term immersion track records of all linings, being some 50 or 100 years. A comparison of coal tar enamels and coal tar epoxies is available in the referenced literature.[8]

It is interesting to note that as long ago as the 1960s, certain North American coating manufacturers took the proactive step to cease production and sales of coatings that contained coal tar pitch.[9] Since then, many other coating manufacturers have followed suit.

Notwithstanding, such was the hallowed appeal of those black coal tar epoxies that some early marketing gobbledygook for alternative colored epoxy coatings described them as "albino tars." This was clearly a reflection that manufacturers thought that keeping the word tar in a new epoxy coating's description conveyed to engineers and owners a similar but white magic immersion performance could be achieved by them.

As long ago as the 1960s, certain North American coating manufacturers took the proactive step to cease production and sales of coatings that contained coal tar pitch. Since then, many other coating manufacturers have followed suit.

Modified Epoxies: The White Knights

What is the best solution to overcome the inherent weaknesses posed by the black knight coal tar epoxy coatings? The answer is safer and higher performing white knight aromatic hydrocarbon-modified epoxies and other newer technology ultra-high solids, and solvent-free epoxies. Several in the newer technology category even possess low temperature cure characteristics down to 0 F (-18 C) and surface tolerance.

Single-coat or multi-coat, light-colored and easily inspected modified epoxy coatings are specified routinely nowadays in the same industrial, marine and

TABLE 1: **Coal Tar Epoxy vs. Typical Hydrocarbon-Modified Epoxy**

REMARKS	COAL TAR EPOXY	HYDROCARBON-MODIFIED EPOXY
Corrosion Resistance	Excellent	Excellent
Extender	Coal tar	Synthetic Hydrocarbon
Package Stability	Poor < 6 months	Excellent > 1 year
Aged Self-Recoat	Poor (12-24 hrs max at 77°F (25°C))	Very Good (30 days)
Skin Irritation	Burning Sensation	Mild to Severe
Vapor Transmission Rate	Low (0.7 perms)	Low (0.7 perms)
Aged Film Brittleness	Fair	Excellent
Abrasion Resistance	Excellent	Excellent
Impact Resistance	Good	Excellent
Minimum Application Temperature	50°F (10°C)	20°F (-7°C)
Meets AWWA C-210	Yes	Yes
Topcoat Bleed	Yes	No
Compatible with CP Systems	Yes	Yes

Single-coat or multi-coat, light-colored and easily inspected modified epoxy coatings are now routinely specified in the same industrial, marine and offshore environments previously served by the precursor coal tar epoxies.

offshore environments previously served so well by the precursor coal tar epoxies. Superior corrosion protection and decades of success in immersion service are achievable using hydrocarbon-modified epoxy coatings.

In the amine-epoxy cure mechanism, reactions between polar groups in coal tar and the epoxy or curing agent can also be detrimental to the epoxy coating development. Such is not the case if coal tar is replaced by a synthetic hydrocarbon resin. The latter are reinforcing resins that are specialty polymers used in modified epoxy coatings.

While they resemble coal tar resins in hydrophobicity, they have the significant advantage of being inert and free from polar groups. Neutral, and with no acid number, these synthetic hydrocarbon resins are essentially inert to acid, alkali, water, salts and resist aliphatic hydrocarbons, fats and oils. Their unusually high carbon to hydrogen ratios (with no free carbon present) account for their stability and inert qualities. Consequently, as highlighted in **Table 1**, hydrocarbon-modified epoxies have equal or better water resistance and shelf-life stability compared to coal tar epoxies.

Since no reaction occurs between the reinforcing hydrocarbon resin and polymer backbone, the coating applied usually does not suffer from in-can stability problems resulting from storage. Hence, the resulting structure and performance of the properly applied modified epoxy coating is more consistent.

HYDROCARBON-MODIFIED EPOXY COATING A

Modified epoxy Coating A consists of a synthetic, light colored hydrocarbon resin in a pigmented modified epoxy base with a special amine adduct curing agent.

A unique amine-epoxy curing mechanism provides excellent immersion performance when Coating A is applied in either a high build single coat or as part of a multi-coat system.

The principal function of the modified epoxy Coating A is to provide long term anticorrosive barrier corrosion protection due to a dense cross-linked molecular structure.

Coating A is ideal for a single coat, high build application over hydroblasted surfaces (HB2) as it possesses good tolerance to damp surfaces.

Originally targeted for the most severe environments encountered in offshore conditions, such as underdeck areas, splash, total immersion and tidal zones, Coating A has a successful track record that spans approximately 30 years. The hydrocarbon modification of the epoxy resin in Coating A provides enhanced surface tolerance making it an ideal product for various maintenance situations.

Like all coatings, epoxies—including hydrocarbon-modified epoxies—can be formulated for specific purposes and service duties. Using these coatings in a slightly different service environment to what was intended can be problematic. For instance, some hydrocarbon-modified epoxies are designed to be used for very early immersion service, for example when recoating wharf piles, an offshore platform jacket or sheet piling in a marine environment between tides. These are specifically designed to be one-coat, high build systems.

Certain hydrocarbon modified epoxies where two coats are required and where there is no requirement for early immersion can cause many problems. The most common manifestation of this is poor adhesion and disbondment between the two coats of high build epoxy caused by an amine blush. The latter is itself caused by a low molecular weight amine from the cuing agent that reacts with humidity and CO_2 under certain environmental conditions. Often invisible the amine blush is a carbamate film that has the potential to act as a very efficient bond-breaker between the first and subsequent coats.

Table 2 shows some performance data for Coating A.

Case Histories

HYDROCARBON-MODIFIED EPOXY COATING A

From 2010 to 2011, some 159 out of approximately 200 pipe cans of a 3.6-kilometer penstock were internally lined in China with a two-coat system of modified

Like all coatings, epoxies—including hydrocarbon-modified epoxies—can be formulated for specific purposes and service duties.

TABLE 2: Performance Test Data for Hydrocarbon-Modified Epoxy Coating A

TEST TYPE	TEST METHOD	RESULTS
Immersion	ISO 2812 Part 2 Resistance to water immersion @ 104°F (40°C)	No film defects after 1 year exposure
Condensation	ISO 6270 Resistance to continuous condensation @ 95°F (35°C)	No film defects after 1 year exposure
Salt Spray	ISO 7253 Resistance to neutral salt spray (fog) @ 95°F (35°C)	No film defects and average 3.5mm rust creep at scribe after 6000 hours exposure
Cathodic Disbondment	ASTM G8 – "Cathodic Disbonding of Pipeline Coatings," Method A @ -1.5V	Typically, < 3mm disbondment after 30 days
Cyclic Corrosion	ASTM D5894 – "Cyclic Salt Fog/UV Exposure of a Coated Metal"	No film defects, and an average 6.5mm rust creep at scribe after 4200 hours exposure (12.5 cycles)
Adhesion	ASTM 4624 – "Tensile & Elongation Properties of Coating"	Not less than 1450 psi (10MPa) using PAT Model GM01 hydraulic adhesion tester on 5mm thick coated steel
Abrasion	ASTM D406 – "Abrasion Resistance of Coatings via Taber Abraser"	Average 88mg weight loss per 1000 cycles using CS10 wheels and 1 Kg load
Impact	ASTM D2794 – "Resistance to Effect of Rapid Deformation (Impact)"	Direct Impact Resistance -2.5 Joules
Tensile Strength	ASTM D2370 – "Tensile & Elongation Properties of Coatings"	Average 1595 psi (11MPa) required to fracture coating

FIG. 3: Hydrocarbon-Modified Epoxy Coating A on penstock exterior.

epoxy Coating A and subsequently shipped to the Yukon in Canada ***(Figs. 3 and 4)***. The remaining lining application was carried out in British Columbia, Canada.

The carbon steel was free of surface contaminants such as soluble salts (e.g., non-visible chloride contamination ≤ 10µg/cm^2) grease, and oil and abrasive blasted to SSPC-SP 10/NACE No. 2 Near White Metal standard. A sharp, angular profile of 2–4 mils was specified using an SSPC-AB 2 (recycled ferrous) mixture of GL25 steel grit and S330 steel shot. Two coats of Coating A were applied at ca 8–10 mils DFT per coat per AWWA C210-07 (initial application and field repair coats).[10, 11]

In another project, between 2017 and 2022, over 25,000 tons of steel piling arrived from China in up to 80-meter length sections before shipment to Burnaby, British Columbia in Canada. The steel piling had been externally coated with a two-coat system of the hydrocarbon epoxy Coating A. The piling was field spliced and joined as it was driven and field prepared to the SSPC-SP 10/NACE No. 2 standard and coated over the water in specially made containments.

Prior to shipment to Canada, the carbon steel was free of surface contaminants

FIG. 4: Hydrocarbon-Modified Epoxy Coating A application in penstock interior.

PHOTOS: (FROM LEFT) COURTESY OF GORDON MCPHAIL KGS GROUP; RAYMOND KUFAAS, NORSKE CORROSION AND INSPECTION SERVICES LTD.

such as soluble salts, grease and oil and abrasive blasted to SSPC-SP 10/NACE No. 2. A sharp and angular profile of 2–3 mils was specified using a mixture of grit and shot. Two coats of Coating A were applied at 12-16 mils DFT per coat ***(Fig. 5)***.

MODIFIED EPOXY COATINGS B1 AND B2

Modified epoxy Coating B1 is an ultra-high-solids epoxy coating that uses a special curing agent package. The latter provides molecular mobility during the epoxy amine reaction and results in a high degree of cure and a coating film with very low permeability.

After 40 years of continuous exposure in the submerged (ISO 12944 IM4 – sea or brackish water with CP), splash/tidal (IM4/CX – immersion and extreme corrosivity) and atmospheric (CX – extreme corrosivity) zones on an offshore platform in Europe's North Sea, the modified epoxy Coating B1 system was found to be 99% intact and still performing well.[12] The raison d'être for the uninterrupted and successful 40-year service was a five-coat system where a three-coat modified epoxy containing high loadings of lamellar glass flake was sandwiched between an epoxy primer and epoxy finish coat. The glass flake modified epoxy Coating B considerably enhanced the abrasion and mechanical properties of the overall coating system.

Another high-solid modified epoxy Coating B2 capable of extremely low temperature cures uses a modified phenalkamine curing agent which ensures that a completely cured film is obtained that has very low water permeability. This modified epoxy coating has decades of proven success on millions of square feet on abrasive blasted steel and on lesser prepared surfaces. Both the ultra-high-solids hydrocarbon-modified epoxy Coating A and modified Coating B2 can be applied in a single coat at 16–18 mils DFT and both are capable of providing rapid immersion service and curing under water.

PHOTOS: COURTESY OF MIKE RABIN, PIPE AND PILING SUPPLIES (B.C.) LTD.

FIG. 5: Steel pilings coated externally with Hydrocarbon-Modified Epoxy Coating A.

FIG. 6: **Modified Epoxy Coating B2 was successfully applied in sewage plants *(top and center)*; and for potable water service *(bottom)*.**

PHOTOS: COURTESY OF THE AUTHORS

Significantly, using electrochemical impedance spectroscopy (EIS) it was shown that a freshly applied two-coat system of modified epoxy Coating B2 (16 mils total DFT) when immersed in 24 to 48 hours in DI water achieved full cure under water just as if it had cured under normal ambient conditions.[13] **Figure 6** shows examples of where Coating B2 has been used in water and wastewater facilities.

In summary, while the arrow of time has progressed, the "black magic" of coal tar epoxies for excellent immersion service cannot be completely dispelled. The black knight coal tar epoxies, as exceptional as they were for asset management and preservation, have largely been relegated to the past with a paradigm shift to higher performing and safer white knight modified epoxy coatings. With better and more consistent application properties, durability, cathodic disbondment resistance, water and chemical resistance, and abrasion resistance, these modified epoxy coatings lie spell-bound in wait for future "magical" challengers.

Conclusions

The coating industry has derived great success from the performance of coal tar epoxies until the introduction of synthetic hydrocarbon-modified epoxy coatings. Without any doubt, the excellent reputation that epoxy coatings now enjoy is due very largely to the simple, effective, low cost and highly reliable coal tar epoxies of yesteryear that served extremely well for many decades. Performance and health and safety issues associated with coal tar has resulted in its restricted use in North America, Europe and other developed nations, and a transition to using synthetic hydrocarbon-modified epoxy coatings.

Well formulated modified epoxies (as well as polyurethanes, and hybrid polyurethanes) can provide similar or better immersion service as compared to coal tar epoxies and they are available in light colors, single application conditions with rapid dry/cure capabilities that affords easy inspection.

Today, modified epoxy coatings that employ special synthetic hydrocarbon resins to replace early coal tar extender resins give coating formulators a powerful tool to provide safer, more appealing and higher performing coating alternatives. JPCL

ABOUT THE AUTHORS

Vijay Datta, MS, Chem. Eng., is the Director of Industrial Maintenance for AkzoNobel. He has more than 50 years of experience in the protective and marine coatings Industry. Datta earned a master's in chemical engineering from New Jersey Institute of Technology, and holds two U.S. patents. He was also the first person to commercialize phenalkamine technology for use in marine and protective coatings.

Dr. Michael (Mike) O'Donoghue is the Director of Engineering and Technical Services for AkzoNobel. He has almost 40 years of experience in the protective and marine coatings industry. O'Donoghue earned his Ph.D. in inorganic chemistry at the University of Surrey, in England. In 2012, he received one of the Clive Hare Honors from JPCL as one of the industry's top 25 thinkers, and has written several JPCL articles.

Tony Belk is a Coating Specialist at Nucor/Skyline with more than 35 years of industrial coatings experience. Previously, he performed field technical services and failure analysis for Porter International and Carboline Company. Currently, he oversees coating operations in Nucor/Skyline plants and researches environmentally sustainable coating products and technology. Belk is a NACE Level 3 certified Coating Inspector and also holds Bridge and Nuclear specialty certifications.

Dr. Cortney Chalifoux, PE is the Program Director for Coatings and Mechanical Integrity at Pond and Company. She has over 15 years of experience in the corrosion industry, specializing in metallurgical and coatings failures. In her current position, she helps clients prevent failures by developing thorough and complete coatings specifications, performing integrity inspections, and managing Pond's QP-5 coatings inspection program. She holds a PhD in Materials Science Engineering from the University of Virginia.

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8 REASONS TO APPLY FIREPROOFING COATINGS IN THE SHOP

BY MAX TRITREMMEL, SHERWIN-WILLIAMS PROTECTIVE & MARINE

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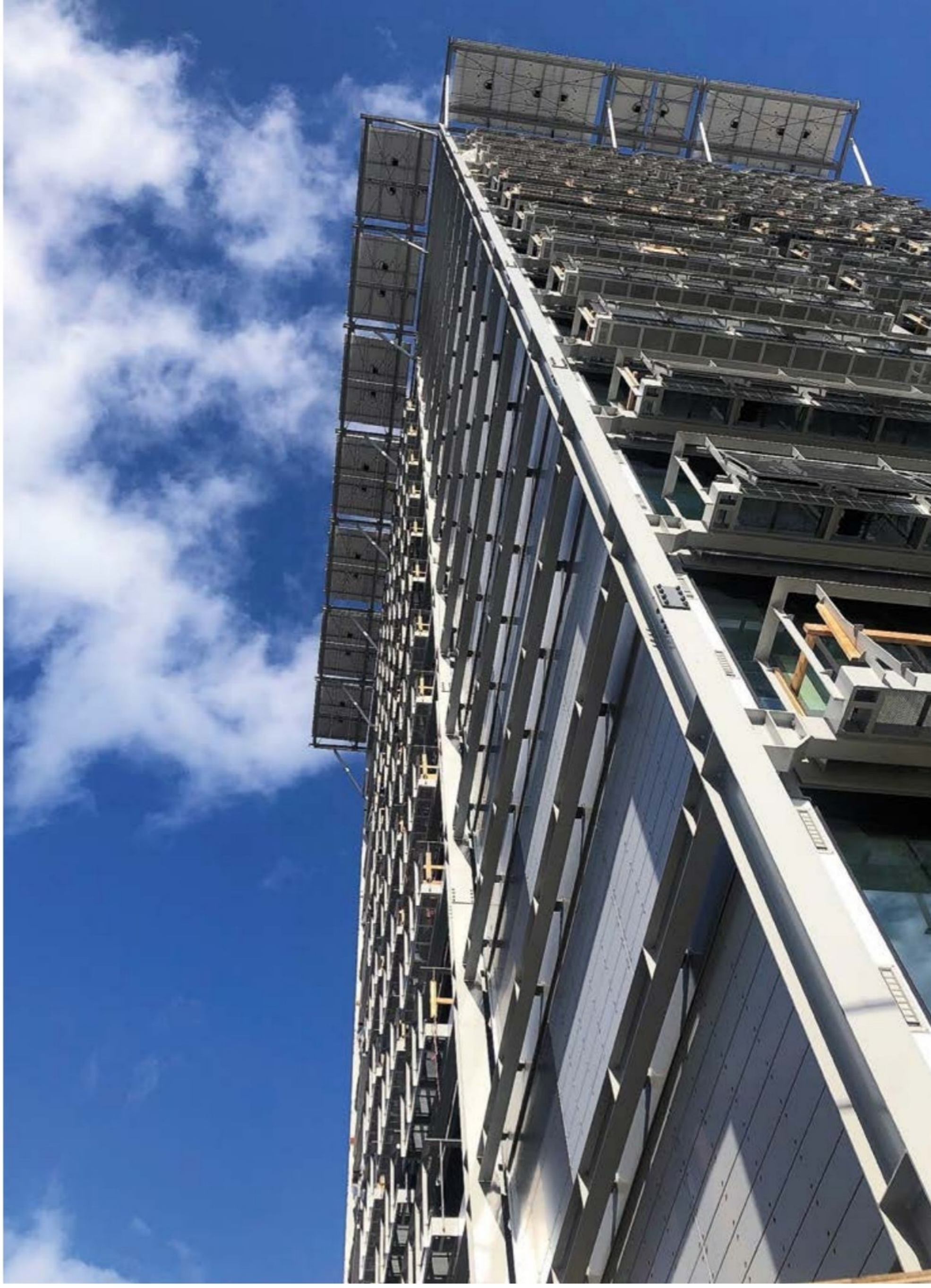
An off-site, controlled environment offers many efficiency and quality advantages in applying intumescent fire protection coatings on steel.

The simple act of moving steel coating application from the construction site to an off-site facility can offer key advantages – particularly when it comes to applying fireproofing coatings. Having precoated fireproofed structural steel arrive to the project site ready for assembly can make a significant difference in project quality, costs, duration, scheduling and efficiency. The method can also promote safety, the use of fewer materials and more opportunities to showcase steel in building designs.

Coatings designed for fire protection slow the rate of heat transfer to steel during a fire, swelling to form a carbon "char" with low thermal conductivity. This insulating layer provides sufficient time to evacuate a structure before steel reaches a critical failure temperature. What's more, in addition to providing effective fire protection for beams, columns and bracing, fireproofing coatings can also mitigate corrosion, helping steel maintain its integrity.

Off-site environments offer maximum control over the application of these coatings, which have advanced in recent years to become more durable and easier to apply, including in thinner layers than previously required. To ensure their optimal performance, fireproofing coatings must be properly applied, making off-site



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facilities an ideal environment because they are not at the mercy of many facets and factors that dictate application conditions at construction sites.

With fireproofed steel delivered to the construction site ready to be installed directly in the structure, developers can also erect buildings where tight site footprints previously made building construction impractical due to the staging needs required for on-site coating application ***(Fig. 1)***.

The proof is in the buildings. Over the last two decades, hundreds of off-site fireproofing projects have been successfully completed in Europe and other global regions. The method has been used in the construction of such iconic structures as The Shard skyscraper in London, as well as the city's Leadenhall Building and Heathrow Airport's Terminal 5.

In the United States, consider the recent example of 303 Battery building ***(Fig. 2)***, a high-rise office and apartment building that completed construction in downtown Seattle in late 2022. Given the tight quarters of the urban construction site, having finished fireproofed steel delivered to the site allowed the project to maintain a smaller, less congested staging area. Plus, as the building was erected over winter months, there was no need to build a makeshift on-site coatings shop

FIG. 1: Delivering fully fireproofed steel to construction sites enables steel members to be pulled directly off a truck and installed directly in the structure, minimizing on-site staging needs.

FIG. 2: Architecturally exposed structural steel (AESS) for 303 Battery was coated in an off-site application shop to provide a variety of efficiencies and cost savings for the project.

and maintain its climate inside. The off-site fireproofing process was also faster, as the applicator could coat one tier, or two floors, of structural steel in just three weeks, saving the entire project an estimated two to three weeks compared to fireproofing the steel on-site.

Quality, cost, time and efficiency improvements are all possible for nearly any construction project that opts to apply intumescent coating systems off-site. This article will explore eight key benefits, which demonstrate how the approach could revolutionize many aspects of building construction.

1 Time (and Cost) Savings

Applying fireproofing coatings in a controlled environment often takes less time than traditional on-site application. Thus, the process has the potential to accelerate many aspects of the entire construction schedule – delivering the project earlier to the client and bringing a quicker return on the investment.

Intumescent coating systems applied off-site have also demonstrated such desirable spray properties as needing fewer coats. Many of these systems use plural component technology, allowing for high wet film builds, which often reduces the application to one or two coats. These ultra-high solids coatings also dry and cure fast – especially in a climate-controlled environment – promoting quick shop throughput.

Off-site applications leave only a small amount of coatings work to be done on-site. For example, applicators can apply primer to steel in the shop and then mask off connection points (whether bolted or welded) and leave those areas free from fireproofing coatings ***(Fig. 3a)***. Then, once the steel is connected on-site, applicators will either spray or hand trowel fireproofing coatings on these "holdback" areas to achieve the required dry film thickness (DFT) ***(Fig. 3b)***.

FIG. 3: Inside a shop, applicators can easily apply primer and then mask off holdback areas *(3a)* before spraying fireproofing coatings. On-site applicators will then fireproof those areas after the steel is integrated into the building's structure *(3b)*.

PHOTOS: COURTESY OF THE SHERWIN-WILLIAMS COMPANY

FIG. 4: **Off-site application shops feature wide-open settings and sufficient space to access steel for better fireproofing applications and easier inspections.**

More Control

Off-site applications usually take place in large, climate-controlled buildings that can easily be made into suitable environments for spraying, curing – and inspecting ***(Fig. 4)***.

These wide-open settings naturally make accessing steel members easier compared to the tight, makeshift coatings booths that are constructed at project sites to manage on-site application. Plus, off-site shops can better control temperature and humidity compared to on-site booths for better application and curing conditions.

Off-site shops also promote proper surface preparation, such as blasting off flash rust and effectively cleaning substrates. This phase is arguably the most important, as intumescent fireproofing systems can fail due to inadequate preparation. These steps ensure proper bonding of the entire system.

In addition, inspections can be carried out more effectively and quickly at off-site facilities, especially compared to at construction sites where fireproofing coatings are applied after the steel is erected. Careful, closer study of already-coated steel at eye level in a shop setting can help inspectors better spot holidays – which would allow moisture to penetrate to the steel substrate – and make appropriate repairs. Checking the wet film thickness (WFT) ***(Fig. 5)*** and DFT of coatings is much safer and accurate on the ground than when taking measurements while on lifts, scaffolding or ladders.

FIG. 5: **Checking the wet film thickness (WFT) of fireproofing coatings is much easier when working on the ground in a shop environment compared to taking measurements while on lifts, scaffolding or ladders in the field.**

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FIG. 6: For in-shop applications, applicators can easily position themselves for better spray control and a more consistent film build.

3

Higher-Quality Application

Uniform film build is more easily achieved indoors under controlled lighting, temperature and humidity. In these environments, applicators have better spray control and can maintain a steady distance from the steel member to achieve a consistent film build that avoids thin and thick areas ***(Fig. 6)***.

Positioning is also easier. An applicator who is too close to a target can "push" material with the force of the spray stream and create wavy patterns in the film. An applicator who is too far from the surface or applies coatings at an acute angle can leave a splattered finish and produce excessive waste.

All methods for applying intumescent coatings – including spraying, brushing, rolling (typically for touching up small areas only) or troweling – can benefit from a controlled environment. There's also less overspray and monitoring wet film build is easier.

Project scheduling is more accurate with shop application, being that the process is not impacted by weather conditions and construction interruptions.

Material and surface temperature are also critical application factors. Application at higher temperatures, or on warmer substrates, generally results in a reduction of coatings' viscosity – allowing applicators to build thinner films that flow better for a smoother finish. Still, temperatures that are too high may result in accelerated "tacking up" of coatings.

At lower temperatures, applicators can increase film builds, but the film appearance may be slightly rougher. The material flow is also reduced at lower application temperatures, reducing efficiency.

Temperature-based factors can be rendered nearly non-existent in an off-site facility, but not so in an on-site coatings booth.

Secondary procedures, such as trowel finishing, finish rolling, rasping, sanding or grinding, also benefit from conditions present inside a shop. Plus, the ability to control humidity – and not needing to worry about the dew point or precipitation – can also improve application outcomes.

4

Show Off Steel

Off-site application is especially compatible with thinner-film water-, solvent- or epoxy-based intumescent coatings that achieve a "paint-like" finish and enable steel to be exposed in new and creative ways.

PHOTO: COURTESY OF THE SHERWIN-WILLIAMS COMPANY

Spray application in controlled environments generally provides the best final finish for Architecturally Exposed Structural Steel (AESS) ***(Fig. 7)***, which is being used in unique, open designs that also use fewer building materials, such as drywall and cladding.

Traditional fire protection materials, known as sprayed fire-resistive materials (SFRMs) or cementitious fire protection, are not well suited to complement the inherent aesthetic beauty of exposed steel. Comprised of cement, aggregate and resin, these so-called “popcorn”-like materials can be unsightly and often need to be concealed with drywall, drop ceilings, sheetrock and other materials to meet design objectives. They can also become porous or peel off.

Some intumescent coatings allow designers to strip away unnecessary building elements and express exposed steel in new ways, creating sleeker, more sustainable buildings.

FIG. 7: **Spraying fireproofing coatings inside a controlled shop environment enables applicators to achieve the best finish for Architecturally Exposed Structural Steel (AESS).**

PHOTO: COURTESY OF THE SHERWIN-WILLIAMS COMPANY

5 Increased Safety, Reduced Risk

Project scheduling is more accurate with shop application, being that the process is not impacted by weather conditions and construction interruptions. Fireproofed steel members arrive at the jobsite ready to be assembled, meaning other trades do not have to wait for fireproofing work to be completed, thus reducing site congestion, promoting safety and expediting the construction schedule.

With fewer tradespersons on-site completing tasks, less equipment may be needed, driving down rental fee costs and helping on-site productivity.

As mentioned earlier, spraying steel on the ground in a shop is safer than doing so on-site from lifts, scaffolding and ladders. Plus, accidents and injury potential can be reduced at the construction site when applying fireproofing off-site due to reduced on-site material handling needs.

Reducing the footprint of staging areas could also result in fewer interruptions at the street level.

6 Go Around Weather

When coating in the field, weather can always be an issue. Unpredictable, uncontrollable conditions impact on-site application schedules, compromising spraying and curing – whether fireproofing structural steel within a temporary on-site enclosure on the ground or doing so up in the air after the steel has been erected.

Temporary structures take up space on a construction site and can be difficult to climate control. Setting up scaffolding and containment tarps to coat already erected steel takes time and increases costs. The tarped areas are also not always sturdy against wind and can allow water to enter, creating application difficulties inside the covered zone. For example, water-based intumescent coatings must be protected from precipitation before being sealed with an approved finish coat, so any water exposure is unwelcome.

Inclement weather is also likely to keep inspectors off scaffolding, which could slow a project. As a result, field applications can face longer application times, more challenging surface preparation and less uniform applications.

Construction managers can ensure more accurate, long-term coating applications by opting to fireproof the steel off-site at an application shop.

7 Superior Sustainability

In-shop applications can be more environmentally friendly than field applications, as shops use exhaust fans to abate emissions and avoid the atmospheric release of volatile organic compounds (VOCs). Such VOCs may otherwise be released in urban areas with concentrated populations when applying coatings at a busy city construction site.

Applicators also face the direct environmental impacts of mixing, heating and spraying coatings. Therefore, coatings with low VOC emissions, reduced application thicknesses and fast drying times are all preferable.

8 Fewer Field Repairs

While field repairs can be done, minimizing these time-consuming hiccups is in everyone's interest. Fortunately, intumescent coatings, especially epoxy-based coatings, typically exhibit excellent durability characteristics, including resistance to mechanical impact from straps and chains during movement, transportation and erection. The coatings can resist gouging and abrasions from lifts, loading and unloading activities, as well as when steel members bump each other. If damage does occur, it can often be easily fixed by mixing a small coating batch and troweling the material onto the affected area after minimal preparation.

Contractors can also be comfortable moving fireproofed steel from the shop to the construction site because the coatings offer protection from corrosion and weather. This is essential, given how steel members may be exposed to fluctuating temperatures, moisture (condensation, rain, snow, sleet), road salts, industrial environments and chemicals.

Conclusion: Off-Site is On Point

High-performance fire and corrosion protection coatings work well for the protection of structural steel in a variety of buildings, including residential, commercial and industrial structures. The coatings typically require little to no maintenance for the life of the structure when applied properly. Construction managers can ensure more accurate, long-term coating applications by opting to fireproof the steel off-site at an application shop rather than at the construction site. This practice offers meaningful benefits on many fronts, from higher quality applications to more efficient and budget-friendly building completions. JPCL

ABOUT THE AUTHOR

Max Tritremmel is Fire Protection Market Segment Director – Americas for Sherwin-Williams Protective & Marine. For more than 27 years, he has served the coatings industry as a sales representative, business leader, industrial painting contractor and now marketer. He is an SSPC Protective Coatings Specialist and an SSPC Level 3 Certified Coatings Inspector.

PHOTO: COURTESY OF THE AUTHOR

PROBLEM SOLVING FORUM

COATING INSPECTION SERIES

Even though it is often the last process completed on a coatings project, inspection of recently applied protective coatings can be the most crucial step in the success – or failure – of a project. Any mistakes that may have been made during the surface preparation and application processes will come to light during inspection, and the independent inspector can often be the bearer of bad news when such an anomaly is uncovered and rework is ordered.

Even in these cases, a good inspector can diagnose problems and suggest remedies before an even more expensive coating failure is allowed to take place down the line.

The following JPCL Problem Solving Forum questions and answers, compiled from inspection-related topics over the years, focus on some of the most commonly encountered interactions between an inspector, a contractor and a facility owner. Hopefully, these answers can help you justify the cost of inspection on your next project, or help you deal with certain types of inspectors on your jobsites.

"All too many times, the discussion of the value of an independent inspector only takes place after a failure."

As an engineer in a moderate-sized chemical plant, how can I justify the cost of third-party inspection to upper management?

DONALD L. CRUSAN, MARCELLUS INDEPENDENT TECHNICAL SOLUTIONS:
"Look no further than two of the better known refineries that had catastrophic accidents, ones that might have been averted by a totally independent third-party inspector, who is not beholden to management for a job and would identify and record findings and indications. It is up to management to make the final call, but the true independence of a third party, not to mention no legacy of benefits, would be the right call."

LARRY STEPHANS, SABUR TECHNOLOGIES:
"All too many times, the discussion of the value of an independent inspector only takes place after a failure. I have been called many times to perform failure analysis in situations where proper inspection during application/installation would have saved the money and grief caused by a failure. I attempt to get clients to consider the consequences and costs of a failure in the field and compare those to the costs of proper application with independent inspection."

PHOTO: XU WU / GETTY IMAGES

> "We all know communication is essential in any enterprise, yet it saddens me how many times asset owners throw a million dollars into the wind without the ability to communicate effectively with us."

GREGORY BERG, AEP:
"Our company incurred costs in excess of $3 million because a project manager didn't want to pay the $100,000 for the third-party inspector on the lining of eight process tanks. When I inspected them, there were so many pinholes and other major defects that my recommendation ended up being a complete removal and replacement of trowel- and spray-applied vinyl ester. To force our project manager's hand, I ended up changing the specification for all lining systems to mandatory full-time, third-party inspections paid for by us. It is the best money you will ever spend, particularly on critical infrastructure."

CHUCK PEASE, MMI TANK:
"The simple answer as all others have stated—money. Do a cost analysis and show the cost of hiring the third party. Then show what a failure of the structure's coatings would cost and the associated cost to remedy a failure. Then let them decide."

TERRY LANE, INDEPENDENT:
"In all of my coating inspection trainings, one thing was repeatedly emphasized, that as a third party inspector, my responsibility is to objectively observe, document, and report—to be the owner's eyes and ears and to advise them of anything anomalous to their written specification and, thus, expectations. As Ben Franklin once said, 'An ounce of prevention is worth a pound of cure.'"

JOHN HARPER, CERTIFIED COATING SPECIALISTS INC.:
"Why I, as an asset owner, would want an independent inspector on a project would be determined by my staff's knowledge level when it comes to coating work and the degree of trust I have in my coating contractor. Trust is defined as my ability to predict the outcome. If I do not have a team member well-versed on the technology and terminology of the coating work I want done, and I am going for a low price contract, then I have to have a team member who does understand the technology and terminology to ensure I receive what I have commissioned.

As a contractor, I want the asset owner who does not understand technology or terminology to hire a credible inspector so that I have someone on the owner's side of the table who understands what it is we will be executing so the inspector can spend the time explaining step by step what is happening—especially when the train falls off the tracks and we have to be reactive. We all know communication is essential in enterprise, yet it saddens me how many times asset owners throw a million dollars into wind without the ability to communicate effectively with us. Just wasteful, considering the cost of inspection is minimal when stood against any failure."

MIKE RUTHERFORD, CONSPECTUS (QLD) PTY LTD:
"Manufacturers are driven by sales; contractors are driven by workload. Between these two parties, you need a gamekeeper to keep them honest."

ERIC MURRELL, SME:
"If you want to convince management, you need to prove the savings will offset the cost. Find a company in your area that has embraced third-party observation and talk to them about why they pay for it. That may give you some ammunition to make your case."

K. SANCHEZ, CSP:
"If 'manufacturers are driven by sales; contractors are driven by workload,' you should also ask what drives inspectors (consultants). I would submit that the answer from Eric is the best: a warranty is always better than an inspection if the contractor has the credibility to back the warranty. Inspectors have the potential to drive up cost by delaying and causing unnecessary work. An inspector may miss things that may not show up for a year or two, but a long-term warranty would encourage a contractor to provide more quality than needed to cover the warranty period. Inspectors are money motivated, as well. We call this 'billable hours'… more delays mean more billed hours. There needs to be checks and balances on all."

PHOTO: VITHUN KHAMSONG / GETTY IMAGES

Some specifications may have requirements that the inspector may know to be extraneous or may be more restrictive than necessary to obtain a quality coating application. What is the ethical responsibility of the inspector to reject non-conforming coatings that they know will perform as intended, particularly where attempted repairs may degrade the coating system?

IVAN LASA, FL DEPT TRANSPORTATION:
"It is the responsibility of the inspector to verify that the coating is applied as per contract. It would be unethical to make a decision to accept a non-conforming product. In such cases, the ethical responsibility rests on the applicator to request acceptance from the owner. The opinion of the inspector may be included as part of the request."

STEPHEN BOTHELLO, JOTUN UAE LTD.:
"The coating inspector should be aware and be absolutely clear about his responsibility and authority. The pre-job conference, where client representative, contractor's representatives and applicator's representatives are present, is a right forum to seek clarification about this or reinforce the dos and don'ts of the inspector's job. The main project documents, that is, specification from client, method statement from contractor/ applicator and Inspection Test Plan/Protocol (ITP) should be absolutely clear in this regard. If the specification, work procedures or acceptance criteria within the ITP are not complied with, the inspector's most ethical responsibility is to raise an observation report or, in the case of serious violations, a non-conformance report (NCR). If a non-conforming coating has been used, it is, of course, non-compliant with the job specification; hence, an NCR needs to be issued. NCRs have provisions for the applicator and supplier to respond within a reasonable time limit, explaining why a non-complying coating was applied and describing any corrective or preventive actions. Though for an inspector it may be good to know that the non-complying coating may perform as intended, it is only ethical to reject, report and document the non-conformance and leave it to the applicator/supplier to explain, and for the other competent authorities of the project to agree/ disagree on final acceptance or rejection of the applied non-conforming coating."

WARREN BRAND, CHICAGO CORROSION GROUP:
"We ran into this exact situation recently. A large pump housing, around the size of a large refrigerator, needed to painted internally. Our client called and asked if we could get an inspector onsite ASAP. As we put things into motion, I asked for a copy of the product data sheet (there was no specification). The internal environment of this pump housing contained water (condensation) at between 100 and 150 F. The housing was already deeply pitted on the inside due to the original paint peeling off. The housing was made by one of the largest manufacturers in the world (a household name), highly sophisticated, one would think. The product data sheet, in part, indicated that the material was surface-tolerant (didn't even need to abrasive blast!) and that it could be used on the exterior of a ship, but not below the water line! The last page of the document clearly indicated that for immersion service (which this clearly was), a completely different product was recommended. I was stunned. I raised this red flag to the owner (even though we were hired only to inspect) because it was the ethically correct and kind thing to do. We ended up with an email chain of about a dozen individuals, including some of the top people from the OEM. Then, I heard the words that OEMs use to defend uneducated, improper coating selections, 'We've been using this material with no problem for more than 20 years.' At the end of the day, I felt my job was to provide my opinion, supported by objective, independent, verifiable data, and then let the client make the decision, which is exactly what happened."

JOHN KERN, VCI:
"In your original statement you indicate there was no specification for the contractor to work to, so my question is, who specified the coating system? As a result of no specification, did the contractor submit to the owner an application and or an ITP? Since neither is indicated, then the 'hired' inspector's job is to report the initial conditions as found to the entity that hired him. He does have the right to interject to this entity his findings such as 'the wrong application' for the product in his report and support this finding per the PDS. It is his responsibility only to observe and report to the entity that hired him and then let the owner make a final decision on the use of the coating system. This should have been accomplished during the pre-job conference and documented by the coating contractor. We as inspectors often find this situation due to the failure of the

> It is the responsibility of the inspector to verify that the coating is applied as per contract. It would be unethical to make a decision to accept a non-conforming product."

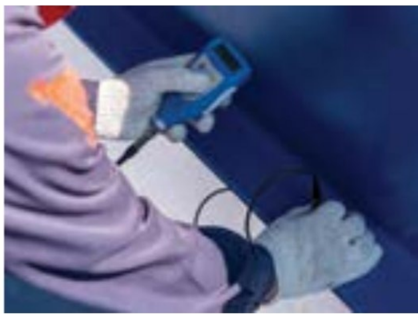


PHOTO: THAWEESAK THIPPHAMON / GETTY IMAGES owner or applicator not performing due diligence in job specifications. In these cases we can only document what we find during the inspection service and report to the appropriate entity. If it is a bad spec, report it to the person you were hired by to perform the service. By reporting it to the other party, you may become liable for the application process. Again, it is our responsibility to document and report the observations and let the contractor or owner make the final decision. If we are working for the contractor and we report to them, then it becomes his responsibility to report to the owner if he sees fit to do so. If it still becomes a bad spec, so be it, as in your stated case. Inspect, document and report; that is your responsibility!"

KAREN FISCHER, AMSTAR OF WNY:
"Coating Inspector training (SSPC or NACE) indicates that the inspector neither writes the specifications, nor is allowed to change them, no matter how they are written. Their job is to enforce the specifications (observe and record compliance). It is up to the contractor to address any conflict or unnecessary requirements in a specification with the owner or designer of the specification. An inspector can voice an opinion on the matter or inform the owner (either verbally or in writing) that enforcing the specification may result in a failure, but it is not within the job description of most inspectors to change the specification or allow anything other than what is called for. As a NACE Certified Inspector, I would inform the owner in writing of a conflict I saw in a specification and that it may result in a coating performance failure, so that I have my backside covered."

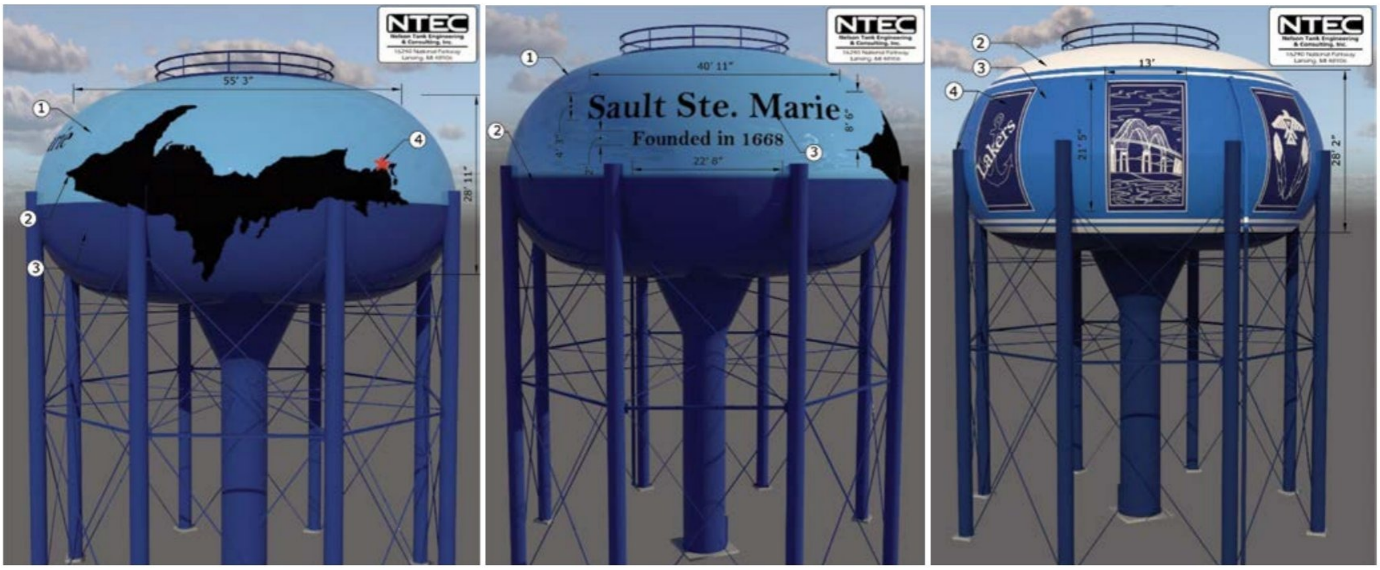
> "An inspector can voice an opinion on the matter or inform the owner that enforcing the specification may result in a failure, but it is not within the job description of most inspectors to change the specification or allow anything other than what is called for."

WARREN BRAND, CHICAGO CORROSION GROUP:
"I've had these conversations before, and have always found myself in the minority. And, I'm very comfortable there. There is a simple, overarching principal that I follow. What is the right thing to do? I simply am not wired to sit back and 'observe, document and report' while something is going wrong. I think this is particularly ironic since my first job was as a daily newspaper reporter where that was all that I did. When people talk of their 'ethical' responsibilities as a coatings inspector, I believe they are misusing the word ethical. Ethics relate to moral values, which, in my mind, override pretty much everything else. What I think these folks mean is 'obligation' or, perhaps, 'authority.' But it is certainly not ethical to watch a coating application go wrong and simply sit back and take notes. It may be their job; it may be their obligation; they may even have the authority; but no, it is certainly not ethical behavior. We, as coating inspectors and professionals, need to rethink our role. Yes, of course, our first job as an inspector on site is to observe and document. However, if we see that 100 tons of the wrong-sized blast grit has been delivered, it's our ethical responsibility to let people know, even if it is not necessarily our role.

I was talking to an inspector working on a bridge project this past summer. He called me, exasperated, asking my advice about a situation where the specification called for a blast profile of between 2.0 and 3.0 mils (or something like that). The blast ended up being between 3.0 and 4.0 mils. The coating consulting firm adamantly refused the blast, saying it was out of spec. The inspector took it upon himself to contact the coating manufacturer, who submitted a letter saying the 1.0 mil difference was acceptable. But the consulting firm refused to budge. The profile was out of spec—and that was that. The job stopped. The blast rusted. Expenses piled up for no technical justification whatsoever. The firm may have been acting 'responsibly,' or perhaps within their 'authority,' but how can that type of blind adherence to a specification ever be considered ethical?"

CHARLES HARVILICZ, HUNTINGTON-INGALLS, NEWPORT NEWS SHIPBUILDING:
"[The inspector] has two obligations. One is contractual, and the other is ethical or moral. They should carry out the first, and inform the owners of what they know about the performance of the coatings system with less stringent requirements to take care of the other."

MICHAEL HALLIWELL, THURBER ENGINEERING LTD.:
"From the consulting side, we're there to look out for our client's interests. If an issue arises, there is an obligation to bring it to the attention of the client, inform them of the situation and options, then let them make an informed decision as to what happens going forward. If I see something not up to spec, I'm going to talk with the client (and hopefully the other stakeholders), saying, 'Things aren't meeting spec, but based on past experience what was done should perform sufficiently. Repairs may cause more harm than good. You need to make the decision because you'll live with the consequences, but my opinion is...'" JPCL



NEWS FROM THE TRACKER

BY KONSTANTINE FEKOS, PAINT BIDTRACKER

Out to Bid:
MI Water Tank Recoat,
TN Lift Station Painting

IL DOT Awards $2.5M
Bridge Painting Contract

PROJECT PREVIEW

This water tank painting project in Sault Ste. Marie, Michigan, includes the option for an alternate tank design *(above, right)*.

The **City of Sault Ste. Marie, Michigan**, is soliciting bids for cleaning, coating and repairs to a 750,000-gallon elevated water storage tank. The contract includes abrasive blasting-cleaning and recoating both interior and exterior tank surfaces, as well as logo painting and lettering to finish the job.

Wet interior surfaces will be abrasive blast-cleaned to a Near-White Metal finish (SSPC-SP 10/NACE No. 2) and coated with a four-coat zinc and high-solids epoxy system. Dry interior surfaces will be abrasive blast-cleaned to a Commercial finish (SSPC-SP 6/NACE No. 3) and coated with a four-coat zinc and amine epoxy system. Exterior surfaces will also be abrasive blast-cleaned to a Commercial finish and coated with a three-coat zinc, epoxy and polyurethane system.

The contract requires Class 2A containment in accordance with SSPC Technology Guide #6. The owner-approved coating manufacturer for this project is Tnemec.

The submittal date for this project is March 25.

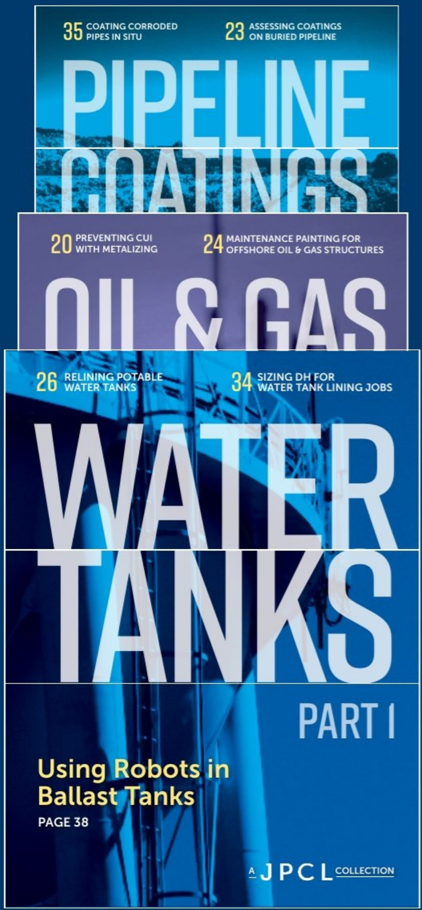
The **City of Brentwood, Tennessee**, is soliciting bids for coatings work, sewer improvements and other upgrades at an existing lift station.

The project includes surface preparation and coating application on a variety of steel and concrete substrates, including valves, piping, manholes, wetwells, containment and other building surfaces. Coating systems to be applied include:

- A two-coat epoxy system on interior non-submerged concrete surfaces;
- A two-coat latex system on exterior non-submerged concrete surfaces;
- A two-coat 100%-solids polyamide epoxy system on submerged concrete surfaces in contact with sewage;
- A three-coat high-solids epoxy system on submerged concrete in contact with raw or potable water;
- A four-coat coal-tar epoxy, latex block filler and polyamide epoxy system on below-grade exterior concrete surfaces;
- A three-coat epoxy system on interior submerged ferrous metal surfaces;

PHOTOS: COURTESY OF CITY OF SAULT STE. MARIE / NELSON TANK ENGINEERING & CONSULTING, INC.

PAINTBIDTRACKER
To try the BidTracker project lead service, visit paintbidtracker.com/free-trial.



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The City of Brentwood, Tennessee's lift station rehabilitation project involves cleaning and coating of steel and concrete structures, as well as sewer system upgrades.

PHOTOS: COURTESY OF CITY OF BRENTWOOD

- A two-coat epoxy system on galvanized steel surfaces; and
- A three-coat zinc, epoxy and polyurethane system on specified ferrous metal surfaces.

Surface preparation standards cited in the specification include Solvent Cleaning (SSPC-SP 1), Hand Tool Cleaning (SSPC-SP 2), Power Tool Cleaning (SSPC-SP 3), White Metal Blast Cleaning (SSPC-SP 5/NACE No. 1), Commercial Blast Cleaning (SSPC-SP 6/NACE No. 3), Brush-Off Blast Cleaning (SSPC-SP 7/NACE No. 4), Near-White Metal Blast Cleaning (SSPC-SP 10/NACE No. 2), Surface Preparation of Concrete (SSPC-SP 13/NACE No. 6) and Brush-Off Blast Cleaning of Coated and Un-coated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals (SSPC-SP 16).

The owner-approved coating manufacturers for this project are Sherwin-Williams, Tnemec and Carboline. Owner-approved wood stain manufacturers are Sherwin-Williams, PPG, Olympic and Pratt & Lambert.

The submittal date for this project is March 21.

PROJECT AWARD

Ten existing steel bridge structures across various counties in Illinois will undergo cleaning, coating and repairs as part of a recently awarded contract from the **Illinois Department of Transportation**.

The contract, valued at $2,546,592, was awarded to Era Valdivia Contractors, Inc., of Chicago.

The contract involves abrasive blast-cleaning the steel to a Near-White Metal finish (SSPC-SP 10/NACE No. 2) and recoating with IDOT's three-coat System 1, which includes a zinc-rich primer, an epoxy intermediate and a polyurethane finish. Steel cables will also receive a three-coat epoxy and urethane system. Containment and disposal of existing lead paint residue is required.

The approved coating manufacturers for this project are Carboline and Sherwin-Williams.

Additional bids submitted for the project included:

- Venus Painting Co. (Valparaiso, IN) at $2,677,104.80; and
- Civil Coatings (Valparaiso, IN) at $3,361,331.25.

1976

The year that Lou Lyras—along with brother Gus and father George—founded their industrial painting company, Corcon Inc. *See p. 1*

8

The number of reasons given for applying fireproofing coatings to steel in the shop instead of in the field. *See p. 22*

3

The number of modified epoxy coatings that were tested against traditional coal-tar epoxy coatings to gauge their performance in oil and gas penstock settings. *See p. 10*

4

The number of coatings industry companies that released their fourth-quarter and 2023 full-year financial reports last month. *See p. 4*

10

The number of bridge structures included in a recently awarded $2.5 million cleaning and coating contract from the Illinois Department of Transportation. *See p. 33*

12+

The number of PaintSquare Problem Solving Forum respondents offering guidance and advice regarding coatings inspection. *See p. 28*

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