

FINALLY!

OSHA PROVIDES ADVANCED NOTICE OF PROPOSED RULEMAKING FOR LEAD STANDARDS

BY ALISON B. KAELIN, CQA, ABKAELIN, LLC

If you know me, or if you have read any of my recent JPCL articles, I've warned you that OSHA is going to change the Lead Standard. Finally, they are doing it.

OSHA issued an Advanced Notice of Proposed Rulemaking (ANPR) on July 2, 2022, signaling intent for major changes and seeking comments from stakeholders. Some information in the ANPR provides new information on routes of entry and health effects among other items, as well as a glimpse at what expected changes may look like.

Routes of Entry/Body Burden

The ANPR summarizes data from a 2020 Agency for Toxic Substances and Disease Registry (ATSDR) report. It indicates that occupational exposure to lead can occur through inhalation, as well as oral and/or dermal routes. OSHA has not previously stated that lead can enter the body through the skin. The ANPR also states all the health effects discussed in Table 1 and 2 can result from all of these routes of exposure.

There are several new and expanded health effects highlighted in **Table 1** *(next page)*, including:

- Cancer of the lung, stomach, kidney and brain;
- Neurological;
- Immunological;
- Musculoskeletal (bone loss, periodontal and dental effects); and
- Body weight.

PHOTO: TOP LEFT, RONBAILEY / GETTY IMAGES; TOP RIGHT, COURTESY OF THE AUTHOR



ABOUT THE AUTHOR

Alison B. Kaelin, owner of ABKaelin, LLC, has over 30 years of experience in quality assurance, construction management, quality control/assurance, safety and health and environmental regulations and standards related to coatings, steel fabrication and related industries. She is a Certified Quality Auditor and a member of AMPP and ASQ.

She is a member of the JPCL Editorial Advisory Board and has over 30 publications related to coatings, quality assurance, bridge painting and regulatory issues.

In "Perspective," guest authors are invited to share their views and information on issues relevant to the protective & marine coatings industry. Opinions expressed do not necessarily reflect the positions of Technology Publishing Co., JPCL or its editors. We welcome your comments. Contact Editor-in-Chief Charlie Lange with feedback: clange@technologypub.com

TABLE 1: Overview of Adverse Health Effects Associated with Exposure to Lead in Adults

HEALTH EFFECT	DESCRIPTIVE DETAIL OF HEALTH EFFECT	
Reproductive and Developmental[3]	Reduced fertility, low sperm mobility, increased risk of miscarriage Effects on developing fetus due to lead exposure in utero: decreased birth size, adverse effects on developing brain, kidney, nervous system, cognitive and learning disabilities, decreased child growth, delayed onset puberty	
Vascular/ Cardiovascular	Hypertension	Increased systolic and/or diastolic pressure, stroke, heart disease
	Cerebrovascular	Stroke
	Cardiac/cardiovascular	Heart disease, atherosclerosis, altered cardiac conduction
Hematological	Heme synthesis (interference with iron uptake), anemia, altered levels of plasma erythropoietin	
Neurological	Reduced performance on neurocognitive and neuropsychological tests, peripheral neuropathy, psychiatric symptoms (depression, panic disorders, anxiety, hostility, anger, schizophrenia) cognitive decrements, lead intoxication, dementia, hearing loss	
Renal	Nephrotoxicity (proximal tubular nephropathy, glomerular sclerosis, interstitial fibrosis, tubular necrosis)	
Respiratory	Decreased lung function, increased bronchial hyperreactivity, increased risk of asthma and obstructive lung diseases	
Endocrine (excluding reproductive)	Alteration of serum thyroid levels (T3, T4, TSH), decreased levels of serum vitamin D	
Hepatic	Liver enlargement, increased gall bladder wall thickness, increased total cholesterol	
Musculoskeletal	Bone loss, increased bone metabolism/turnover, adverse periodontal and dental effects	
Gastrointestinal	Constipation, colic, abdominal cramps	
Body weight	Decreased body mass index (BMI) in adolescents and adults	
Immunological	Decreased complement, changes in indicators of inflammation (monocytes, macrophages, neutrophils) and cell-mediated immunity (T cells, natural killer cells)	
Cancer	Lung, stomach, kidney and brain cancer	

Based on information contained in ATSDR, 2020.

Table 2 *(next page)* identifies new symptoms of potential lead health effects and the thresholds at which they may appear. Current data also appears to suggest that zinc protoporphyrin (ZPP) testing – which I wrote about in my May JPCL column – is not meaningful in managing elevated lead.

Expected Proposed/Final Rule

Right now, we can only guess at what the final rule changes will look like.

In the ANPR, OSHA discusses existing Michigan and proposed California and Washington state regulations extensively. They also introduce new data provided in the previously mentioned ATSDR (2020), medical guidelines from Association of Occupational and Environmental Clinics and Adult Blood Lead Epidemiology and Surveillance (2016), National Institute for Occupational Safety and Health, Understanding Blood Lead Levels (2021) and Department of Health and Human Services report on human exposure to environmental chemicals (2022) and others.

Based upon the information discussed in the ANPR, the questions asked and increasing health effects related to low level chronic exposures, I expect the following changes, or similar measures, to be implemented:

Medical Surveillance

- Blood lead level (BLL) limits of 10-20 micrograms per deciliter (µg/dL);
- New triggers for initial BLL testing;
- Increased frequency of testing (monthly or bi-monthly) and if certain levels are exceeded; and
- Removal of ZPP testing.

Medical Removal

- At 20-30 µg/dL, one high BLL above the threshold and/or repeated elevated values.

Return to Work

- 2 BLLs, taken 2 weeks apart, below 15 µg/dL.

Permissible Exposure Limit (PEL)

- 10 – 20 µg/m3 as 8-hour time weighted average (TWA);
- Action Level at ½ the PEL, 5-10 µg/m3 as 8-hour time weighted average (TWA); and

TABLES: COURTESY OF OSHA

TABLE 2: **Overview of Health Effects Associated with Elevated BLL in Adults**

BLL (µG/DL)	HEALTH EFFECTS
5–10	Acute decrease in renal function
	Elevated blood pressure
	Altered heme synthesis
	Impaired neurocognitive and neuropsychological assessment
	Developmental effects (e.g., decreased cognitive and reduced birthweights)–fetuses exposed to lead in utero through pregnant worker lead exposure
10–20	Spontaneous abortion (miscarriage)
	Hypertension
	Decreased renal function
	Decreased platelet count
	Decreased blood hemoglobin
20–40	Headache
	Fatigue
	Anemia
	Sleep disturbance
	Anorexia
	Bowel changes
	Arthralgia
	Myalgia
	Decreased libido
	Personality changes
40–60	Sperm effects (decreased number and function)
	Subclinical peripheral neuropathy
	Altered red blood cell function
	Renal damage
	Cognitive dysfunction
60–80	Hemolytic anemia
	Renal failure
	Stroke
Above 80	Central Nervous System (CNS) effects
	Nephropathy
	Gout
	Hearing loss
	Encephalopathy

Adapted from AOEC, 2007. For additional resources please also see: NTP Monograph on Health Effects of Low-Level Lead, avaiilable at https://ntp.niehs.nih.gov/ntp/ohat/lead/final/monographhealtheffectslowlevellead_newissn_508.pdf.

CONT. P. 16

JPCL
JOURNAL OF PROTECTIVE COATINGS & LININGS

EDITORIAL

EDITOR-IN-CHIEF
Charles Lange, clange@technologypub.com

MANAGING EDITOR
Destiny Johnson, djohnson@technologypub.com

TECHNICAL EDITOR
Brian Goldie, bgoldie@jpcleurope.com

EDITORIAL ASSISTANT, PUBLICATIONS & SOCIAL MEDIA
Haley Carnahan, hcarnahan@technologypub.com

EDITORIAL ADVISORY BOARD

Edye Fox Abrams, Peter Bock, Warren Brand, Robert Ikenberry, Alison Kaelin, Ralitsa Mihaylova, Dudley Primeaux, Tom Schwerdt, Gregory "Chip" Stein, Ken Trimber

CREATIVE & PRODUCTION

VICE PRESIDENT, CREATIVE & CUSTOM MEDIA
Ashley Pound, apound@technologypub.com

PRODUCTION DESIGN MANAGER
Daniel Yauger, dyauger@technologypub.com

SENIOR WEB DEVELOPER
Rich Mahathey, rmahathey@technologypub.com

CIRCULATION
subscriptions@paintsquare.com

AD SALES & BUSINESS DEVELOPMENT

BUSINESS DEVELOPMENT MANAGER
Tracy Dunglinson, tdunglinson@technologypub.com

BUSINESS DEVELOPMENT MANAGER
Lauren Skrainy, lskrainy@technologypub.com

CLASSIFIED SALES
sales@technologypub.com

TECHNOLOGY PUBLISHING COMPANY

CHIEF EXECUTIVE & REVENUE OFFICER
Brion D. Palmer, bpalmer@technologypub.com

GENERAL MANAGER, INDUSTRIAL
Andy Folmer, afolmer@technologypub.com

CONTROLLER
Andrew Thomas, athomas@technologypub.com

BUSINESS ADMINISTRATION MANAGER
Nichole Altieri, naltieri@technologypub.com

Periodical class postage at Pittsburgh, PA, and additional mailing offices. The Journal of Protective Coatings & Linings [ISSN 2688-741X (online) ISSN 8755-1985 (print)] is published monthly by Technology Publishing Co. The content published in JPCL does not necessarily reflect the views of the editors or the publisher. Reproduction of the contents, either as a whole or in part, is forbidden without express permission from the publisher. To inquire about reprints or digital copies of articles, email info@paintsquare.com. Subscribe at: paintsquare.com/subscribe or contact us at: Journal of Protective Coatings and Linings, 1501 Reedsdale St., Ste. 2008, Pittsburgh, PA 15233-2341; Tel: 1-800-837-8303 (toll free); 412-431-8300 (direct); Fax: 412-431-5428; email: subscriptions@paintsquare.com. Subscription Rates, Print plus Digital Edition: U.S., $59 per year; outside the U.S., $100 per year. Digital Edition only: $39 per year. Single Print Issue: $10. POSTMASTER: Send address changes to Journal of Protective Coatings and Linings, 1501 Reedsdale St., Ste. 2008, Pittsburgh PA 15233-2341. © 2022, Technology Publishing Co. Printed in the U.S.A.



LEAD FEATURE

28 The Biofuel Mission: Advanced Lining Systems for Energy Transition

BY MIKE O'DONOGHUE, PH.D., AND
VIJAY DATTA, MS, CHEM. ENG., AKZONOBEL

As the world continues to seek renewable, biofuel-based energy sources, owners and operators must rely on manufacturers to provide linings proven to perform well in biomass feedstock transmission and storage systems. This article presents the results of accelerated laboratory tests and real-world, in-situ testing conforming to the owner's service conditions for an array of lining options currently available for corrosion protection.

AUGUST 2022

JPCL

VOL. 39, NO. 8



FEATURES

17 An Unexpected Challenge Leads to a High-Tech Solution

BY DREW JOHNSON, CORROSION CONTROL RESOURCES, INC.

When a coating contractor crew arrived on a project site expecting to find a raw water pipe lined with coal tar epoxy, but instead found a thicker, more difficult to remove coal-tar enamel, they had to pivot and come up with a new solution for the lining removal. This article will describe how the crew was able to employ robotic blasting with sponge media to get the interior of the pipe ready for a new coating system.

41 2022 JPCL Annual Directory of Industrial Painting Contractors

The 2022 JPCL Annual Directory of Industrial Painting Contractors includes listings for painting contractor companies located primarily in North America, but also around the world. The information presented was obtained through a survey conducted among painting contractors known to JPCL and is displayed in alphabetical order by country and then by state or province.

DEPARTMENTS

1 PERSPECTIVE

Finally! OSHA Provides Advanced Notice of Proposed Rulemaking for Lead Standards

BY ALISON B. KAELIN, CQA, ABKAELIN, LLC

6 COVERAGE

- Coatings Companies: Q2 Financial Reports
- Consultant, JPCL Author Publishes Book
- Third Attempt to Bid IL Bridge Rehab Fails

13 COATINGS 101

Surface Preparation: The Foundation of Every Coating Project

52 BID BITS

- Bids Out for NY Water Treatment Plant Job
- Awards: PA Bridge, FL Water Facility Projects

56 PAINT BY NUMBERS

ALSO IN THIS ISSUE

54 PRODUCT & SERVICE DIRECTORY

55 INDEX TO ADVERTISERS



ORDER BACK ISSUES

store.technologypub.com/products/JPCL-Back-Issues/

ON THE COVER

Photo: Azmanl / Getty Images; Illustration: Ysuel / Getty Images

PHOTOS: FACING PAGE, ONURDONGEL / GETTY IMAGES; TOP, COURTESY OF DREW JOHNSON; BOTTOM RIGHT, VITTAYA25 / GETTY IMAGES

COVERAGE

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



Coatings Companies: Q2 Financial Reports

PPG ANNOUNCES RECORD NET SALES

Global coatings company PPG released its second-quarter earnings report on July 21, reporting $4.7 billion in net sales – approximately 8% higher than this time last year. Net income for the second quarter came in at $443 million with adjusted net income landing at $430 million.

PPG also noted in its release that, compared to Q2 2021, selling prices increased by 12%, but sales volumes were down by about 4%. The company pointed to COVID-19 restrictions in China, as well as cost inflation leading to higher sequential operation margins, as impacting the results. However, raw materials and logistics availability was noted to improve during this quarter, with PPG expecting it to improve even further in the third quarter.

"For the seventh consecutive quarter, we delivered record quarterly sales driven by our continued implementation of real-time selling price increases to fully counter inflation and we benefitted from our recent acquisitions," said Michael H. McGarry, PPG Chairman and Chief Executive Officer.

PHOTO: ISLANDER11 / GETTY IMAGES

In the Performance Coatings segment, PPG reported $2.93 billion in net sales compared to $2.75 billion in the same period last year for a 7% increase. Income came in at $446 million, compared to $454 million in 2021. Within the Performance Coatings segment, the company noted that while net sales increased due to price increases across all business and acquisition-related sales, certain raw material availably and bottlenecks constrained coatings manufacturing in the United States, impacting sales volumes.

Sales volumes in the Protective and Marine Coatings business were heavily impacted by the COVID-19 restrictions in China. Aerospace sales volumes were up by about 10% compared to second quarter 2021, as after-market demand continued to recover. Sales volumes for automotive refinish coatings were also up by a low-teen percentage, with traffic solutions delivering organic sales growth of about 15% compared to the year prior.

The Industrial Coatings segment's net sales increased by about 9% coming in at $1.76 billion compared to $1.6 billion year-over-year. Segment income landed at $156 million, 18% lower compared to $190 million this time last year. This was primarily driven by raw material and energy cost inflation, currency translation impact, elevated operating costs in China due to restrictions and lower sales volumes. However, these were partially offset by higher selling prices and restructuring cost savings.

"We anticipate strong sequential growth in Asia due to higher industrial production compared to the second quarter. Positive growth trends are generally expected to continue in North America. In Europe, we expect conditions to remain soft." *— Michael McGarry*

OEM coatings were impacted by OEM customer component shortages and China production curtailments. Industrial coatings organic sales were up about 10%, driven by strong selling price realization and solid sales volumes growth in the Americas, but partially offset by lower demand due to pandemic-related restrictions in China and lower activity in Europe.

The company had cash and short-term investments totaling approximately $1 billion at the end of the quarter and net debt of $6.1 billion. PPG noted that acquisition-related synergies and business restructuring programs delivered about $30 million of cost savings.

"Looking ahead, in most major regions and end-use markets underlying demand for PPG products is expected to remain solid," said McGarry. "We anticipate strong sequential growth in Asia due to higher industrial production compared to the second quarter. Positive growth trends are generally expected to continue in North America. In Europe, we expect economic conditions to remain soft, including normal seasonal demand trends."

AKZONOBEL REPORTS REVENUE GROWTH

On July 20, AkzoNobel released its 2022 second-quarter financial report, revealing a 14% increase in revenue (10% higher in constant currencies) along with an 8.7% ROS despite the impact of lockdowns in China and destocking in EMEA DIY channels. The company attributes the growth to completed and intended acquisitions, in addition to upped pricing (16%).

AkzoNobel also reported, however, that operating income was down from 384 million euros (slightly over $390 million) a year ago to 205 million euros. Adjusted operating income was also down, reporting 249 million euros from 335 million euros, and a reduced net income from 261 million euros in 2021 to 106 million euros.

"Our Q2 results were clearly impacted by two months of lockdowns in China and destocking in decorative paint do-it-yourself channels in Europe," said noted AkzoNobel CEO Thierry Vanlancker. "Demand from our customers got back on track in June. Despite the significant Q2 headwinds we were able to match the volumes from pre-COVID Q2 2019."

When looking at numbers for the first half of the year, AkzoNobel's revenue landed at 5.378 billion euros, up from 4.774 billion this time last year. This is noted to be

a 13% increase from last year and 10% higher in constant currencies, mainly resulting from significant price initiatives. Volumes were 8% lower, which was mostly attributed to destocking the DIY channel in Europe and continued COVID-19 restrictions in China for both Performance Coatings and Decorative Paints. Furthermore, volumes were negatively impacted by supply constraints, especially in North America.

Adjusted operating income was down year-over-year from 642 million euros to 479 million euros. Operating income revealed a decrease as well, reduced to 437 million euros from 687 million euros documented in mid-2021. Acquisitions added 2% and pricing was up 16%. AkzoNobel also noted the cost of sales, which showed an increase of 321 million euros for raw materials and other viable costs, which adjusted for the impact of lower volumes.

AkzoNobel attributes both its second-quarter earnings and half-year success to a series of highlights and incentives the company has completed or is working to finalize. This includes AkzoNobel's recent acquisition of Grupo Orbis in April and its intention to acquire Kansai Paint's business in Africa and Lankwitzer Lackfabrik GmbH in Germany. The company also touted its involvement with the world's biggest offshore wind farm, Hornsea 2, a new solar project in Türkiye and the recent launch of its mosquito-repellent coating by its Coral brand in Brazil.

The company noted that moving forward, it plans to grow at or above its relevant markets, in line with the company's Grow & Deliver strategy. Trends differ per region and segment, with raw material and other variable cost inflation (including freight) expected to gradually ease towards the end of 2022.

AkzoNobel also aims to continue to offset raw material and other variable cost inflation (including freight) through pricing initiatives. Macroeconomic uncertainties have increased due to geopolitical tension, the resurgence of COVID-19 and inflation.

In assuming that there will be no further significant market disruptions, AkzoNobel aims to deliver a 2 billion euro adjusted EBITDA target for 2023, and an average annual 50 basis points increase in return on sales over the period 2021-2023. The company targets a leverage ratio of 1-2 times net debt/EBITDA and is committed to retaining a strong investment grade credit rating.



POLL

(PaintSquare Poll, August 8-12)

Several coatings manufacturers have recently released their second-quarter financial results, indicating positive numbers and net sales increases year-over-year. Do you believe these numbers will continue to remain positive in the next quarter?

YES 100%

SHERWIN-WILLIAMS SHARES POSITIVE EARNINGS

The Sherwin-Williams Company announced its 2022 second-quarter financial results on July 27, reporting a 9.2% net sales increase year-over-year to $5.87 billion. However, the company noted that diluted net income per share decreased to $2.21 per share from the $2.42 per share recorded in the second quarter of 2021.

"Demand remained strong during the second quarter in The Americas Group and the Performance Coatings Group, as both groups delivered sales within our guidance," said Chairman and Chief Executive Officer, John G. Morikis. "Internationally, demand deteriorated faster than anticipated in Europe, and no meaningful recovery occurred in China following the lifting of COVID lockdowns, both of which meaningfully impacted Consumer Brands Group and Performance Coatings Group sales."

In the Americas Group, net sales increased to $3.3 billion from $3.09 billion in Q2 of last year. The company attributes this primarily to selling price increases and higher professional architectural sales volume in North America paint stores, partially offset by lower sales volumes in Protective and Marine and DIY end markets. Segment profit, however, decreased by 3.7%, reporting $700.4 million compared to $727.3 million reported in 2021. The decrease was

ILLUSTRATION: TREETY / GETTY IMAGES

noted to be due primarily to higher sales volumes and selling price increases, which were partially offset by increased raw material costs.

In the Performance Coatings Group, net sales increased by 15.2%—from $1.55 billion to $1.79 billion, due to higher sales in most end markets, primarily attributable to selling price increases and sales volume growth in the company's packaging and coil businesses, according to Sherwin. Segment profit also increased by 35.9%, from $144.8 million to $196.8 million, primarily due to selling price increases, partially offset by increased raw material costs. Acquisitions reportedly increased sales by 2.9%, while currency translation rate changes decreased the Group's net sales by 3.7%.

"We are responding aggressively to inflationary pressures by implementing a 10% price increase in The Americas Group. We will manage our expenses tightly; however, we will continue to invest in growth." — *John G. Morikis*

To note Sherwin's liquidity and cash flow, the company reported having generated $639.7 million in net operating cash during the first six months of 2022, a decrease from the $1.20 billion reported in the same period last year. This cash generation, along with an increase in the company's short-term borrowings, allowed Sherwin-Williams to return cash of approximately $1.01 billion to its shareholders in the form of dividends and share repurchases, as well as repay $260.2 million in long-term debt, and close an acquisition in the second quarter. It was also reported that Sherwin-Williams closed two additional acquisitions on July 1, which will be reported in the company's third-quarter results.

Looking ahead, Morikis noted that the company is expecting to see an increase in consolidated net sales by a high-single- to low-double-digit percentage, thanks to strong demands witnessed in the company's pro architectural business and industrial markets.



"We are responding aggressively to inflationary pressures by implementing a 10% price increase in The Americas Group, effective September 6, with significant additional pricing actions being taken in our other two operating segments," said Morikis in closing. "We will manage our expenses tightly in the second half with the slowdown in market demand in certain regions and businesses; however, we will continue to invest in growth, including stores, sales representatives and innovative products. We remain highly confident in our strategy, our people, and our ability to emerge as an even stronger company following the current near-term pressures."

RPM RELEASES STRONG Q4, 2022 EARNINGS

RPM International Inc., parent company of specialty coatings and sealants brands including Carboline and Tremco, released its fourth-quarter and year-end financial report July 25, reporting record sales increases of 13.7% and 9.8%, respectively.

RPM's 2022 fiscal year began June 1, 2021, and closed May 31, 2022. Fourth-quarter sales landed at $1.98 billion and year-end came in at $6.71 billion.

"Our nimble businesses quickly adapted to dynamically shifting supply chain constraints, inflationary challenges and foreign exchange headwinds to steadily generate momentum in the second half of fiscal 2022. Our associates' efforts culminated in a fourth quarter of consolidated record sales and record adjusted EBIT," stated RPM Chairman and CEO Frank C. Sullivan.

"This fourth-quarter performance was driven on the top line by all four of our segments, each of which generated record sales. On the bottom line, three of our four segments produced record fourth-quarter adjusted EBIT. In our Consumer Group, which was the outlier, the year-over-year gap in adjusted EBIT results has begun to narrow as price increases have started to catch up with inflation and access to raw materials has improved. Better materials availability was largely due to our well-timed acquisition last fall of a production facility in Texas, which is now making alkyd resins that are critical to many of the segment's products."

The company's Performance Coatings Group net sales were a record $329.4 million during the fourth quarter, which was an increase of 16.3% compared to the $283.3 million reported a year ago. Organic sales increased 17.4% and acquisitions contributed 1.8%. Foreign currency translation was a 2.9% headwind. For the full year, net sales were $1.19 billion, an increase of 15.5% compared to $1.03 billion during fiscal 2021.

"A rebound in international markets, as well as continued success in vertical end markets – such as energy, technology, and food and beverage – helped drive PCG's results. Additionally, improved sales management systems and price increases were major factors in the segment's top-line success," the report stated. It went on to note that flooring systems, protective coatings and fiberglass reinforced plastic grating all generated double-digit sales growth.

Looking ahead, RPM expects the strengthening U.S. dollar to be a headwind impacting the translation of RPM's international results. The company also expects significant cost increases to continue for certain raw materials, labor and packaging.

In addition, management anticipates continued higher costs from unreliable bulk transportation, which creates production inefficiencies, as well as fuel surcharges, which are being driven by high energy prices that have been exacerbated by the conflict in Ukraine. These cost pressures are expected to disproportionately affect the Consumer segment.

Despite these challenges, the company reports that its management's proactive measures over the course of fiscal 2022 enabled RPM to accelerate momentum in the business and it is expected to carry over into fiscal 2023, which commenced June 1, 2022. The company expects to continue implementing price increases as needed and improving operational efficiencies in order to minimize cost pressures and restore margins closer to historical levels.

Based on these factors, RPM expects to generate fiscal 2023 first-quarter consolidated sales growth in the mid-teens over last year's record first-quarter sales. The company anticipates sales growth in the teens in all four of its operating segments.

"Better materials availability was largely due to our well-timed acquisition last fall of a production facility in Texas, which is now making alkyd resins that are critical to many of the segment's products." — *Frank C. Sullivan*

Coatings Consultant, JPCL Author Publishes Book



Raouf Kattan

Raouf Kattan, a longtime protective and marine coatings consultant, current Principal with Safinah Group Ltd., and author of numerous JPCL articles, has recently written a book, *Beyond the Pail*, detailing his involvement in the coatings industry, the progression of his career through the establishment of his consultancy, and some of the lessons he's learned along the way.

The book focuses on Kattan's life and foray into the industry, and the influences that factored into his development, as well as the adventures he had, all of which eventually resulted in his establishment of Safinah Ltd., as a consultancy to the marine industry. Kattan describes working with the main players in the industry internationally, and some of the highlights – as well as the trials and tribulations – he has experienced during his career. Along with Kattan's own personal story, the book presents an interesting history of the marine coatings industry over the 30 years from his experience, and hopefully could encourage newcomers to the industry.

Recently, Kattan was a co-author of the JPCL Readers' Choice Award-winning two-part series of articles, "The Future of Ship Painting," in 2019 and 2020. Earlier this year, he also shared some of the important advice that he has gleaned over the course of his career in his May 2022 JPCL article, "What Makes a Good Consultant?" He has written many other technical articles about the marine coatings industry and its problems throughout his career.



The book is available as a free downloadable e-book at safinah-group.com/beyond-the-pail.

PHOTOS: COURTESY OF AUTHOR





Third Attempt to Bid IL Bridge Rehab Fails

In July, officials in Riverside Township, Illinois, reported that a third attempt to receive bids for a bridge rehabilitation project was unsuccessful. The project involves removing and replacing the coating on the structure of the H. Wallace Caldwell Memorial Bridge, also known as the Swinging Bridge, as well as performing some structural repairs.

The latest bidding, which was formally announced in May, received no bids by the June 22 deadline. Riverside Township Supervisor Vera Wilt broke the bad news to trustees at their meeting on July 13.

The 210-feet long cable suspension bridge over the Des Plaines River was originally built in 1940 and rebuilt in 2002. The last coating work was completed in 2011.

In November of 2021, it was reported that the Riverside Board of Trustees were having trouble getting bids for coating the rusting and flaking bridge. An inspection of the bridge in 2020 found that the coating that had been applied in 2011 was in a state of "widespread failure."

Previously, in January 2020, the Riverside Township Board of Trustees had voted unanimously to hire API Architects to manage the project. Reported by *The Riverside-Brookfield Landmark*, API recommended removing all existing coatings, dirt, oil and rust from the bridge prior to applying new coating. After receiving no response from seeking bids in the spring and summer, trustees reached out directly to firms for proposals.

The township board budgeted $75,000 for the project in its 2021-2022 budget, but the two bids were more than expected. Lakes and Rivers Contracting July proposal was priced at $725,000, citing a need to abate lead paint, while Era Valdivia Contractors Inc. proposed at an amount of $155,000.

The proposal from Era Valdivia Contractors Inc. did not meet API's specifications to completely remove the existing coating, instead proposing using liquid detergent and hand tools to prepare the surface. Era Valdiva reportedly told API Architects it would resubmit to meet their specifications, but it was never updated.

Ken Nadolski, Principal of API Architects, noted that the project is "extremely small" and not worth it to firms looking for large-scale work through agencies like the Illinois Department of Transportation. *The Landmark* reported that the township board was trying to find a way to scale back the scope of the work to make it affordable, if they can find a company to complete the project.

In light of the most recent failed bidding attempt, Wilt suggested to the board that she work with Nadolski to reduce the scope of work in order to attract bids for a smaller scale project. This would involve separating structural repairs from the project, as well as foregoing a complete coating removal and replacement. Instead, the exposed, rusted sections of the bridge would be scraped, and a surface paint job would be completed.

"I've asked the architect to let me know how we can break down the project into essential repairs and aesthetically coating it with the least disturbance of potential lead [paint] issues," Wilt said. Additionally, she added choosing a scaled-back solution will mean the township board must accept that the bridge will need more frequent touchups if it cannot afford or find any company to do a full coating removal/replacement.

"I don't want the bridge to go another winter without, at least, a perfunctory coating," Wilt said. However, that "perfunctory" coating job might not even fall within the township's budget. Nadolski will reportedly prepare a proposal for new bid documents that Wilt suggested. This was expected to be presented to the board at its August meeting.

PHOTO: STEVE CONRO / BRIDGEHUNTER.COM



THE FOUNDATION FOR EVERY COATING PROJECT: SURFACE PREPARATION

PHOTO: GLENJ / GETTY IMAGES

EDITOR'S NOTE: This article is the next installment in the ongoing JPCL Coatings 101 series, which presents basic information on coatings for industry newcomers and veterans alike. A version of this article was published in January 2005 as the first in JPCL's Applicator Training Bulletin series, based on a series of original articles developed by the Houston Coating Society and published in JPCL between 1988 and 1992. The authors of the original article, "Why Surface Preparation Is Important," were Robert Barnhart, Devoe Coatings; Debbie Mericle, Sline Industrial Painters; Chuck Mobley, Mobley Industrial Painters, Inc.; Tom Hocking, Sullair of Houston; Jeff Bogran, Bob Schmidt, Inc.; and Ernestine McDaniel, Stan-Blast. The article has been updated for this issue by JPCL staff.

Coatings experts often say that surface preparation of a steel surface is the most important part of a coating system. By this they mean that surface preparation affects the performance of the coating more than any other variable. Given that the proper coating system has been selected, if the surface preparation is poor, coating performance will often be compromised, even when the application is perfect. If surface preparation is good, then the coating applied over it is likely to perform well. For you, the applicator, it is useful to know why surface preparation is so important, because knowing why can help you do a better job. The following discussion focuses on the preparation of steel, but the concepts apply to concrete and other substrates as well.

QUIZ QUESTION

a

True or False? A very smooth surface is ideal for promoting coating adhesion.

SEE ANSWER, P. 16.

Surface Preparation Is a Foundation

First, we can express the reason for the importance of surface preparation in a broad, general way, with the help of an analogy or comparison.

Surface preparation is to a coating system what a foundation is to a building. If a building has a poor foundation, it can list or lean, as the famous Leaning Tower of Pisa does, or it can collapse altogether. If a coating system has a poor foundation (surface preparation), it will fail sooner than expected (say, after five years rather than ten years); or it can fail catastrophically, within the first year of application. In both instances, reduced service life and catastrophic failure can result in great financial losses to a facility owner. The contractor may be held responsible for these losses if the surface preparation work is found to be faulty. As a professional painter, you have a responsibility to your employer to make certain that the surface preparation work you provide complies with the specification requirements – to provide the solid foundation necessary for the proper performance of the coating system.

When speaking about the function of surface preparation, it is important to go beyond the general concept of a foundation, and look to specific attributes. Surface preparation creates a foundation in two important ways: a mechanical way, by providing an anchor for the coating; and a chemical way, by allowing intimate contact of coating molecules with the steel surface. These elements of foundation are best understood by their opposites – the negative or detrimental conditions of slipperiness and debris on the surface.

Overcoming the Negative of Slipperiness

When a surface is very smooth, coatings have a difficult time adhering strongly. Imagine a coating on glass, for instance, and the ease with which it can be removed by a scraper or even a fingernail. Imagine, on the other hand, a rough surface like sandpaper on the same piece of glass, and how difficult it would be to remove a coating film from it. Steel, when it is abrasive blasted, has a surface that is rough like sandpaper, with a series of tiny peaks and valleys called surface profile.

Coatings anchor themselves to the valleys of the profile, and the peaks are like teeth. This is why surface profile created by blasting is sometimes called an "anchor pattern" or "mechanical tooth."



PHOTO: HUDIEMM / GETTY IMAGES

Overcoming the Negative of Debris

Debris on a steel surface can be comprised of many different materials. They include dirt, dust, grease, oil, rust, moisture and, in some cases, millscale. When materials such as these are painted over, they

Want more coatings quiz questions? Test your knowledge on current industry ongoings with our daily quiz in *PaintSquare Daily News*. Sign in at **paintsquare.com/register** and go to My Account to select your FREE newsletter subscription.

interfere with both mechanical and chemical adhesion of the coating to the substrate and make it likely that the coating will fail prematurely.

On the other hand, when all debris is removed, the coating can achieve complete and continuous contact with the steel substrate, thus assuring the best possible adhesion. When a coating adheres well, it will create a more effective barrier, minimizing the moisture that reaches the steel substrate and that helps corrosion.

Non-Visible Contaminants

Other forms of debris, not visible to the naked eye, are chemical contaminants. The most dangerous forms of chemical contaminants are soluble salts such as chlorides and sulfates. When such contaminants are painted over, they have the power to draw the moisture through the coating to cause blistering, detachment and accelerated corrosion of the underlying steel.

When structural steel is going to be repainted, areas that were previously rusted and pitted may contain soluble salt contamination, especially in the bases of the pits. Dry abrasive blasting typically does not remove these salts, so it is wise to check for their presence with specially designed field test kits before painting and then to take additional cleaning steps to remove the salts, if they are present in detrimental amounts. Testing for and removal of soluble salts will be discussed in detail in a later lesson.

Degrees of Surface Preparation

In any job specification, the degree of cleaning required for a given steel substrate before painting depends on a number of factors. The service environment of the coating system is perhaps the most important and, normally, is the first consideration when determining the degree of surface preparation. Generally, the more severe the environment, the better the surface preparation required. Severe service environments include immersion in liquids, exposure to aggressive chemicals or environments, high temperatures or combinations of these conditions.

A second consideration is the generic kind of coating used. Some coatings, such as oils and alkyds, can tolerate application over minimally prepared or hand-cleaned surfaces because they flow out and wet the surface well. In addition, some epoxy mastics and other "surface-tolerant" coatings are formulated to be applied over hand- and power tool-cleaned surfaces. Coatings such as inorganic zincs, however, are at the other end of the spectrum. They require a higher degree of cleaning than many other types.

Cost is another factor in selecting the degree of surface preparation. Blast cleaning to SSPC-SP 5 (White Metal) is about four to five times more costly than to SSPC-SP 7 (Brush-Off) or SSPC-SP 3 (Power Tool). In some severe environments and with some coating types, rigorous cleaning is necessary; but in other instances, the cost and cost-benefit of higher grades of cleaning relative to increased coating lifetime will become an important factor in selecting the degree of surface preparation.

Finally, regulations may have an impact on the degree and method of surface preparation. In residential or congested urban environments, open blasting may be prohibited; in addition, where lead- or chromate-based paints are being removed, environmental and hazardous waste regulations may require containment and use of special surface preparation methods.

Determining the degree of surface preparation, as described above, is the job of a specifier or engineer. The task of doing the work is the contractor's. No matter what

QUIZ QUESTION

b

Of all of the different surface preparation methods, which method—while arguably the most effective—tends to be the most expensive?

SEE ANSWER, P. 16.

QUIZ QUESTION

C

True or False? Removing visible contaminants, such as oil, dirt, dust and debris, should be the first step taken during surface preparation.

SEE ANSWER, BELOW.

QUIZ ANSWERS

A: False. A clean, rough, profiled surface is required for coating adhesion.
B: Abrasive blast-cleaning.
C: True. SSPC-SP 1, Solvent Cleaning, is the industry standard for removing visible contaminants.

degree of surface preparation is required, it must be done thoroughly. If hand-tool cleaning is required, then all of the surface area specified must be hand-tool cleaned, after it has been first cleaned by water or solvent according to SSPC-SP 1 to remove dirt, oil or grease. If SSPC-SP 5 is specified, then conformance with the written description of SP 5 must be achieved on all designated surfaces. In cleaning steel, it is also important to follow the proper sequence.

First, you must remove dirt and other debris. It is a lot easier to sweep mounds of dirt and other loose material off a surface with a broom (or by vacuuming in the case of lead-contaminated debris) than to try to remove it with surface preparation tools. The next step is removing visible oil and grease by solvent cleaning. Then you must conduct the operation of ultra-high-pressure waterjetting, hand tool, power tool or abrasive blast-cleaning.

If you reverse these steps, particularly with blast cleaning, the force of the blasting abrasive may drive the debris into the roughened steel surface or profile, or spread it around as is the case with grease and oil. Then it is not easy to remove, and it may interfere with coating adhesion. In addition, it is important to achieve the surface profile required by specifications. When the profile is too rough, the coating may not cover the peaks of the profile, and the result will be pinpoint rusting. When the profile is not rough enough, the coating may not anchor well to the surface, and will result in loss of adhesion.

To make sure that a coating system will perform well as a barrier to prevent corrosion, you must roughen the steel surface for mechanical adhesion and make sure that all debris is removed so that the coating contacts the entire surface of the steel. In achieving these two conditions of cleanliness and profile, you will have assured that a proper foundation has been created for application of a coating system. This good foundation should help to provide many years of service life for the coating. JPCL

PERSPECTIVE, CONT. FROM P. 3

- Would revise triggers for engineering controls, showers, compliance plans, etc.

- **PPE and Hygiene**
  - Impermeable PPE;
  - Changes regarding personal clothing worn under PPE; and
  - Triggers for providing PPE.
- **Training**
  - Updated to address new health effects, routes of entry and changes to work practices based on these.

Questions for Employers/ Opportunities for Comment

OSHA is accepting comments from industry stakeholders through Oct. 28.

OSHA has put together a list of over 60 specific questions on which they are seeking input. Any individual, company or organization can provide comments online at regulations.gov, by referring to Docket No. OSHA-2018-0004.

The brief comment period – extended from the original Aug. 29 deadline – appears to signify a rapid movement from the issuing of the ANPR to the establishment of the final rule.

Summary

These changes, or something similar, are coming before 2024. I urge you, the reader, to submit comments directly to OSHA and/or to engage in organizational responses through groups like AMPP, the National Steel Painting Contractors Association (NSPCA), the International Union of Painters and Allied Trades (IUPAT) and others to provide information to OSHA regarding abrasive blast-cleaning and other surface preparation methods, containment, ventilation and work practices that we use and the types of exposures we experience. Also, work with your employees now to reduce BLLs to as low as feasible and consider how you will manage them once these changes take effect.

You can obtain a copy of the ANPR at osha.gov/lead. The 60 questions detailed in the ANPR are also included on the OSHA website. JPCL

An Unexpected Challenge Leads to a HIGH-TECH SOLUTION

BY DREW JOHNSON, CORROSION CONTROL RESOURCES, INC.

Unexpected jobsite findings, especially when combined with an extremely tight deadline, can completely derail a project, costing both the client and the contractor time, resources and money.

This, however, was not the case when one coating contractor arrived on the scene at Arlington Water Utilities Pump Station in Arlington, Texas, expecting to find a raw water pipe lined with coal tar epoxy, but instead found coal tar enamel in the pipe's interior – which is a much thicker coating than coal tar epoxy.

With that discovery, the contractors knew that they had to pivot and come up with another solution for the lining removal. Ordinary hand-blasting with coal slag was no longer a viable option for the removal of the coating and the surface preparation of the water pipe.

This article will describe how, by working with a great team of experts, the crew was able to switch gears and remove the coating by robotic blasting with sponge media and get the interior surface of the pipe ready for a new coating system application.

FIG. 1: The contractor found that the pipe interior was lined with coal tar enamel, a much thicker and harder to remove coating than coal-tar epoxy. The coal-tar enamel coating varied in thickness throughout the pipe, averaging between 250 and 500 mils.

PHOTO: COURTESY OF THE AUTHOR

Unexpected jobsite findings, especially when combined with an extremely tight project deadline, can completely derail a project, costing both the client and the contractor time, resources and money.

Project Background

The raw water pump station at the heart of this project sits on Lake Arlington and is owned by Arlington Water Utilities. The City of Arlington, as well as the Trinity River Authority (TRA), use Lake Arlington as a source for raw water. The lake was built in the late 1950s and spans 1,926 acres. Although the City of Arlington owns the lake, it is a part of a chain of reservoirs and lakes that provide water to North Central Texas.

The Arlington Water Utilities Pump Station was built in 1974 and, as with most infrastructure from this time period, various rehabilitations and repairs have been made over the years. Recently, however, it became apparent that a complete overhaul of the pump station and piping was needed. The $21 million renovation project was a joint venture funded by Arlington Water Utilities and TRA.

The coating contractor was brought on by the project's general contractor to perform removal of the existing internal lining of a 60-inch (1.5 m) raw water line. Once the liner was removed, the crew was tasked with relining the pipe. Limits of the liner removal and relining were defined as inside the pump station to outside the pump station where the aerial (aboveground) pipe transitioned below grade.

The pump station and pipe are a crucial part of the water supply system, and the coating contractor crew felt the pressure of getting the pipe back into service as quickly as possible, with only 28 days allotted to remove the existing liner in the pipe, recoat, allow for cure time and get the pipe back into service. As a result, the crew would have to work around the clock to meet this deadline, and there was little – if any – room for error.

An Unwelcome Surprise

Prior to the five-man crew beginning the surface preparation and coating application, the old pumps and piping were removed from the pump station. These were to be replaced



FIG. 2: The crew had their work cut out for them as the coal-tar enamel had failed in areas, leaving behind corrosion in the 60-inch raw water pipe.

PHOTO: COURTESY OF THE AUTHOR





FIG. 3: Given the surface area, the total coal slag abrasive media *(top)* required for this job was estimated to be 21 to 22 semi-trucks filled with abrasive media. After test blasting determined that 100 lbs. of coal slag removed just under 1 square foot of coal-tar enamel, it was apparent that sponge media *(bottom)*, along with robotic abrasive blasting, was the only viable option.

later on in the overall rehabilitation project with new pumps and piping. Inside the pump station, a butterfly valve was cut out of the water pipe to create an 8-linear-foot access opening for the crew.

When the contractor's project manager and team arrived and began disassembling the piping, they found the pump cans were lined with coal-tar epoxy lining, but the pipe was lined with coal tar enamel. The coal-tar enamel varied in thickness, but averaged between 250-500 mils (6,500-13,000 microns).

The discovery of coal-tar enamel coating was a huge roadblock for the crew. Coal-tar enamel is a very thick lining that has been phased out over the last couple decades.

PHOTOS: COURTESY OF THE AUTHOR

To give readers an idea of the difference between epoxy and enamel: coal-tar epoxy is typically anywhere from 8–15 mils (200–400 microns) thick, while coal-tar enamel is 10 times that thickness.

Faced with having to remove a lot more material using hand blasting with coal slag abrasive, the project manager immediately knew that this method wasn't going to work and started to consider other approaches – namely, using sponge media through a robotic abrasive blasting unit to pull off this undertaking.

To prove that ordinary grit was not the right choice given the newly discovered coal-tar enamel lining, the crew performed a test blast using ordinary blasting equipment and coal slag abrasive on a section of the pipe. Results of the test blast showed that 100 lbs. (45 kgs) of media removed just under 1 ft^2 (0.1 m^2) of coal-tar enamel. Given the surface area of 3,500 ft^2 (325 m^2), the total media required with minimal waste would be 350,000 lbs. (160,000 kgs) – or about 21 or 22 semi-trucks filled with abrasive media.

In addition, the estimated timeframe to complete the removal with grit was 20 weeks, a schedule that was unacceptable to the project manager, not to mention the general contractor and the client. There was simply no way that the pipe could be out of commission for that long.

After the test blast, the engineers on the project determined that sponge media, along with robotic abrasive blasting equipment, would the most viable option to save the job and keep the contractor's schedule on track.

The speed of coal-tar enamel removal varied based on the thickness of the coal-tar enamel. The robot speed varied, but ran most of the time at 2.2 inches (6 cm) per minute.

In addition to saving time and money, the robotic system provided a safer way to remove the coal-tar enamel lining from the interior of the pipe.



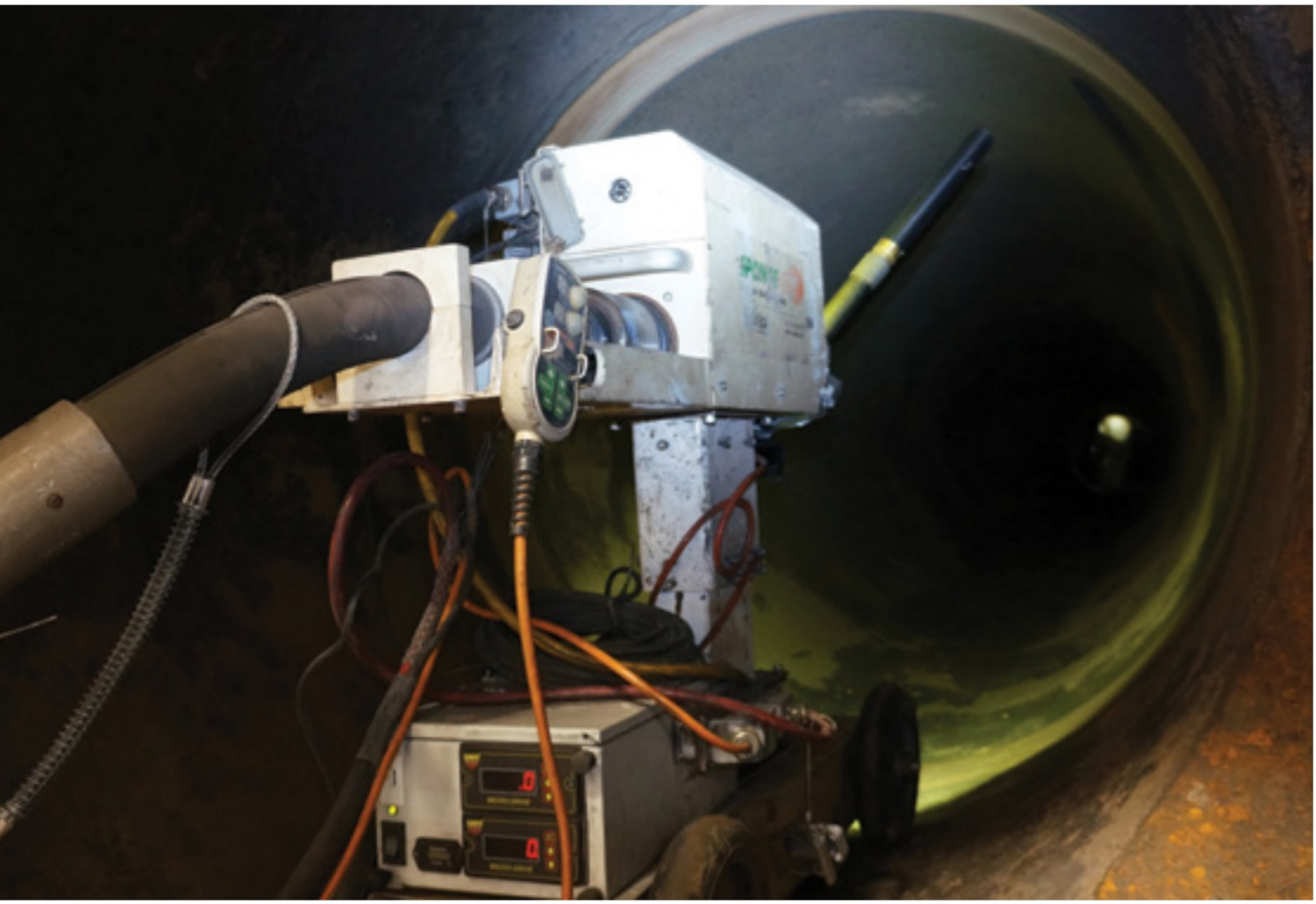


FIG. 4: **Robotic abrasive blasting was a safer option for the crew, allowing for reduced man hours spent in the confined space of the pipe.**

With the 60-inch diameter pipe, that equates to 2.87 ft^2 (.25m^2) per minute. To compare, it took two minutes and 32 seconds to remove under 1 ft^2 (.1m^2) of liner when hand-blasting with coal slag. Even when accounting for the robot having two nozzles, it is still safe to say that using this method was approximately three-to-four times as fast as conventional hand blasting.

In addition to saving time and money, the robotic system provided a safer way to remove the coal-tar enamel lining from the interior of the pipe. If the contractors had attempted to use hand blasting with coal slag, the crew would not only have been blasting in a confined space, but they would have also had to carry the 350,000 lbs. (160,000 kgs) of abrasive media out of the pipe, bucket by bucket. With robotic abrasive blasting, the man-hours the crew spent in the confined space of the pipe was significantly reduced, making the jobsite much safer. The robot was operated from a pendant, which allowed operators to remotely adjust drive speed, direction and blast arm rotation. However, because of the hazardous nature of the existing lining, the team wore special protective suits, extra-heavy chemical gloves and utilized protective breathing gear when in any type of contact with the coal tar enamel. The same PPE was used later on in the project when they began the coating application process.

Ultimately, only one truckload of sponge media waste was hauled away from the jobsite – a great reduction from the more than 20 truckloads that could have been required if grit and hand blasting was used.

PHOTO: COURTESY OF THE AUTHOR

Coating the Pipe Interior

The coating contractor crew spent 11 days on the lining removal and surface preparation portion of the job, and a third-party inspector was brought onsite prior to the application of the lining system. The inspector measured pipe wall thickness, surface profile and surface cleanliness to make sure that proper adhesion of the new lining system could occur.

When it came to the lining system chosen for the interior of the raw water pipe, the contractor consulted with coating manufacturers to come up with the correct specifications for the lining system, ultimately choosing an 80%-solids epoxy coating specially designed for application in pipes and tanks containing potable water, wastewater and salt water. The chemical- and abrasion-resistant coating meets requirements of AWWA C210 for coating systems for the interior and exterior of steel water pipelines, and was formulated with cure times that ensure a rapid return to service.

Using heavy-duty pneumatic airless spray equipment, the crew applied three coats of the coating in contrasting colors (white, blue and white) at a DFT of 7 mils per layer. In between the first white coat and the blue coat, the crew applied a stripe coat to all edges, welds and transition areas. Special termination was made in some areas using a 100%-solids epoxy surfacing compound designed as a fairing compound for weld seams and riveted connections. The crew also sealed the areas where the pipe was mechanically joined together internally

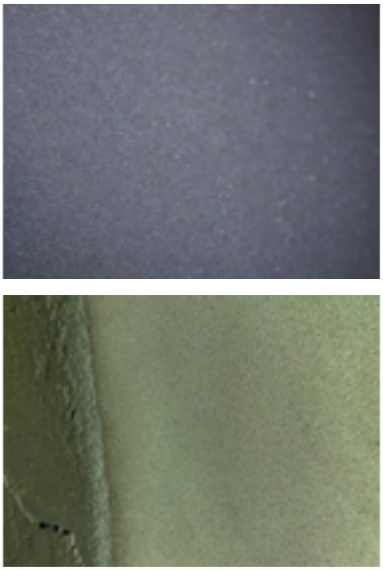


FIG. 5: **At top is the SSPC-SP5/NACE No. 1, "White Metal Blast Cleaning" finish achieved using robotic blasting. The bottom photo shows *(from left to right)* the surface before and after robotic blasting with sponge media.**



PHOTOS: COURTESY OF THE AUTHOR



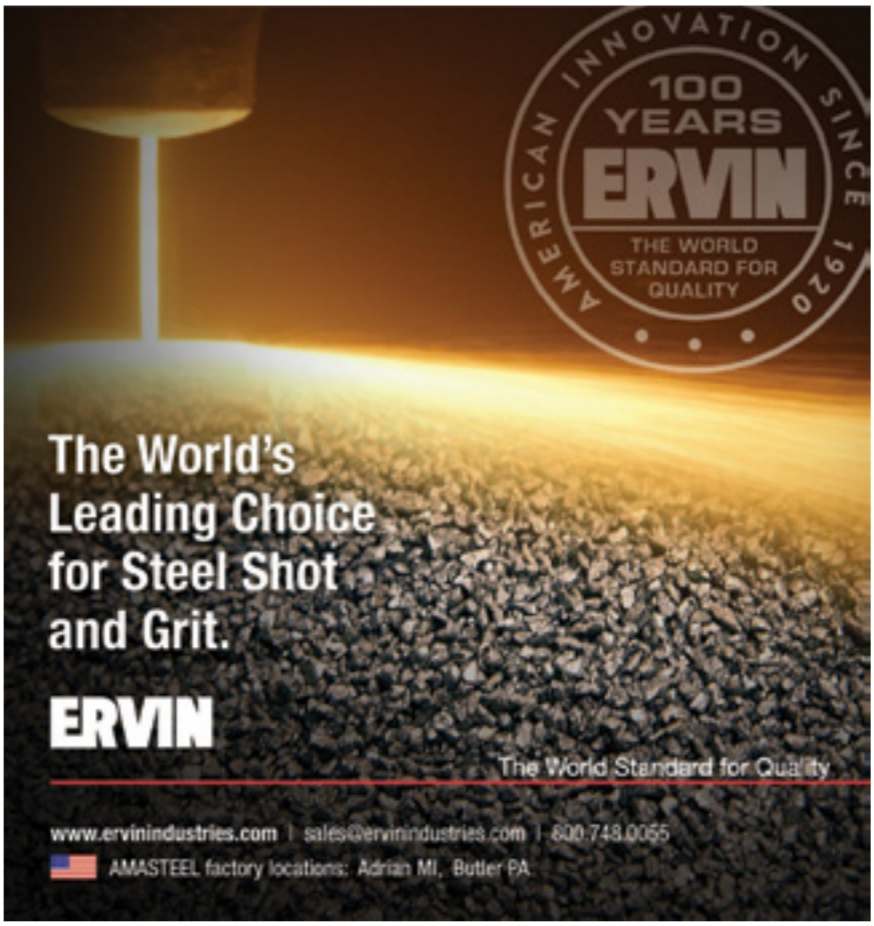




FIG. 6: Using spray application equipment, the crew applied three coats of an 80%-solids epoxy coating specially designed for application in pipes and tanks containing potable water, wastewater and salt water, in contrasting colors (white, blue and white) at dry film thickness of 7 mils per layer. In between the first white coat and the blue coat, the crew applied a stripe coat to all edges, welds and transition areas.

PHOTOS: COURTESY OF THE AUTHOR

with a high-performance, non-sag, NSF-approved chemical resistant elastomeric joint sealant.

After the coating application, the contractor performed QC testing that included visual inspection, dry film thickness measurements and holiday testing in accordance with NACE SP0188. A third-party inspection was also performed and, after any necessary repairs were made, the pipe lining underwent a final inspection and holiday test.

Controlling Environmental Conditions

Throughout the duration of the project, the contractor continuously monitored environmental conditions inside the pipe to ensure the success of each stage of the process.

Dealing with the humidity was a huge factor in the success of this job, both from the surface preparation and coating application standpoint. In Texas, relative humidity is always an issue, and in this case, the crew also had to deal with being only 15 feet from the lake, in some areas. To combat the humidity and keep the interior of the pipe dry, the crew built their own scaffolding system and built containment around the pipe opening using a high-mil poly.



FIG. 7: **The crew performed QC testing that included visual inspection, wet film thickness testing, dry film thickness measurements and holiday testing in accordance with NACE SP0188.**

PHOTO: COURTESY OF THE AUTHOR



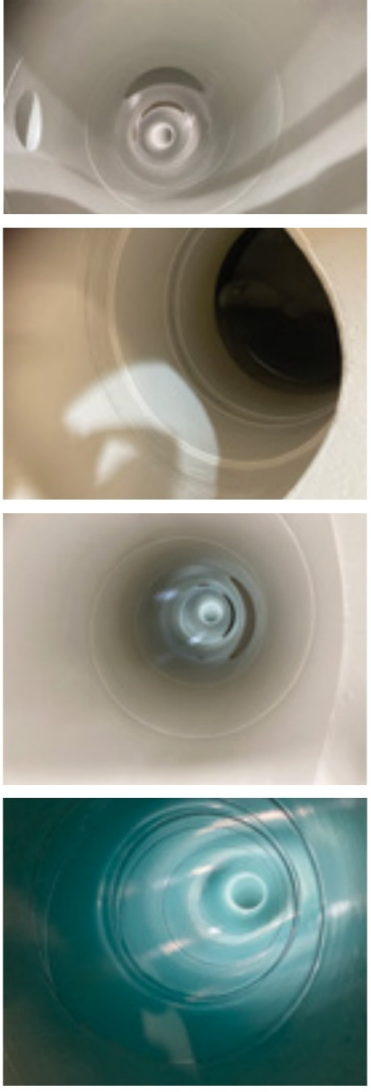


FIG. 8: **The contractor was able to complete the job in the extremely tight timeframe of 28 days; 11 days were spent on lining removal and surface preparation, and the remaining time was dedicated to the application of the new lining system.**

A 5,000 CFM desiccant wheel dehumidification unit was set up and ran the entire duration of the project. The dehumidification unit allowed for a constant flow of dry air to go through the pipe. The contractor was able to environmentally control the interior of the pipe to prevent flash rusting during the robotic abrasive blasting and create the proper conditions for the application of the new liner.

Conclusion

At first, finding the coal-tar enamel coating in the pipe seemed like an insurmountable challenge for the contractor, especially given the original plan to remove the existing liner using hand blasting and coal slag. However, with some outside-the-box thinking, a team of industry experts, a high-tech surface prep and coating removal method, and a carefully chosen coating system, a resounding success was achieved on all fronts.

Using robotic abrasive blasting saved time and money, created less waste and, most importantly, provided a much safer option for the contractor's crew. All of this, coupled with high-performance coating materials, allowed the team to turn the water pipe over to Arlington Water Utilities on schedule and with a new liner that will extend the service life of the pipe and keep water flowing to residents. JPCL



ABOUT THE AUTHOR

Drew Johnson is the General Manager of Corrosion Control Resources. He has more than 20 years of experience in the protective coatings industry, holding various technical service and project management positions over the course of his career. Johnson is a NACE-certified Coating Inspector (Level 3) and an SSPC-certified Protective Coatings Specialist and is currently working towards earning a degree in construction engineering from the University of Southern Mississippi.



PHOTOS: COURTESY OF THE AUTHOR



THE BIOFUEL MISSION

Advanced Lining Systems for Energy Transition

BY MIKE O'DONOGHUE, PH.D., AND VIJAY DATTA, MS, CHEM. ENG., AKZONOBEL

"For a successful technology, reality must take precedence over public relations, for Nature cannot be fooled."

— *Richard P. Feynman*

Déjà vu? Several years ago there you were, coatings chemists and chemical engineers, on the brink of a publication in the protective coatings industry – one in which both your scientific endeavor, and those of several others in industry, had come together to address and provide insight on the thorny environmental issue of volatile organic compounds (VOCs).[1,2]

Fast forward to today, where the world, in some ways, has changed almost out of recognition. Yet, we find the same chemists, engineers and coatings practitioners now prolifically working in an interdisciplinary approach alongside colleagues in biotechnology, this time on an associated problem: energy transformation. What, then, is the task at hand? As much as possible, it is to realistically lower global energy dependence on non-renewable fossil fuel resources like coal, traditional sweet and sour crude oils, and shale oil.

Now, the optics are focused on clean energy: renewable bio-based feedstocks to "grow" renewable biofuels, and with that, the development of innovative lining systems to better protect steel from the deleterious chemical and thermal exposures from free fatty acids in the feedstocks.

Another Green "A" Grade is on the horizon for those helping planet Earth with its smorgasbord of issues, some of which are highly contentious. These include climate change, CO_2 and other greenhouse gas (GHG) emissions, carbon footprint reduction, food and forest management, safety and sustainability, the energy transition mix and – most germane to readers of this publication – corrosion mitigation with high-performance linings.

PHOTO: ONURDONGEL / GETTY IMAGES

Influential Pulitzer Prize recipient and a world authority on global energy, Daniel Yergin, noted in his 2011 book, *The Quest: Energy, Security and the Remaking of the Modern World*, that the switch from fossil fuel to biofuel can be envisioned as an energy transition from 20th-century "Hydrocarbon Man" to 21st- century "Carbohydrate Man."[3] This is arguably a rather big step for humanity and environmental social governance (ESG), especially in countries not blessed with tar sands, shale plays or conventional oil reserves.[4]

It's inarguable, though, that biofuels have arrived – and for traditional fossil fuels, it's time to move over and share the stage.

The focus of this article is not on renewables for energy supply – such as geothermal, hydroelectric, solar, wind, batteries or fuel from hydrogen – nor the gasoline additive bioethanol, an alcohol made by fermentation of crops like corn and soya beans, sugar cane and the so-called fast growing C4 grasses. Rather, the primary focus is on biomass, composed of common oils and fatty acids, and biodiesel, or renewable diesel.

Renewable, non-toxic and biodegradable fuels such as biodiesel and sustainable aviation fuel are part of an increasingly fast-growing energy source in the U.S., Canada and Europe. For instance, renewable diesel can replace traditional petroleum in diesel combustion engines. Blends of biodiesel and regular diesel are available as shown by B100, B20 and B5 biodiesel specifications, respectively 100% biodiesel, 20% biodiesel: 80% diesel, and 5% biodiesel: 95% diesel.

IS THERE MORE DÉJÀ VU?

Harking back to the 1970s and 1980s, the use of biofuels was an early example of a crude oil replacement strategy. But, in that era, an abundance of inexpensive fossil fuels largely put paid to any significant further use of biofuels – that is, until now. Today's macroeconomic upheaval with excessive oil prices, uncertainty with supplies, energy shortages and a full-throttle ambition by many for the "Green New Deal" could mean that biofuel production as an energy transition strategy may increase dramatically in importance ***(Fig. 1)***.[9]

Recent examples where biofuels have been used for commercial and armed forces transportation include:

Canada Steamship Lines running eight out of 16 ships on the St. Lawrence river and Great Lakes in 2021 on 100% soybean-derived diesel;[5]

Air France with their first long-haul flight in May 2021 from Paris to Montreal having replaced 16% of the traditional jet fuel with used cooking oil;[6]

A United Airlines Boeing 737 jet in December 2021 flying from Chicago's O'Hare and Washington to D.C.'s Reagan National with one engine powered by 100% sustainable aviation fuel. Interestingly, the latter was the first passenger flight to use the new eco-friendly fuel;[7] and

The U.S. Navy Frigate, USS Ford, sailing in 2020 from Everett, Washington, to San Diego, powered by a 1:1 blend of algae-based biofuel and F-76 military diesel.[8]

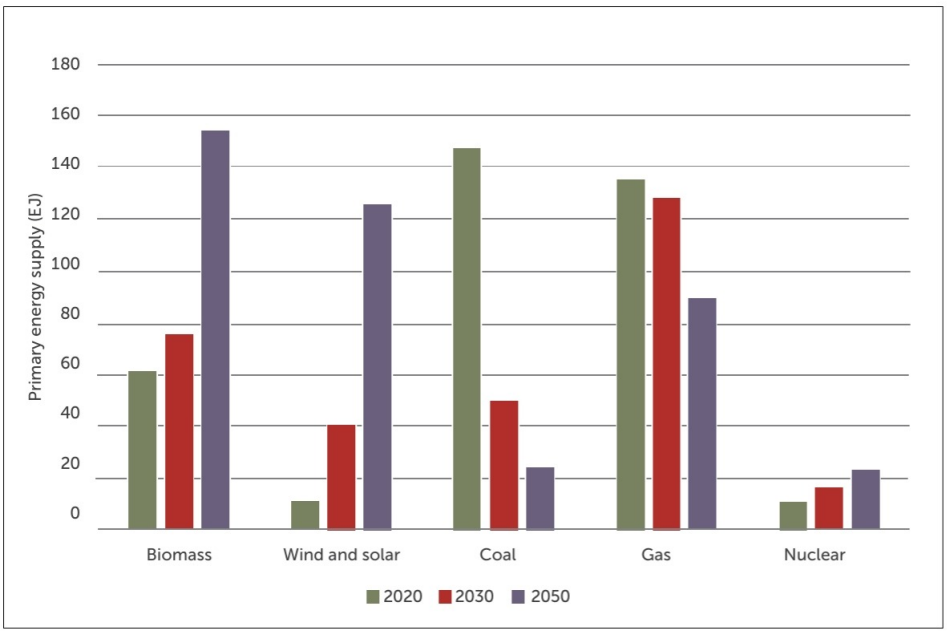


FIG. 1: **Projected worldwide energy sector production through 2050; note the anticipated increases in biomass, wind and solar energy production.[9]**

TABLE 1: **Fatty Acid Content of Common Oils**[12]

FREE FATTY ACID (R1, R2 AND R3)	DOUBLE BONDS	CASTOR	COCONUT	COTTON SEED	LINSEED	SOYBEAN	SAFFLOWER	TALL OIL ACIDS
Oleic	1			24	22	25	14	
Linoleic	2	82	7	42	16	13	75	41
Linolenic	3		2		52	9	1	5
Eleosteric	3							
Licanic	3							
Ricinoleic	1	9	7					
Palmitoleic	1							
Arachidonic	4							
Clupanodonic	5							
Stearic	0	2	6	4	4	4	4	3
Palmitic	0		11	29	6	11	6	5
Myristic	0		18					
Lauric	0		44					
Capric	0		6					
Caprylic	0		6					
Hydroxy Acids	0							

According to IAAGlobal, the demand for biofuels is expected to grow by a substantial 41 billion liters between 2021 and 2026.[10] However, while the armed forces and several new and existing industrial and marine facilities do use renewable fuels like biodiesel and aviation fuels, there are some daunting in-service challenges for the storage and transmission linings supplied by coating manufacturers for corrosion protection.

The diversity and chemical composition of the ever-changing biomass feedstocks used to make various biofuels presents a big challenge. It is a situation compounded by facility owners often not having sufficient in-house know-how of technical issues associated with biofuels and their precursor feedstocks.

Unsurprisingly, owners and operators must rely on EPCs and technology providers – and especially on lining manufacturers – to provide functional specifications with linings proven to perform well in relevant and non-arbitrary, accelerated laboratory tests and real-world, in-situ testing conforming to the owner's service conditions.[11] This article will present results of such testing for an array of lining options for corrosion protection of biomass feedstock transmission and storage systems.

The Many Faces of Molecules

But first: what exactly is a biofuel?

In simple terms, it is a "green" fuel derived from a biomass conversion process, where biomass refers to recently living organisms, such as plants or plant-derived materials. Examples of biomass include wood; crops like corn and sugar cane; oils and fats; organic waste such as municipal waste or rotten food; nutshells; and the superfood par excellence, algae.

Fulfilling the desire to "go progressively green," the commercial and military use of biofuels – especially for transportation – will likely be further catapulted into prominence given existing infrastructure for biofuel synthesis, lining know-how, easy and safe biomass and biofuel handling and storage. Biofuels that are in greatest production today are cellulosic ethanol, which is made by fermenting starch or sugar, followed by biodiesel which is made from soybean, palm oil or even waste cooking fat.

Raw feedstocks, such as tallow, distillers' corn oil, soybean oil and used cooking/vegetable oil, come into an owner's facility where they enter a pre-treatment unit (PTU) to reduce contaminants to pre-determined levels of acceptability. From there, the cleaned feedstocks are processed in a renewable diesel unit (RDU) with an appropriate catalyst. The finished products are renewable diesel, renewable liquid petroleum gas and renewable naptha.

It is instructive to look at some molecules germane to biofuels, where (tongue-in-cheek) some of them are tasty, while others are nutritious. **Table 1** shows a list of typical oils (triglyceride

esters of mixed fatty acids) used for biodiesel production.[12] **Figure 2** shows that fatty acids in the oils are organic acids.

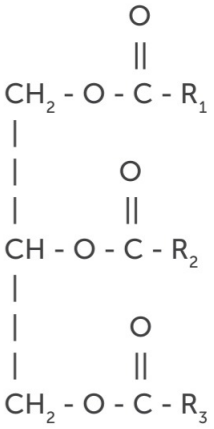
Table 1 also shows the fatty acid content of the common oils listed. The fatty acids in the oils often have up to 20 carbon atoms in chains classified as saturated, where there are no reactive double bonds, or unsaturated, where the chains contain the reactive double bonds.

Note that coconut oil listed in Table 1, with its large number and high concentration of fatty acids, stands out as the most aggressive vegetable oil toward linings. Therefore, in the present work coconut oil was chosen as the benchmark for evaluating lining performance in a spectrum of vegetable oils.

Biodiesel refers to a vegetable oil, or animal fat-based diesel fuel consisting of long-chain alkyl (methyl, ethyl or propyl) esters having typically been made by reacting vegetable oil with alcohol, thereby producing fatty acid esters.

FAME AND FORTUNE MOLECULES

Consider for a moment a class of chemicals that are known as free fatty acids (FFAs) and fatty acid methyl esters (FAMEs) in particular. These are a type of fatty acid ester that can be produced by an alkali-catalyzed reaction between fats, or fatty acids, and methanol. FAMEs are primarily the molecules found in biodiesel. Most often they are obtained from vegetable oils by a process familiar

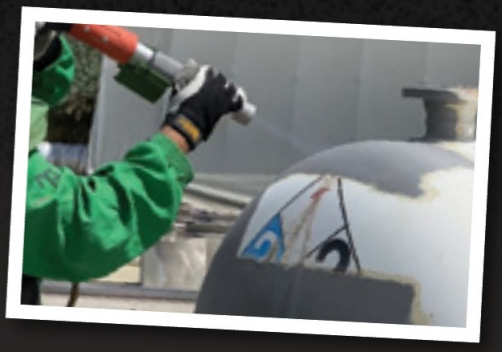


Triglyceride

FIG. 2: General formula of a triglyceride, an ester of mixed fatty acids with alkyl chains R1, R2 and R3.

NEW PATENT-PENDING ABRASIVES

WITH SPEED & DUST SUPPRESSION



SUPER MEDIA-1™ Aggressive Coating/ Contaminant Removal and Profiling
hubs.ly/Q01j8fXX0

CONTRACTOR BLEND 2.0 SPONGE MEDIA™
Ideal for preparing new construction *(mill scale)*
hubs.ly/Q01j8gkc0

And more NEW abrasives targeting key features - for Faster/Better/Economical Surface Prep

©2021 Sponge-Jet Inc. All rights reserved.

SAVE TIME. SAVE MONEY.
Call +1-603-610-7950

SPONGE JET
Low Dust Abrasive Blasting Technology

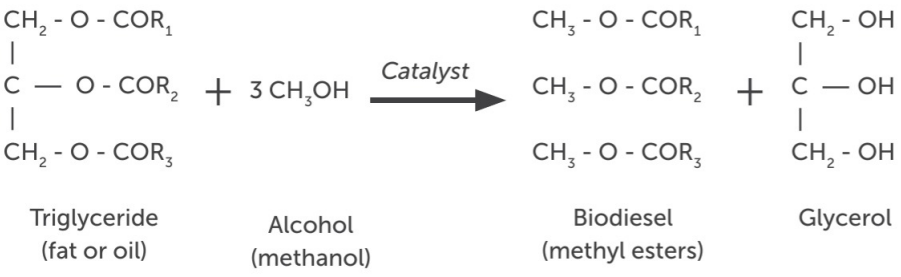


FIG 3: **Transesterification reaction of a triglyceride and an alcohol.**[13]

to chemists known as transesterification ***(Fig. 3)***.

There are four primary ways to synthesize biodiesel:

1. Direct use and blending;
2. Micro-emulsions;
3. Thermal cracking (pyrolysis); and
4. The aforementioned transesterification process, which is the most common process.[13]

Biomass feedstocks and chemicals for biodiesel production vary considerably and include (but are not limited to) virgin oil feedstock; used cooking oils (UCOs); waste animal fats such as tallow; seaweed; algae; alkalis (for base catalyzed transesterification); acids; methanol or ethanol; and glycerol.

Despite much positive press for biofuels, there are a number of technical concerns that need to be addressed. These concerns include potential corrosivity of biofuels to steel and engine alloys; microbially induced corrosion (MIC) reported with biodiesel storage; corrosion by-products that contaminate or consume catalysts in the renewable diesel unit (RDU); the effects of mineral acids and alkalis; the diverse range of feedstocks; FAMES, i.e., free fatty acid types whose concentrations in oils and fats pose corrosion risks during storage, loading and operating at "upset" temperatures.

No surprise, then, that carbon steel storage tanks, pipes and vessels require long-lasting corrosion mitigation from a wide range of feedstocks and the ravages of fatty acid attack, high temperatures and MIC. It is, therefore, imperative that coating manufacturers provide high-performance linings that afford long lasting chemical, hydrolytic and thermal resistance when exposed to renewable feedstock oils that sometimes contain as much as 15–20% FFAs and small amounts of water at temperatures as high as 160–194 F (71–90 C).

Biomass raw feedstocks need to be characterized by their percentage of FFA, and/or total acid number (TAN). The latter is a measure of their acidity as determined by the amount of potassium hydroxide in milligrams required to neutralize the fatty acids in one gram of oil; their water content percentage; and their temperature (storage, loading, potential upsets).

In terms of compliance with industry standards, biodiesel must comply with ASTM D6751 or EN14214 standards. The water content must be less than 0.05% by volume (ASTM D2709) or 500 mg/kg (EN ISO 12937). The acid number must be less than 0.5 mg KOH/g (ASTM D664 or EN 14104) and the methanol content must be less than 0.2% (EN 14110). These standards and requirements are of crucial importance when rail car linings carry biodiesel.

Lining Testing: T-Minus 12 Months

At NASA, the countdown for a rocket launch is normally T-minus 10 seconds and counting – then lift-off. For coating and lining testing, the countdown for lining performance in oil and fat feedstocks is normally T-minus 12 months and counting. Then, we want no lift-off.

Against this backdrop, all carbon steel test panels were abrasive blast-cleaned to SSPC-SP 10/NACE No. 2, "Near-White Metal Blast Cleaning" standard using steel grit. A 3-mil jagged profile was obtained. The laboratory conditions were typically 70–77 F (21–25 C) and 60% relative humidity.

The two-coat, thin-film solvent-borne epoxy phenolic (A; EP) and epoxy novolac coatings (B; EN) were applied at approximately 5 mils (127um) DFT per coat by airless spray at 70–77 F (21–25 C) and cured at for a minimum of 21 days prior to testing.

The single-coat, thick film solvent free epoxy phenolic (C; EP) and epoxy novolac coatings (D; EN) were applied at approximately 30–50 mils (750–1,250 um) DFT by plural spray, as were the vinyl ester novolac coatings (E and F; both VEN). For consistency, all of coatings were cured at 70–77 F (21–25 C) for a minimum 21 days prior to testing.

Lining Performance: No Lift-Off

ISOTHERMAL PERFORMANCE IN COCONUT OIL

A series of carbon steel panels coated with two epoxy phenolics, two epoxy novolacs and two novolac vinyl esters were evaluated for immersion performance, varying the amount of FFA within the coconut oil.

Assessment of lining performance was carried out according to ISO 2812-1 (Determination of

Resistance to Liquids at Elevated Temperature). A triplicate set of panels from each lining series A–F was tested for 12 months at 158 F (70 C) and 194 F (90 C). The panels were placed in glass jars and partially immersed in a 99% FFA and 1% water solution. Then, the glass jars were placed into a plastic secondary containment and put in an oven, as shown in **Figure 4**. The oven temperature selected remained constant for a period of 12 months.

To reiterate, immersion in coconut oil at elevated temperatures was the benchmark for evaluating lining performance in all vegetable oils.

The results of an ISO 2812-1 study of steel panels coated with the thin-film, two-coat



FIG. 4: Coated test panels partially immersed in candidate FFAs kept in an oven under isothermal conditions at pre-determined temperatures for 12 months.

PHOTO: COURTESY OF THE AUTHORS



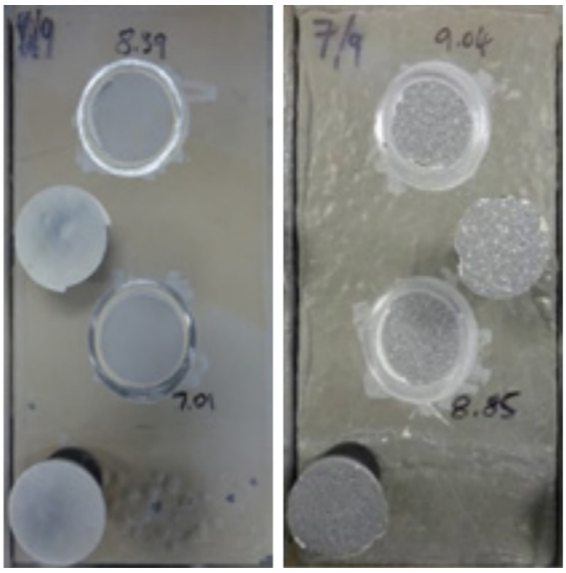


FIG. 5: ***(Left)*** **Lining B after 12 months immersion in Coconut oil fatty acid 99%/water 1%, at 158 F (70 C);** ***(right)*** **Lining F at same conditions as Lining B.**

solvent-borne epoxy novolac Lining B are presented in **Table 2**. **Figure 5** shows the excellent post-test condition of Lining B and after-test adhesion values in MPa measured according to ASTM D4541.

Why did this particular epoxy novolac lining perform so well? Essentially, because its fully-cured film had a high cross-link density, low permeability to corrosive fluids and excellent chemical resistance, namely barrier properties that lend themselves nicely to the corrosive onsite processes associated with biomass and biofuels.

Tables 3 and **4** show the results of testing of the triplicate set of panels from each lining series A–F tested for 12 months at 158 F (70 C) and 194 F (90 C) and the best-in-test overall performance was exhibited by the novolac vinyl esters. This was expected, given that novolac vinyl ester linings have very good thermal stability and chemical resistance (especially to acids) and mechanical properties at high temperatures.

TABLE 2: **ISO 2812-1 Elevated Temperature Testing of Lining B (Epoxy Novolac) for 12 months in 99% Coconut Oil/1% Water at 158 F (70 C).**

LINING B (EN) IN CHEMICAL	BLISTERING ISO4628-2	SOFTENING ISO4628-1	DISCOLORATION ISO4628-1	ADHESION ISO4624	PASS/FAIL
Coconut oil fatty acid 99%, water 1% (acid value: 276 mg KOH)[a]	0/0	0	1	1122psi 7.7Mpa average	Pass NFD[b]

a: Total Acid Number (TAN); a measure of acidity determined by the amount of potassium hydroxide KOH in milligrams required to neutralize the fatty acids in one gram of oil.
b: NFD No Film Defect

TABLE 3: **Linings Tested in Coconut Oil at 158 F (70 C).**

FREE FATTY ACID	LINING A (EP) THIN FILM	LINING B (EN) THIN FILM	LINING C (EP) THICK FILM	LINING D (EN) THICK FILM	LINING E (VEN) THICK FILM	LINING F (VEN) THICK FILM
0% FFA	NFD	NFD	NFD	NFD	NFD	NFD
2.5%FFA	NFD	NFD	Blistered @12 months	NFD	NFD	NFD
10%FFA	Blistered @12 months	NFD	Blistered @6 months	NFD	NFD	NFD
50%FFA	Blistered @1 month	NFD	Blistered @1 month	Blistered @3 months	NFD	NFD
100%FFA	Blistered @1 month	NFD	Blistered @1 month	Blistered @1 month	NFD	NFD

NFD: No Film Defect

TABLE 4: **Linings Tested in Coconut Oil at 194 F (90 C)**

FREE FATTY ACID	LINING A (EP) THIN FILM	LINING B (EN) THIN FILM	LINING C (EP) THICK FILM	LINING D (EN) THICK FILM	LINING E (VEN) THICK FILM	LINING F (VEN) THICK FILM
0% FFA	NFD	NFD	NFD	NFD	NFD	NFD
2.5% FFA	NFD	NFD	Blistered @12 months	NFD	NFD	NFD
10% FFA	Blistered @3 months	NFD	Blistered @6 months	Blistered @3 months	NFD	NFD
50% FFA	Blistered @1 month	Blistered @12 months	Blistered @1 month	NFD	NFD	NFD
100% FFA	Blistered @1 month	Blistered @3 months	Blistered @1 month	Blistered @1 month	NFD	NFD

NFD: No Film Defect

PHOTOS: COURTESY OF THE AUTHORS

Interestingly, with respect to processes involving biofuel production, owners and specification authorities will recognize that for storage, loading and discharge, and upset service temperatures, some of the best linings are those that handle high temperature immersion in oilfield production fluids. Several of those linings are based on thin-film, multi-coat epoxy phenolics (Lining A) or thick film, single coat epoxy phenolics such as Lining C. These linings are easy to use and applied with airless equipment using in-line heaters for viscosity control.

For higher service temperatures in the 158 F (70 C) to 194 F (90 C) range, thin- and thick-film epoxy novolacs (Linings B and D, respectively) and vinyl ester novolacs (Linings E and F) with higher cross-link density provide enhanced protection in immersion. The epoxy Lining D is made with a polycyclamine curing agent and possesses rapid and low-temperature-cure characteristics.[14]

LININGS DESERVE RESPECT

No matter how well a specified lining performed in accelerated laboratory tests, or in-situ panel testing in an owner's facility, the lining deserves respect when it is applied.

When properly applied, a single-coat, thick-film application of an epoxy phenolic or epoxy novolac is effective for loading, storage and discharge and upset conditions of biomass and biofuel cargos. This translates to enhanced productivity, significant lining and labor savings, and a reduction in the number of quality controls and inspections required for a given project.

The rapid-cure characteristics of advanced solvent-free lining materials also saves time and money and eliminates concerns for inter-coat contamination that can occur with multi-coat systems.

For testing purposes, coconut oil has the most aggressive fatty acid content. However, various linings were tested in common oils and fats at 158 F (70 C) to 194 F (90 C) and with 1% water to make the



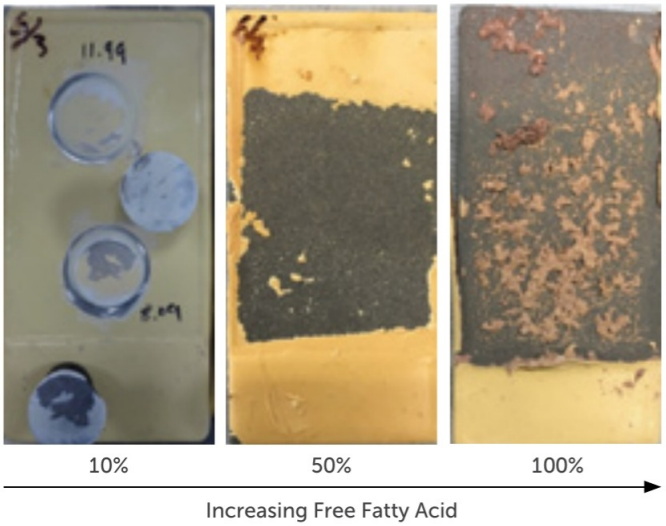


FIG. 6: **Chemical immersion attack of a generic epoxy coating at 140 F (60 C) as a function of increasing fatty acid content.**

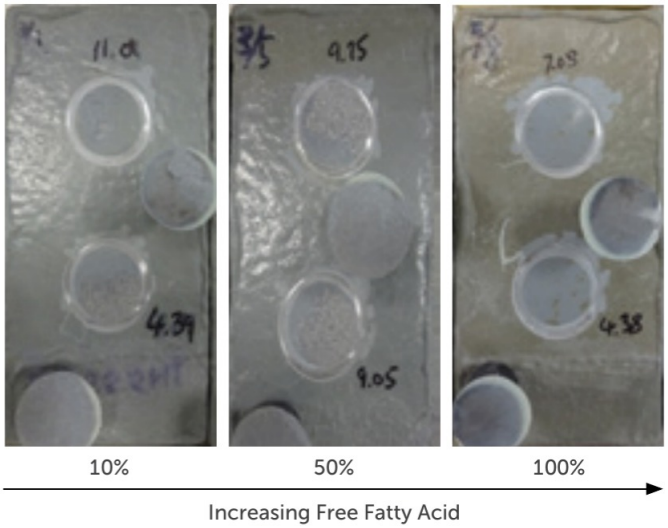


FIG. 7: **The absence of chemical immersion attack of a novolac vinyl ester coating at 140 F as a function of increasing fatty acid content.**

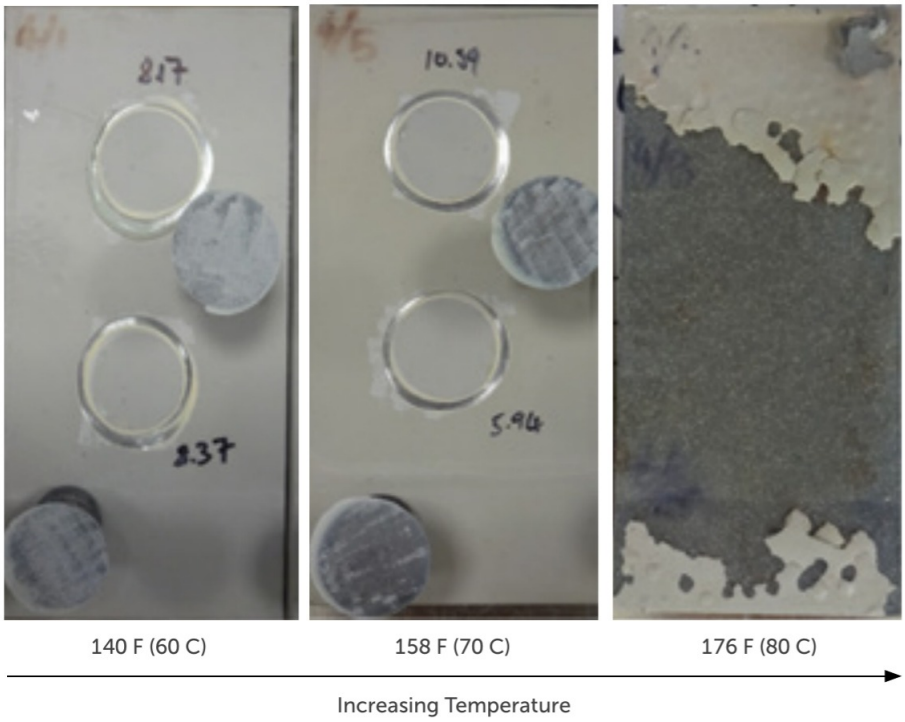


FIG. 8: **Impact of increasing temperature at 100% fatty acid content on a generic epoxy coating.**

immersion conditions markedly more aggressive.

Figures 6 and **7** show how increasing the FFA content of a vegetable oil feedstock is increasingly aggressive towards a generic epoxy lining at a temperature of 60 C, but not so towards a vinyl ester novolac.

The increasing effect of temperature on a generic epoxy lining immersed in aggressive FFAs is shown in **Figure 8**. This illustrates how higher storage temperatures render feedstocks more aggressive and a lining, which is resistant at 60 or 70 C storage temperature, may fail at 80 C.

Rancidity changes feedstock composition unlike hydrocarbon feedstocks. The chemical composition of biodiesel feedstocks can become increasingly aggressive over time. Fats and oils when exposed to air, light, moisture or bacterial action are subject to oxidation and hydrolysis, increasing the free fatty acid content or forming aldehydes and ketones, thereby potentially increasing the aggressive nature of the feedstock.

Case Histories: Successful Landings

Since 2017 several North American owners have lined carbon steel tanks with specialty vinyl ester novolac linings and epoxy novolac linings *(as shown in **Tables 3** and **4**, p. 34)*.

TALLOW-FATTY ACID STORAGE TANK #1

In 2017, some six months after the application of a lining on the floor and eight feet up the shell wall in a carbon steel tallow/fatty acid tank, inspection revealed that lining failure and severe corrosion

PHOTOS: COURTESY OF THE AUTHORS

had occurred ***(Fig. 9)***. Corrosion was most pronounced in the previously unlined vapor phase area of the tank and on the areas of unlined shell walls. Hence, the tank was taken out of service.

As a result, the facility owner installed several new shell courses and a new tank top, and in this remediation the entire tank internals were abrasive blast-cleaned to the SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" standard. Using an angular grit abrasive, a coarse, 3–5-mil jagged profile was obtained. A judiciously selected single coat vinyl ester novolac (VEN) lining was subsequently applied at 30–50 mils (750–1,250 um) DFT.

Four years later, the tank was opened for inspection whereupon it was reported that the lining looked "like the day it was installed." The successful performance of the single-coat novolac vinyl ester then served as the basis for use to line six more tallow/fatty acid tanks, completing designated phase 1 and phase 2 of a redesigned plant. In addition, the lining became the owner's preferred go-to lining in tallow/fatty acid service for future new construction tanks and maintenance and repair work.



FIG. 9: **Corrosion in tank internal prior to original coating removal and application of a vinyl ester novolac (similar to VEN Lining F in Tables 3 and 4) for tallow/fatty acid storage at temperatures of 194 F (90 C).**

TALLOW-FATTY ACID STORAGE TANK #2

A new 180-foot-diameter tank designated for raw or pre-treated (degummed) tallow storage was abrasive blast-cleaned to the SSPC-SP 5/NACE



THE FUTURE IS NOW!

For the custom machine you need, now is the time to order.

ADI

11505 Pocomoke Ct
Baltimore, MD 21220

866.call.ADI
410.335.1400

callADI.com

PHOTO: COURTESY OF THE AUTHORS

RAPID PREP

Full Service Provider of Sandblasting & All Other Surface Preparation Equipment

Dust Free Slurry Blasting



VB-2400 Blast & Recovery System



Enhanced Portable Blaster Package



RUST NEVER SLEEPS

877.529.2124 | www.rapidprep.com



FIG. 10: **Application of a solvent-free epoxy novolac (Lining D in Tables 3 and 4) used for tallow storage.**

No. 1, "White Metal Blast Cleaning" standard to achieve a 3–5 mil jagged profile.

A solvent-free epoxy novolac epoxy Lining D (from Tables 3 and 4) was applied in a single coat at 25–35 mils (675–875um) DFT ***(Fig. 10)***. Plural-component spray equipment was used to apply the lining.

The applicators were impressed with the spray characteristics of the lining and its rapid-curing property. This enabled the lining to be walked upon within 24 hours and facilitate early holiday testing. The project was completed on schedule and all parties were reportedly very pleased.

Conclusions

In North America and Europe biofuel renewables are gaining momentum replacing traditional fossil fuels. We began this article by noting the interdisciplinary approach by scientists to launch a planet-conscious biofuel energy transition strategy. The mission of this biofuel energy transition was two-fold:

- To provide advanced lining systems to store and handle raw feedstock biomass, like oils and fats, as well as biodiesel; and
- To help towards showcasing the reality of Daniel Yergin's elegantly described climate-friendly energy transition, from "Hydrocarbon Man" to "Carbohydrate Man."

The wide spectrum of renewable biomass feedstocks used for biodiesel production necessitates careful selection of high-performance linings such as multi-coat or single coat epoxy phenolics, epoxy novolacs and novolac vinyl esters.

Accelerated laboratory testing has shown that the chemical composition, temperature and water content of renewable feedstocks markedly affects the performance of linings tested.

Novolac vinyl esters were found to exhibit the best chemical, hydrolytic and thermal resistance in coconut oil, and a broad spectrum of other edible and non-edible oils and fats.

The successful performance and applications of the various specialty epoxy linings and novolac vinyl ester linings in a variety of FFAs show that the "biofuel mission" is, in fact, "Mission Accomplished." JPCL

REFERENCES

1. O'Donoghue, M., and Datta, V.J. "The VOC Odyssey: An Epic Tale of the Green World of Coating Formulators," *JPCL*, May 2009.
2. Hare, C.H. "VOC Compliance," *JPCL*, July 2007.
3. Yergin, D. *The Quest: Energy, Security, and the Remaking of the Modern World*. The Penguin Press, 2011.
4. "What happened to biofuels?" *The Economist*, Technology Quarterly, September 2013.

PHOTO: COURTESY OF THE AUTHORS

5. "CSL Group trials biofuel on eight Great Lakes ships." Chamber of Marine Commerce, November 2021.
6. "Air France uses cooking oil to fly to Canada as green fuel debate rages." *Reuters*, May 2021.
7. Rains, T. "United Airlines just became the first airline in history to operate a passenger flight using 100% sustainable aviation fuel." *Insider*, December 2021.
8. https://energydigital.com, May, 2020.
9. *Global Change Biology*, Volume: 26, Issue: 1, Pages: 274-286, October 23, 2019, DOI: (10.1111/gcb.14883).
10. https://www.iea.org/reports/renewables-2021/biofuels?mode=transport&region=World&publication=2021&flow=Consumption&product=.
11. O'Donoghue, M., Datta, V.J., Winter, M., and Reed, C. "Hubble, Bubble, Tests and Trouble: The Dark Side of Misreading the Relevance of Coating Testing." *JPCL*, May 2010.
12. Hare, C.H. *Protective Coatings: Fundamentals of Chemistry and Composition*. Technology Publishing Company, 1994, p. 53.
13. Gashaw, A., Getachew, T., and Teshita, A; "A Review on Biodiesel Production as Alternative Fuel", *Journal of Forest Products and Industries*, 2015.
14. Winter, M. "Fast-Curing Polycyclamine Cured Tank Linings." Paper No. 11040, NACE International CORROSION Conference 2011, March 13-17, 2011, Houston, Texas.

ACKNOWLEDGEMENTS

The authors gratefully acknowledge the assistance of their colleagues Bob Bernard, Chis Jones and Matt Perduk for their assistance. Special thanks to Adam Cochrane and his research team at AkzoNobel UK for information pertaining to lining testing in various oils and fats.

ABOUT THE AUTHORS



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 co-written several JPCL articles.



Vijay Datta, MS, 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.

PHOTOS: COURTESY OF THE AUTHORS





2022 ANNUAL DIRECTORY OF INDUSTRIAL PAINTING CONTRACTORS

The 2022 JPCL Annual Directory of Industrial Painting Contractors includes listings for painting contractor companies located primarily in North America, but also around the world. The information presented was obtained through a survey conducted among painting contractors known to JPCL and is displayed in alphabetical order by country, and then by state or province.

Expanded details for each company – including contact information, web addresses, breadth of industry experience and specialty services – are available in the fully searchable digital edition of the Directory at **paintsquare.com/bg**. While contractors have paid an advertising fee for oversized entries, regular listings are entered at no cost to companies.

If your company does not appear in these pages, you can still submit information for the 2022 online edition of the Directory by contacting Nichole Altieri, Business Administration Manager, JPCL, at naltieri@technologypub.com.

JPCL, jpcl.com and paintsquare.com are owned by parent company, Technology Publishing Co. Information submitted by contracting companies is thought to be current but has not been verified.

INSIDE

Featured Contractors 42
Contractors by Location
International 43
USA by State 44

PHOTO: VITTAYA25 / GETTY IMAGES

ARIZONA

Arizona Coating Applicators, Inc.
3531 W. Lower Buckeye Rd., Phoenix, AZ, 85009;
Nick Androsiuk; 602-263-9065; nick@azcoating.com

STRUCTURES AND SPECIALTIES:
Chemical Processing Power, Conventional
Refinery/Petrochem Transmission Pipeline
Wastewater Treatment Water Tanks/Works
Concrete Coating & Repair Lead Paint Removal
Access & Containment Shop Painting
Tank Linings Thermal Spray Waterjetting



Arizona Coating Applicators

Full listing at paintsquare.com/cd/arizona

CALIFORNIA

COR-RAY PAINTING
AMPP QP1 – QP2 – QS1

DoD Fuels - Aerospace & Aviation - Infrastructure
Power & Energy - Water & Wastewater - Stadiums & Arenas

Servicing all 50 states & US territories overseas
corraypainting.com - 562-906-9770 - sales@corraypainting.com

Full listing at paintsquare.com/cd/cor-ray

COLORADO

COBLACO
Get it done. Do it right.
44 years delivering consistent solutions for complex and challenging projects
visit us @ Coblaco.com

Full listing at paintsquare.com/cd/coblaco

FLORIDA

Overspray Removal Specialists, Inc.
Complete on-site overspray management since 1967



George Colliard
President
7415 Weeping Willow Drive
Phone: 800-835-5858
Fax: 888-777-2925 (sprayclaims)
E-mail: george@overspray.com
Website: www.overspray.com

Full listing at paintsquare.com/cd/overspray

MARYLAND

Sound solutions, safely delivered on time at an excellent value.
O.T. NEIGHOFF & SONS, INC.
PAINTING & CONSTRUCTION SERVICES
(410) 766-3000 • otn@otneighoff.com • otneighoff.com

Full listing at paintsquare.com/cd/neighoff

OREGON



SHRINK WRAP FOR CONTAINMENT AND PROJECT WEATHERIZATION
TRANSPORT
CONTAINMENT
STORAGE (800) 889-WRAP
GSA Advantage!
shrinkwrapcontainments.com
PRO-TECT Plastics & Supply, Inc.

Full listing at paintsquare.com/cd/protect

PENNSYLVANIA



Painting
Tank Linings
Fireproofing
Abatement
Shop Coatings
Concrete & Masonry
Repair & Restoration

ZARNAS
G.C. ZARNAS & CO., INC.
Industrial & Commercial Specialty Services

Contact Us:
610-866-0923
gczarnas.com
Since 1948

Full listing at paintsquare.com/cd/zarnas

TEXAS

Blastco*
a TF Warren Company
FIELD APPLICATORS OF PROTECTIVE COATINGS AND LININGS
TFWARREN.COM | 281-590-3200

Full listing at paintsquare.com/cd/blastco

TEXAS

NATIONWIDE OVERSPRAY
Professional Overspray Removal
800.345.1269 | service@nationwideoverspray.com
NATIONWIDE OVERSPRAY
NATIONWIDEOVERSPRAY.COM

Full listing at paintsquare.com/cd/nationwide

LOOKING TO HIRE OR SELL?
Reach prospects through JPCL and PaintSquare classified ads.
For information, contact your sales representative or email sales@technologypub.com.

View listings at paintsquare.com/classifieds/

CONTRACTORS BY LOCATION

INTERNATIONAL

ALBANIA
Donelli Sh.p.k

ARGENTINA
CIMSA

AUSTRALIA
QIC Protective Coatings (Aust) Pty Ltd

BRAZIL
Narus Auditoria & Consultoria
Setaviso Engenharia LTDA

BULGARIA
Donelli Bulgaria EOOD

CANADA – ALBERTA
Abrasive Blast and Paint Inc.
Brother's Specialized Coating Systems Ltd
Desco Coatings of Alberta Ltd.
Dragon Sandblasting & Painting 2001 Ltd.
Park Derochie Inc.
Spence Corrosion Services Ltd.

CANADA – BRITISH COLUMBIA
Aegis Industrial Finishing Ltd.



WHAT IS YOUR COMPANY BEST KNOWN FOR?
Preserving our nation's critical infrastructure

Viking works with engineers, third-party inspectors and tank owners to renovate and protect steel tanks. We take a consultative approach to develop a plan that proactively protects your tank and allows for financial planning and fixed expenses to ease annual budgeting.

WHO ARE YOUR CUSTOMERS?
Municipalities, power plants, bio fuel plants, private and public companies

WHAT LOCATIONS DO YOU SERVE?
U.S., nationwide

HOW LONG HAVE YOU BEEN IN BUSINESS?
125+ years across our family of companies

WHAT SETS YOU APART FROM THE COMPETITION?
Our care for our customers and our fellow coworkers



CONTACT
Brandon Vandermey
Director of Sales
brandon@viptanks.com
1-833-VIPTANK

VIKING INDUSTRIAL PAINTING
MONGAN PAINTING SANDBLASTING
Neumann Company Contractors, Inc.

Viking Companies

Mongan Painting, Neumann Company Contractors, and Viking Industrial Painting
10905 Harrison St., LaVista, NE 68128
viptanks.com

Full listing at paintsquare.com/cd/viking

CONTRACTORS BY LOCATION, CONT.

Atlas Painting & Restorations Ltd
Global Mountain Solutions USA LLC
dba Global Rope Access

CANADA – MANITOBA
Western Industrial Services Ltd.

CANADA – NEW BRUNSWICK
MacDonald Applicators Ltd.

CANADA – ONTARIO
Fishburn Proctor Ltd
GMW Restoration Services Ltd.
Harrison Muir, Inc.
Park Derochie Inc.

CANADA – QUEBEC
Nor-Lag Coatings Ltd.
Yvon Couture Inc.

GUATEMALA
Paintec
Serinco

INDIA
Jal Engineers Pvt. Ltd.
M. Pallonji & Co. Pvt. Ltd.
Polycoates Engineering Services

ITALY
BerSud S.r.l.
Donelli Alexo S.r.l.
Donelli Eos S.r.l.

MEXICO
Copromex

MOZAMBIQUE
Donelli Mozambique LDA

NETHERLANDS
Brand Energy & Infrastructure Services

NEW ZEALAND
Cake Commercial Services Ltd

PANAMA
Naval and Industrial Solutions SA

SAUDI ARABIA
Excel Engineering & Contracting Co. Ltd

SINGAPORE
Blast & Peen Services Pte. Ltd.
FRP Products Co. Pte. Ltd.
PJI Contract Pte Ltd
Thomas Coatings and Construction

SOUTH KOREA
BC Taechang Industrial Corporation
Samsung Heavy Industries

SPAIN
Proinbel

TAIWAN
Megaway Corporation

UNITED ARAB EMIRATES
Abu Dhabi Construction Company LLC

UNITED KINGDOM
Corroserve
Rhinoceros Limited

VENEZUELA
Micast Servicios Industriales

USA

ALASKA
Kane, Inc.

ALABAMA
Alabama Painting, Inc.
Allied Steel Corp
Industrial Coatings Group, Inc.
We Paint It

ARIZONA
Arizona Coating Applicators, Inc.



CONTRACTORS BY LOCATION, CONT.

C & L Electrostatic Painting
JPCI Services
Paramount Painting

CALIFORNIA

Accurate Colors Inc
Andy's Painting
California Engineering Contractors, Inc.
California Painting & Drywall
Cor-Ray Painting
HiTech Painting Inc.
KR Surface Industries
Lynco Associates, Inc.
Murphy Industrial Coatings, Inc.
National Coating & Lining
National Sandblasting Co., Inc.
Polytech Industrial, Incorporated
Raider Painting Co.
Redwood Painting Co., Inc.
Sanders & Wohrman Corporation
T Paul Sek EcoPainting
Techno Coatings, Inc.
Techno West, Inc.
Thermech Corporation
Tri-Co/TACM Technical Concrete
Valhalla Contractors Inc.

COLORADO

Better Painting & Coatings
Coblaco Services Inc

CONNECTICUT

Cenaxo LLC
Finishing Trades Institute of Southern New England Inc.

FLORIDA

Advance Industrial Coatings LLC
Americoat Corporation
Cortru
Dependable Painting And Wallcovering
Elite Industrial Inc.
Exceletech Coating & Applications, LLC
Finishing Systems of Florida, Inc.
Fresh Coats LLC
Gordon Wallis Wallcovering
Industrial Marine, Inc.
International Metalizing
KVK Contracting, Inc.
Overspray Removal Specialists
Professional Tank Cleaning & Sandblasting
Universal Painting Corporation

GEORGIA

Benise-Dowling & Associates, Inc.
Black Dog Painting, LLC
CDS Group, LLC
Spectrum Painting, Inc.
Titus Restoration Services, Inc.

IOWA

DPI Quality Custom Finishes

ILLINOIS

Chicago Corrosion Group
Demos Painting & Decorating Inc.
Knodel Enterprises Inc.
McCahill Painting Company
Ostrom Painting & Sandblasting, Inc.
Paint Platoon USA
Pecover Decorating Services, Inc.
PPD Painting
Quincy Industrial
Shopwerks Inc.
Teschner and Sons Painting

INDIANA

ACS Ventures, LLC
Capital Industrial Coatings LLC
N.A. Logan, Inc.
Summit Painting Co Inc

KANSAS

J. F. McGivern, Inc.

TRU
PERFORMANCE
QUALITY
HEALTH
SUSTAINABILITY
RESULTS
A TRUly different abrasive.
© 2021 All Rights Reserved. TRUABRASIVES is a trademark of Strategic Materials, Inc.
• 100% recycled glass
• Non-reactive & inert
• Less than 1% free silica
• Beryllium is not listed on our SDS
• White post-blast finish
• Translucent dust
• QPL, SSPC AB-1, MIL-A-22262B(SH), CARB approved (select plants)

1-866-775-6226
www.TruAbrasives.com
TRU ABRASIVES

CONTRACTORS BY LOCATION, CONT.

Rob Carroll's Sandblasting & Painting Inc

KENTUCKY
Peak Industrial Coatings & Linings
Precision Flooring, Inc.

LOUISIANA
Lanehart, Inc.
Martin Specialty Coatings, Inc.

MASSACHUSETTS
Carol Leonesio, Custom Decorative Finishes
Donlon Coatings
Prime Coatings, Inc.
R J Forbes
Warren Environmental

MARYLAND
A I W, Inc.
Mediterranean Construction Co. Inc.
O.T. Neighoff & Sons, Inc.
Symmetric Painting LLC
Titan Industrial Services

MAINE
Central Maine Industrial Painting Inc.

MICHIGAN
Bosk Corporation
George Kountoupes Painting Co.
Green Earth Coatings LLC.
H&H Painting Co., Inc.
Protective Coatings Epoxy Systems
Richard Brothers Painting
Signature Contracting Group, LLC

MINNESOTA
Abhe & Svoboda, Inc.
Padco
Rainbow Inc.
United Painting & Sandblasting, Inc.

MISSOURI
Coatings Unlimited Inc
GOAD Company

NORTH CAROLINA
Carolina Management Team
Southern Corrosion Inc

NEBRASKA
Lindner Painting, Inc.
Wittrock Sandblasting Inc.

NEW HAMPSHIRE
Tri-State Painting, LLC (TSI)

NEW JERSEY
Alpine Painting & Sandblasting Contractors
Five Star Painting Inc.
Floor Skinz
J.G. Nasile Painting Company, Inc.
PIM Corporation – A SBE Company
Wall Decor
West Virginia Paint LLC

NEW YORK
Ahern Painting Contractors Inc.
BrandSafway, LLC
Eastern Tank Services
Frank J. Ryan & Sons, Inc.
Limnes Corp.
New York Structural Steel Painting Contractors Association Inc.
Sage Bros Painting Co., Inc.
Secondary Services
Tower Maintenance Corp
Wiltsie Construction Co., Inc.

OHIO
Euro Paint, LLC
LRT Restoration Technologies
Summit Industrial Flooring
Tank Services
Thomarios
UCL, Inc.



CONTRACTORS BY LOCATION, CONT.

OKLAHOMA
Kimery Painting Inc.

OREGON
Pro-Tect Plastic & Supply, Inc.

PENNSYLVANIA
F-A-D Corporation
Fenton T Lemmon Painting and Line Striping LLC
Fisher Tank Company
G.C. Zarnas & Co., Inc.
Greiner Industries Inc.
H&W Global Industries Inc
Hadek Protective Systems, Inc.
I.K. Stoltzfus Service Corp.
John B. Conomos, Inc.
Postupak Painting
Ralph E. Jones, Inc.
Sauereisen, Inc.
Stronghold Floors
USRoofCoaters, Inc.

RHODE ISLAND
Inter-City Contracting, Inc. (SSPC-QP3)

SOUTH CAROLINA
Fisher Tank Company
Hacquard & Compton Industrial Maintenance Contractors, Inc.
Phillips Industrial Services Corporation

TENNESSEE
Charlie Irwin Painting, LLC
M&D Coatings, Inc.
Murals & More LLC

TEXAS
American Electrostatic Ptg., Inc.
Blastco
Chacho's Painting
GCE INC.
Gorrell Coatings
J & B Painting & Construction Services
Keith, Inc.
Nationwide Overspray
Praxair Surface Technologies
Quality Product Finishing, Inc.
S & S Bridge Painting, Inc.
San-Coat Inc.
Travis Industries, LLC
Valhalla Contractors Inc.

UTAH
Great Basin Industrial

VIRGINIA
Chlomil Inc. dba Phoenix Maintenance Coatings
EPAcoat, Inc.
Vanwin Coatings of VA, LLC
W.W. Enroughty & Son Inc.

WASHINGTON
Coatings Northwest
Hancock Sandblast & Paint LLC
Hunnicutts Inc.
Lawless Construction/CSMI
Long Painting Company
Western Technology, Inc.
Wilbur Fletcher, Inc.

WISCONSIN
Classic Protective Coatings
DCS Tank Lining Inc.
Marathon Industrial Finishing LLC
Precision Iceblast Corporation
Quality Sandblasting LLC
Spiegel Sandblasting & Specialty Coatings, LLC
Symet Inc.

WEST VIRGINIA
Ridgeline Coatings
Specialty Groups, Inc.





NEWS FROM THE TRACKER

Bids Out for NY Water Treatment Plant Job

Project Awards: PA Bridge, FL Water Facility

BY KONSTANTINE FEKOS, PAINT BIDTRACKER

PAINTBIDTRACKER

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

PROJECT PREVIEW

The **Town of Esopus, New York**, is soliciting bids for painting and upgrades to the town's Roger Mabie Water Treatment Plant. This project involves applying zinc, epoxy, latex and urethane coating systems on submerged and non-submerged steel tankage, piping, ductile iron, wet well and concrete masonry surfaces. Surfaces will require preparation in accordance with standards for 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 Blast Cleaning (SSPC-SP 10/NACE No. 2), Surface Preparation of Concrete (SSPC-SP 13) and Brush-Off Blast Cleaning of Galvanized and Non-Ferrous Metals (SSPC-SP 16). The owner-specified manufacturer for this project is Sherwin-Williams. The submittal date for this project is Sept. 21.

PHOTO: COURTESY OF TOWN OF ESOPUS, NEW YORK



PROJECT AWARDS

The **Township of Lathrop, Pennsylvania**, has awarded a $924,264 contract to Susquehanna Valley Construction Corporation (New Cumberland, Pennsylvania) for the replacement of Wright Road Bridge *(shown above)* in Susquehanna County, Pennsylvania. The project involves application of three-coat systems of epoxy and urethane on galvanized structural steel surfaces. Surfaces must be prepared in accordance with standards for 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), Near-White Metal Blast Cleaning (SSPC-SP 10/NACE No. 2) and Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels and Non-Ferrous Metals (SSPC-SP 16). The owner-specified manufacturers for this project are ICI Paints, Sherwin-Williams and Tnemec.

The **Tohopekaliga Water Authority** has awarded a $99,123 contract to Five 12 Painting & Remodeling (Orlando, Florida) for exterior painting and repairs to various structures *(shown below)* at Camelot Water Reclamation Facility in Kissimmee, Florida. The project includes applying coatings to 77,222 square feet of surfaces, including two effluent tanks, an aeration tank, an office building, a blower building, an equalization tank, a digester tank and an anoxic basin. Concrete tanks and basins will require application of a three-coat system of latex. Ductile iron pipe and miscellaneous metal surfaces will require application of a two-coat system of epoxy and siloxane. Other specified concrete masonry surfaces will require application of a coating system of Portland cement and polyurethane. Surfaces must be prepared in accordance with standards for Hand Tool Cleaning (SSPC-SP 2) and Power Tool Cleaning (SSPC-SP 3). The owner-specified manufacturer is Sherwin-Williams.





PHOTO: TOP, COURTESY OF TOWNSHIP OF LATHROP, PENNSYLVANIA; BOTTOM, © GOOGLE, INC., 2022

PAINT BY NUMBERS



10/28

The deadline for industry stakeholders to submit comments on OSHA's most recently proposed lead rulemaking. P1

100%

The percentage of PaintSquare Poll respondents who believe that coatings manufacturers' recent positive financial results will continue throughout the rest of the year. P6

3

The main surface prep methods—waterjetting, abrasive blast-cleaning and hand- and power-tool cleaning—discussed in this month's Coatings 101 column. P13

6

The number of lining types that were included in performance testing for biofuel transmission and storage structures. P28

28 days

The timeframe allotted for the relining of a raw water pipeline, which was challenged when the contractors discovered the existing coal-tar enamel lining. P17

225+

The number of surface preparation and protective coatings contracting companies listed in the 2022 JPCL Annual Directory of Industrial Painting Contractors. P41

9/21

The bid submission date for a water treatment plant rehabilitation project currently out to bid in the Town of Esopus, New York. P52

PHOTO: BEAUCROFT / GETTY IMAGES