March 2008

Finishing TODAY

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SPECIAL SECTION
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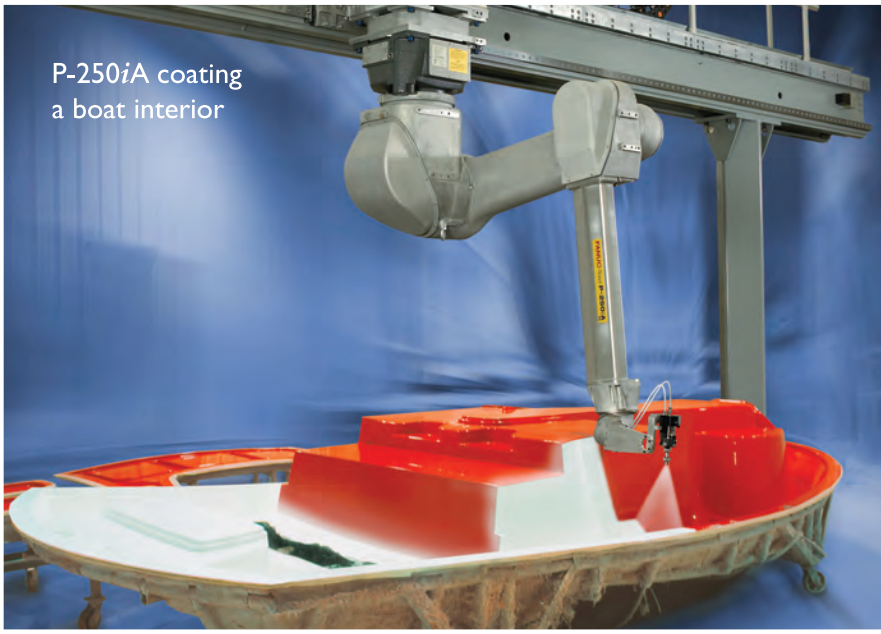
FIT for COATINGS

P-250*i*A applying finish to an automotive fascia



P-250*i*A coating a boat interior

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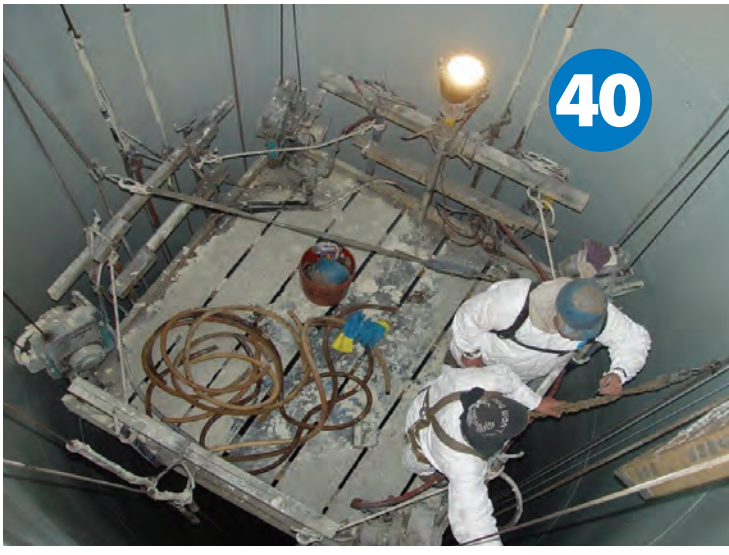

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ON THE COVER

Growth in the use of engineered hard chrome finishing alternatives has accelerated as OEMs and their customers have recognized that alternatives can provide better wear and corrosion performance. Story on p. 22.

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Lessons from a Two-Year-Old

Christine Grahl, Managing Editor

"Can't" has become a new four-letter-word around our house lately, thanks to my enterprising two-year-old. He's a determined kid, who refuses to take no for an answer, even when something seems physically impossible.

"Touch the ceiling, Mama," he'll say, when clearly it's out of my reach. Or, after he's done numerous somersaults in our living room, he'll turn to me and say, "You do it." Never mind that it's been decades since I last attempted a somersault, and even then I was no good at it.

Telling him "I can't" always elicits the same response. My son tilts his head to the side, narrows his eyes in a defiant challenge and commands, "Try it."

Wait a minute. Aren't I supposed to be the one challenging him?

When the U.S. Occupational Safety and Health Administration (OSHA) implemented stringent permissible exposure limits for hexavalent chromium in early 2006, the goals seemed impossible. Achieving the same or higher levels of performance with chrome-free technologies, particularly in the aerospace industry, simply didn't appear feasible. The hurdles were too great. The costs were too high. The finishing industry collectively groaned, "We can't."

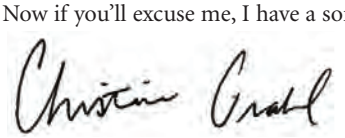
OSHA set the bar and said, "Try it."

And guess what — we've come a long way. Technologies such as high-velocity oxygen-fuel (HVOF) thermal spray have replaced engineered hard chrome (EHC) in many aerospace applications and have even exhibited benefits over conventional chromium coatings. (See the article on pp. 22-28 in this issue.) Likewise, a new cryogenic nitrogen vapor cooling process for HVOF coatings has been shown to improve productivity significantly over traditional air-cooled processes, while also reducing the spraying time and the amount of powder and process gases consumed (pp. 29-31).

And such success stories aren't limited to the aerospace industry. For example, while many U.S. manufacturing plants and finishing firms are struggling to stay in business, Architectural & Industrial Metal Finishing Co. in Vermillion, OH, is experiencing rapid growth. Faced with the challenge of increasing costs, the company could have thrown in the towel. Instead, it invested in a new spray booth that has increased its powder coating efficiency and optimized color changes, which ultimately has made the company more profitable (pp. 32-34). And when Hollman, Inc., of Irving, TX, challenged its suppliers to provide environmentally friendly wood finishing products, the result was a stunning new line of high-end "green" kitchen cabinetry (pp. 37-39).

Faced with a seemingly insurmountable obstacle, it's easy to become discouraged and say, "I can't." But applying yourself to the challenge can bring substantial rewards.

Now if you'll excuse me, I have a somersault to try.



"Whether you think that you can, or that you can't, you are usually right."
—Henry Ford

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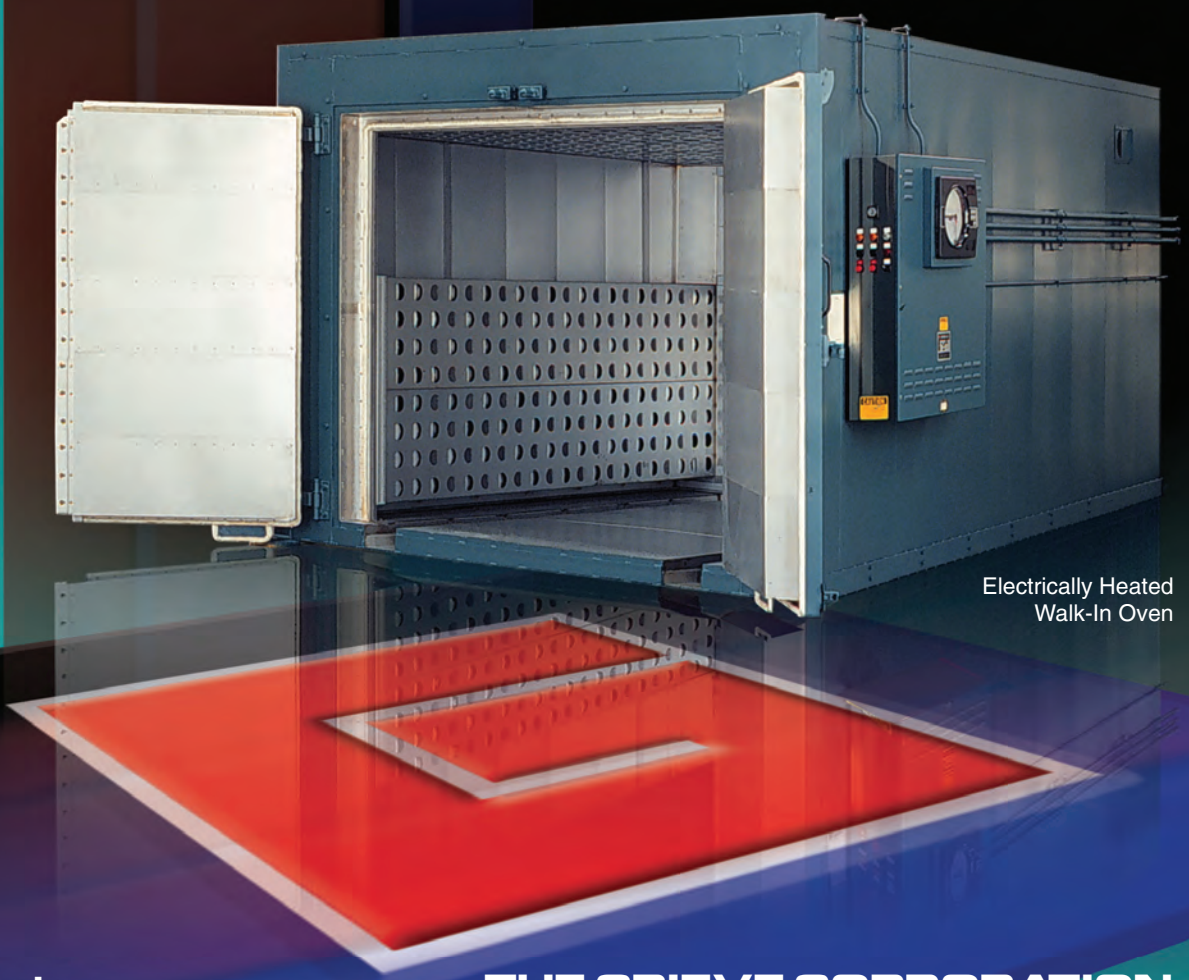

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MEETINGS, SHOWS AND SEMINARS IN 2008

MARCH 16-20
Corrosion 2008 Conference & Expo, Ernest N. Morial Convention Center New Orleans, LA, 800.797.NACE, cindy.euton@nace.org, *www.nace.org*

18-20
Spray Finishing Technology Workshop, Mount Wachusett Community College (MWCC), Robert D. Wetmore Technology Center, Gardner, MA, 978.630.9179, Khanson@mwcc.mass.edu, *www.mwcc.mass.edu/programs/FWP/FINISHINGWORKSHOP.html*

APRIL 8-10
ExpoCoating 2008 - The International Exhibition and Conference for Coatings and Surface Treatment, WTC Congress Center, Moscow, Russia, *www.expocoating.ru/eng*

8-11
Polyurea Development Association Applicator Spray Course, Polyvers Facility, Houston, TX, *www.pda-online.org*

20-23
Southern Society for Coatings Technology (SSCT) 2008 Annual Technical Conference, Sandestin Beach and Golf Resort, San Destin, FL, 800.969.1606, dr@mccanda.com

21-23
11th Annual Coatings for Plastics Symposium, Westin Yorktown Center, Lombard, IL, 888.530.6714, *www.coatingsforplastics.com*

22-24
2008 NASF Washington Forum, L'Enfant Plaza Hotel, Washington, DC, *www.nasf.org*

MAY 4-7
RadTech UV & EB Technology Expo & Conference 2008, McCormick Place, Chicago, IL, 240.497.1242, uveb@radtech.org, *www.uveb2008.com*

5-6
IHEA Safety Standards & Codes Seminar, Indianapolis, IN, 513.231.5613, *www.ihea.org*

6
Pittsburgh Chemical Day, Pittsburgh Hilton & Towers, Pittsburgh, PA, *www.pittchemday.com*

14-16
Electrocoat 2008, Marriott of Indianapolis, Indianapolis, IN, 816.496.2308, kmcglothlin@electrocoat.org, *www.electrocoat.org*

JUNE 3-5
American Coatings Show and Conference, Charlotte Convention Center, Charlotte, NC, 202.462.6272, cmatthews@paint.org, *www.american-coatings-show.com*

15-18
ASTM International Committee D01 on Paint and Related Coatings, Materials, and Applications, Hyatt Regency Vancouver, Vancouver, BC Canada, 610.832.9738, jadkins@astm.org, *www.astm.org/COMMIT/D01.htm*

16-18
SUR/FIN 2008, Indiana Convention Center, Indianapolis, IN, *www.sur-fin.net*

JULY 8-11
Polyurea Development Association Applicator Spray Course, Houston, TX *www.pda-online.org*

SEPTEMBER 10-11
Powder Coating Forum, Cleveland, OH 888.530.6714, *www.pcimag.com/pcforum*

22-25
COATING 2008, Indiana Convention Center, Indianapolis, IN, 513.624.9988, lmuck@one.net, *www.thecoatingshow.com*

MARCH '08

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MORE EVENTS CAN BE FOUND IN OUR ONLINE AGENDA AT WWW.FINISHINGTODAYMAG.COM.

SBIR Contract Advances Cure Monitoring Technology

Picometrix, LLC, a subsidiary of Advanced Photonix, Inc. has received a follow-on $750,000 Phase II SBIR contract from the Air Force for further nondestructive testing (NDT) application development for the in-process cure monitoring of specialty material coatings applied to military aircraft, using the T-Ray™ 4000 tetrahertz (THz) method.

Because current methods are contact in nature, they can identify a bad coating only after completion, and substantial scrap and rework often are needed to produce good parts. Since the terahertz (THz) method would monitor the process in real time, allowing for process adjustments, it has the potential to materially reduce scrap and rework and thus improve productivity in the production of the next generation of fighter jets.

Picometrix has partnered with Northrup Grumman to accelerate the adoption of this technique once developed. Northrup Grumman has the prime contract to produce up to $100 trillion of the next generation fighter jets for the Air Force through 2050.

Upon a successful completion of Phase II, the THz specialty coating monitoring inspection system is expected to provide the Air Force with an in-process, noncontact, accurate method for measuring the thickness and cure state of coatings such as polyurethanes used in aircraft. The proposed system not only will be able to monitor the specialty coatings of interest to the Air Force, but also other coatings of interest to the Army and Navy. In addition, the method could be applicable for monitoring and inspecting coatings and paints applied in industrial settings, such as automobile manufacturing.

For more information, visit www.advancedphotonix.com.

Electrocoat Association Seeks Brewer Award Nominations

The Electrocoat Association is soliciting nominations for the prestigious George E.F. Brewer Award, which will be announced during the Wednesday, May 14th, opening Keynote Session at Electrocoat 2008 in Indianapolis, IN. The award was established to recognize individuals who have made outstanding contributions to the field of electrocoating in the categories of paint and process technology (Technology), application of the technology

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(Application) or market promotion of the technology (Promotion).

Nominations can be submitted by e-mail or fax to Anne Von Moll, The Electrocoat Association, anne@electrocoat.org, fax 513.527.8801.

Subcommittee Seeks Input for Proposed Zirconium Standard

ASTM Coil Coated Metal Subcommittee is inviting interested parties to participate in the development of WK17368, Test Method for Determination of Zirconium Treatment Weight on Metal Substrates by X-Ray Fluorescence. The proposed new standard is being drafted by Subcommittee D01.53 on Coil Coated Metal, part of ASTM International Committee D01 on Paint and Related Coatings, Materials and Applications.

According to Robert Cianflone, president of Cianflone Scientific Instruments Corp. and a member of Subcommittee D01.53, coaters need a reliable method of measuring the coating weight of zirconium treatments on metal substrates. The proposed standard would be used at coil coater plants and at R&D and analytical laboratories.

"Surface treatments containing zirconium appear to be one of the future replacements for zinc phosphate in the automotive industry, as well as the elimination of chromium pretreatment in the coil coating industry," says Cianflone. "So, it will become more prominent in other steel-related applications."

The techniques described in the proposed standard will be applicable for determination of the coating weight of zirconium or total weight of a zirconium-containing treatment, or both, on a variety of metal substrates.

For more technical information, contact Robert Cianflone, Cianflone Scientific Instruments Corp., Pittsburgh, PA, at 412.787.3600 or rac@cianflone.com. For membership or meeting information, contact Jeff Adkins, technical committee operations, ASTM International, at 610.832.9738 or jadkins@astm.org, or visit www.astm.org.

Research Explores Effect of Electron Beams on Plastics

Advanced Electron Beams (AEB) has entered into a sponsored research agreement with the Department of Plastics Engineering at the University of Massachusetts Lowell. Considered one of the premier plastics engineering programs in the U.S., the UMass department will explore the effect of low energy electron beams on polymers and plastics.

Under the direction of UMass Lowell professor Stephen McCarthy, Ph.D., and aided by AEB's technical representative Somchintana Norasetthekul, Ph.D., the sponsored research project will enable UMass Lowell to investigate low-energy industrial electron beams at atmospheric pressure, and the effect that the beams have on polymeric and plastic materials. To maximize beneficial project results, the research team will study a wide range of substances under varying conditions.

During the course of this relationship, graduates will explore the chemical, physical and mechanical changes to the surface and thin film properties of a variety of polymeric and plastic materials under radiation, analyzing and documenting the results.

For more information, visit www.aeb.com.

PPG Acquires NanoProducts Corp.

PPG Industries has acquired the assets and intellectual property of NanoProducts Corp., Longmont, CO, a producer of nanoproduct materials and a developer of nanoproduct technology. Terms were not disclosed. The nanoparticle technology company has an extensive patent estate and operates pilot facilities for the development and manufacture of unique nanoparticles.

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"With these new materials, PPG can offer its customers and development partners unique, high-value solutions. PPG will also license nanotechnology solutions, particularly in areas outside its existing businesses," said James A. Trainham, PPG vice president, science and technology.

For more information, visit www.ppg.com.

LORD Corp. Adds Custom Coater in Europe

LORD Corp., manufacturer of MetalJacket® coatings, has added a new MetalJacket custom coater to its team. The coater, AquaArmour France of Bernay, France, reportedly will help LORD Corp. customers meet the growing demand for the coatings in both automotive and industrial applications. The AquaArmour France application line installed a traditional hoist transfer process and will apply the LORD MetalJacket 1510-5001 system.

The coatings are applied through an autodeposition process over either bare steel or zinc phosphate pretreatment. The final finish reportedly exhibits a uniform film thickness, without high voltage electric assistance or rinses, regardless of part configuration. Using an automated application process — coatings can be applied via both indexing and monorail systems — the product is designed to provide high-performance coatings at a lower overall cost, and it is also environmentally friendly.

For more information, visit www.MetalJacket.com.

Ecology Coatings to Participate in Automotive Research

Ecology Coatings, Inc. has signed a letter of intent with the U.S. Automotive Partnership for Advancing Research & Technologies (USAutoPARTS) to participate in a nonprofit automotive research initiative program. USAutoPARTS, which is to be located in a 56,000 ft^2 research and development facility in Shelby, MI, donated by Delphi Corp., has invited a number of companies to locate a portion of their R&D organization within the facility. The funding of the R&D facility will be obtained from companies in the automotive industry, foundations, government grants and other financial resources. The participating companies will focus their research on three areas: lightweight materials, electric and electronic thermal manage-

ment systems, and carbon emissions control. No date has been set for completion of the fundraising or for USAutoPARTS to move into the Delphi facility.

For more information, call 248.723.2223 or visit www.ecologycoatings.com.

Longevity Coatings Expands Thermal Spray Operations

Longevity Coatings, a thermal spray coating service firm, has relocated its production plant from Pen Argyl, PA, to a newly acquired office and production facility on a two-acre site near Allentown, PA. The company, founded in 2005, now occupies 8,800 ft^2 in two single-story buildings at 6047 Adams Lane, East Allen Township, about a mile west of the Lehigh Valley International Airport.

Although the Pen Argyl facility adequately met Longevity's immediate and near-term needs, "our unexpectedly rapid growth in little more than two years of operation necessitated that we look to the future and future growth," explained Mark A. Purington, the company's founder and president. "The acquisition of a modern facility, along with two acres of developable ground, should meet our needs for many years to come."

For more information, visit www.longevitycoatings.com.

Sherwin-Williams to Buy Inchem Holdings International

Sherwin-Williams Co. has signed a definitive agreement to buy the liquid coating division of Inchem Holdings International Ltd., expanding the paint producer's reach in Southeast Asia. Terms of the deal were not disclosed.

Inchem's coating operation is based in Singapore and makes products applied to wood and plastic. The coatings are produced in China, Vietnam and Malaysia and are sold in those countries and 15 others in Asia.

For more information, visit www.sherwin-williams.com.

Akzo Nobel Opens Powder Coating Facility in Dubai

Akzo Nobel Powder Coatings has opened a powder coating facility in Dubai — the company's first manufacturing site in the United Arab Emirates. According to a statement from the company, the investment represents an acceleration of the company's Middle East growth plans and underlines the strategic importance of the region to its Powder Coatings business.

"There is huge growth potential in the Middle East, particularly in the architectural sector, which accounts for around 60% of the area's powder coatings market," said Powder Coatings General Manager Rob Molenaar.

Located in Jebel Ali, 35 kilometers south west of Dubai, the new site offers color matching, rapid made-to-order products, and technical support.

For more information about the facility, visit www.akzonobel.com.

Shepherd Color and Shepherd Chemical Form Joint REACH Entity

The Shepherd Color Co. and The Shepherd Chemical Co. have jointly formed a legal entity, Shepherd Europe Ltd., to serve as an "Only Representative" for REACH pre-registration and registration of its non-European manufactured products. Established in the UK, this new service company reportedly has proficiency in REACH compliance and expertise in the pigment and chemical industries.

For more information about the Only Representative function and Shepherd Europe, e-mail rsorice@shepherdcolor.com. Shepherd Color's website is at www.shepherdcolor.com.

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Alliance Advances Marine Coatings Technology

A strategic alliance between Rolls-Royce, a market leader in marine applications, and UCT Coatings Inc. is bringing new technology to the marine market and is about to start work on a $7 million U.S. Navy research contract. The contract, placed with Rolls-Royce, will evaluate UCT's patented UltraCem™ nickel boron coatings on naval propulsion systems such as propellers and waterjets. These coatings reportedly have the capability to change the hydrodynamic performance, cavitation characteristics and sea-growth fouling of propellers and waterjets. Performance, reliability and time between repair of marine equipment also can be increased by reduced friction and wear. UCT has granted Rolls-Royce a long-term exclusive license to use this technology for a wide range of commercial and naval marine equipment.

For more information, visit www.rolls-royce.com or www.universalchemical.com.

EcoConcept Coatings Technology Expands in Europe

Bollig & Kemper, a German manufacturer of coatings for the European auto industry, has signed a license agreement for DuPont EcoConcept, a patented coatings technology that reportedly enables auto manufacturers to realize substantial reductions in energy use, environmental emissions and capital costs. Under the license agreement, the Cologne-based paint maker will manufacture and sell water-based basecoats for use in the EcoConcept process at automotive manufacturing plants in Germany and elsewhere in Europe.

The EcoConcept technology was recognized in 2007, when *Automotive News* presented DuPont with a PACE Award. The technology eliminates one complete coating layer, the primer-surfacer, and combines it into a single environmentally compliant water-based basecoat. As a result, a spray booth and curing oven are eliminated from the auto production line. The technology reportedly reduces energy consumption and solvent emissions related to the painting process by approximately 25%. Carbon dioxide emissions are reduced by 45-50 kg per vehicle built. The combination of two coats into one reduces production time and saves on the cost of equipment needed for the conventional three-coat process.

For more information about the technology, visit www.dupont.com.

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METALAST Develops Compliance/QA Program

In an effort to assist manufacturers in confirming the implementation of product specifications throughout their supply chain, METALAST has introduced a no-cost Product Compliance and Quality Assurance Program. This new service reportedly includes all METALAST products that have been specified by manufacturers.

The program was initiated primarily as a result of the increased number of METALAST TCP-HF manufacturer specifications that have been issued over the past 12 months. These companies are relying on specification compliance and timely implementation throughout their supply chain. As part of the program, METALAST will provide specification compliance and confirmation of the METALAST TCP-HF product and its use within metal finishing facilities. According to the company, the product is an environmentally safe and superior trivalent chromate chemical alternative to hexavalent chromates. This "green" chemical is QPL approved, RoHS compliant and meets the MIL-C-5541 specification. The product primarily is used in chromate conversion processes, as an anodize sealer and in paint bonding applications.

For more information about the program, call 888.METALAST or visit www.metalast.com.

PPG Coatings Projects Garner SSPC Awards

PPG Industries' Protective and Marine Coatings (PMC) business won two of the four annual Structure Awards for excellence in coatings projects from The Society of Protective Coatings (SSPC).

The E. Crone Knoy Award recognized PPG's project, the Arecibo Observatory in Arecibo, Puerto Rico, for outstanding achievement in coatings work that demonstrates innovation, durability or utility on a commercial-use structure. The project was selected based on excellence in craftsmanship and execution of work, and use of state-of-the-art techniques such as patented polysiloxane technology to solve problems and provide long-term service. PMC worked with Spensieri Painting to coat the giant observatory, which is part of the National Astronomy and Ionosphere Center operated by Cornell University under a cooperative agreement with the National Science Foundation.

The William Johnson Award, recognizing outstanding achievement demonstrating aesthetic merit in industrial coatings work, was presented to PPG for work on the Six Flags Scream Thrill Ride at Six Flags Over Fiesta, San Antonio, TX. Qualities considered include color, gloss or texture, and that coatings on the structure complement the environment while enhancing the structure. PPG worked with Baynum Painting on this amusement-park project.

For more information, visit www.ppg.com.

Send your press releases to Kristi Grahl, managing editor, at grahlk@sbcglobal.net.

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Stefan Marcinowski

Chairman, Coatings Supervisory Board, BASF Coatings AG

Dr. Stefan Marcinowski, member of the board of executive directors of BASF SE, took over the chairmanship of the supervisory board of BASF Coatings AG on January 1, 2008. The Board elected him to succeed the former chairman, Dr. Andreas Kreimeyer. Marcinowski joined BASF's main laboratory in 1979 after completing his doctorate. In 1986, he joined the team led by the chairman of the board of executive directors. He became the senior vice president of the public relations department in 1988. In 1992, he took over managerial functions in Brazil. After returning to Germany, he was appointed president of the Plastic Foams & Reaction Resins division in 1995, before being nominated as a member of the board of executive directors in 1997.

Mark Baker

Franchise Development Officer, Painting Pros

The Painting Pros, a franchisor of residential and commercial painting services, has appointed Mark Baker as franchise development officer. Baker's experience includes nearly two decades in the coatings industry for various companies, including such well-known brands as Liquid Ceramic. With The Painting Pros Co., Baker directed the operational and developmental growth of the Charlotte facility.

Steve Ritchie

Marketing Director, North American Automotive Division, Henkel

Henkel has appointed Steve Ritchie as marketing director of its North American Automotive division. In his new role, Ritchie will lead the marketing team in providing strategic and operational direction for growth and financial returns in the automotive industry. In his 11-year career with Henkel, Ritchie has held management roles in Henkel's marketing and market development divisions. For the past four years, he served as marketing development manager in the automotive assembly segment, responsible for identifying and implementing strategies and new applicable technologies for sustainable growth in the automotive assembly business.

Adam Li

General Manager, Galaxy Associates

Galaxy Associates, Inc. has established a legal entity and office in Shanghai, China, and has hired Adam Li to be the general manager for the new office. Li will be based in Shanghai but will support customers throughout China. He has more than 18 years of experience in sales and customer service and spent the last eight years working in the specialty chemical industry. He will report to Tim Scarbrough.

Bob Zipperer

Quality Manager, Professional Plating

Professional Plating Inc. has promoted Robert Zipperer to the role of quality manager. Zipperer has more than 16 years of experience at Professional Plating and served as the quality improvement coordinator for the past seven years.

Fourth Generation Leads Jamestown Paint

Standing, left to right: D. Michael Walton, J.P. Walton. Seated, left to right. J.D. Walton, J.M. Walton, Michael P. Walton.

Joseph P. Walton and D. Michael Walton have stepped down as CEO and president, respectively, at Jamestown Paint Co. Succeeding them will be their sons, **Joseph D. Walton** (president) and **Michael P. Walton** (CEO). This marks the fourth generation of Walton family members to lead the manufacturer of industrial paints and coatings, which was founded in 1885.

J.D. Walton, who lives in Perrysburg, OH, began with Jamestown Paint in 1994. Prior to being named president, J.D. was vice president, sales. He will continue to focus on sales, with an emphasis on developing new markets.

Michael P. Walton is in his 10th year with Jamestown Paint and lives in Hermitage, PA. He was most recently vice president, marketing. As CEO, Michael will focus on improving the company's infrastructure and developing strategic alliances both in the U.S. and abroad.

Michael and J.D. Walton also have joined Jamestown Paint Co.'s board of directors, which is led by their grandfather, Joseph M. Walton, chairman.

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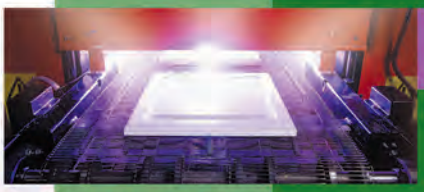

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Monday April 21

6:00-8:00pm	***Welcoming Reception***

Tuesday April 22

8:00-9:00am	***Registration / Continental Breakfast / Exibits Open***
9:00am	***Exhibits Close for Sessions***
9:00-10:00am	***KeyNote*** **Paul Mills**, *UV Robotics* **Overview of the Industry and Conference Schedule** Plastic Bling! – Recent Advances in Decorative Plastic Metallization
10:00-10:30am	**Amy Wylie**, *Bayer Material Science* The New Age of Waterborne Soft Feel Coatings
10:30-11:00am	**Ken Raby**, *Walther-Trowal* Automated Small Parts Coating System for Plastic Parts
11:00-1:00pm	***Lunch / Exhibits Open***
1:00pm	***Exhibits Close for Sessions***
1:00-1:30pm	**Susan Sobek**, *Akzo Nobel Coatings, Inc.* Pre-Mold Powder Coatings for Plastics
1:30-2:00pm	**Robert McMullin**, *BYK USA* Dispersed Nano-oxides for Today's Coatings Systems to Increase Wear and Scratch Resistance
2:00-2:30pm	**Michael Kelly**, *Allied PhotoChemical* Qualifying, Designing & Implementing a Plastic UV Coatings Project
2:30-3:00pm	**Robert Langlois**, *Alliance Surface Finishing, Inc.* Film Techologies
3:00pm	***Break / Exhibits Open***
3:30-6:30pm	***Exhibit Networking Reception***
6:30pm	***Exhibits Close***

Wednesday April 23

8:00-8:30am	***Continental Breakfast***
8:30-9:00am	**Steve Block**, *Dow Corning Corporation* New Anti Fingerprint Coatings
9:00-9:30am	**John Owed**, *ITW Automotive* Advancements for Plastics Finishing

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Wednesday continued…

9:30-10:00am	**I-Hsiung Wang**, *Apollo Coating Technologies, Inc.* Low-Energy Cure One Component Waterborne Black Primer for Polypropylene Auto Bumper
10:00-10:30am	**Winn Darden**, *AGC Chemicals Americas* Fluropolymer Coatings for Plastics
10:30-10:45am	***Break***
10:45-11:15am	**Bob Gilbert**, *Chemguard, Inc.* REACH Implementation by a Small Chemical Manufacturer: Key Aspects and Requirements
11:15-11:45am	**Marcus Hutchins**, *Cytec Industries, Inc.* Ultraviolet Curable Coatings for Hardcoat Applications
11:45-12:45pm	***Lunch***
12:45-1:15pm	**Rich Stewart**, *Wright Coatings Technologies* Powder Coatings for Plastics
1:15-1:45pm	**Thad Druffel**, *Optical Dynamics* Engineered Polymer/Nanoparticle Composites for Flexible Transparent Films
1:45-2:00pm	***Break***
2:00-2:30pm	**Al Zielnik**, *Atlas Material Testing Technology LLC* Eartherability Testing of Plastics - Some Things We've Learned in the Past 85 Years
2:30-3:00pm	**Dr. Steffen Pilotek**, *Buhler, Inc (PARTEC)* Surface-Engineered Nanoparticles for Real World Products
3:00-3:30pm	**Ramanand Jagtap**, *University of Mumbai, Institute of Chemical Technology* UV Cured Soft Feel Coatings for ABS Plastics
3:30pm	***Conference Ends***

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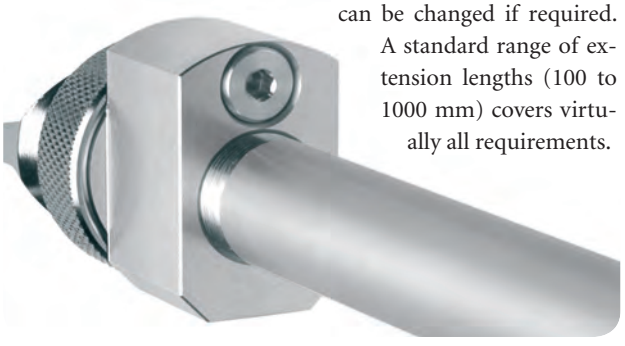
Flexible Spraying

A new modular spraying system makes it possible to achieve high-quality, reproducible coatings, even in difficult-to-reach areas on complex components.

BY WALTER KASPERS
Walther Pilot
AND BILL JOHNESEE
Walther Pilot
North America

There is a huge demand for nozzle extensions for coating areas that are difficult to reach, such as grooves, hollow profiles and the inner surfaces of pipes. A new modular spraying system can make it possible to achieve optimum and reproducible coating results even in problematic areas.

The new generation of nozzle extensions can be used for both manual and automatic spray guns. The extensions are designed as a modular system. All parts are screwed together and not brazed, as in previous systems, which means that the parts are ordered separately and can be changed if required. A standard range of extension lengths (100 to 1000 mm) covers virtually all requirements.



The required jet width can be adjusted at the spraying cap with an adjustor screw.

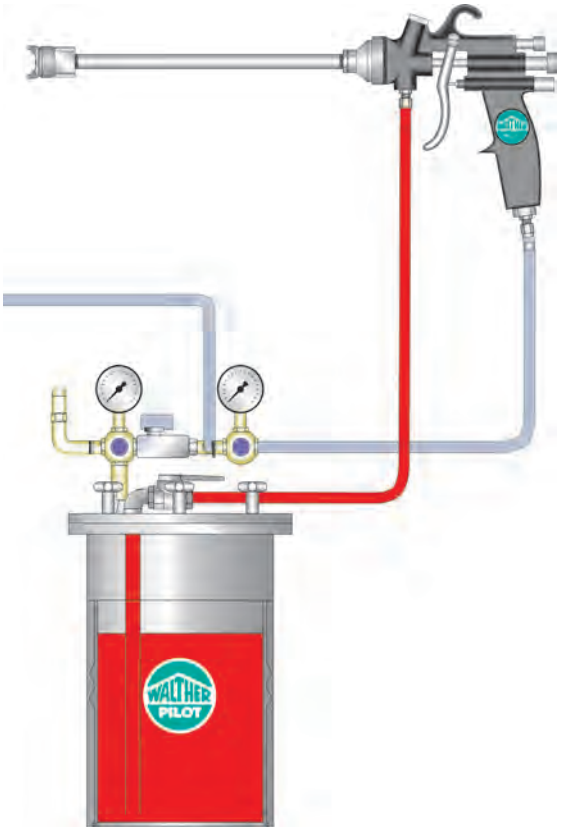
The modular system allows custom combinations of extensions to be put together for the most varied applications, reducing the number of spare parts required and simplifying cleaning and maintenance. All materials — including water-based materials — can be sprayed, as the needle, nozzle and material pipe are made of stainless steel. This construction also ensures that the extensions are tough and resistant to wear. The outer pipe is made of aluminum for low weight; this characteristic, combined with the system's compact design, provides for easy handling.

Precise Finishes

The new air caps with round/wide jet adjustment are compact and are designed to fit into small openings. The required jet width can be adjusted with an adjustor screw and hex-head wrench. This feature is integrated into the spraying cap to ensure that it is protected and cannot be changed by mistake.

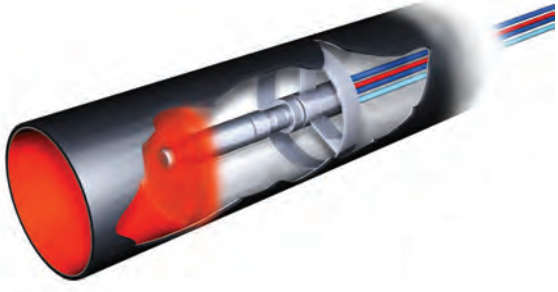
In order to cover as many requirements and object geometries as possible, the system not only offers straight-spraying caps but also caps that spray the material at an angle of 45 degrees or 90 degrees. Furthermore, the wide range

ABOVE: The new modular system of spray gun extensions adds flexibility to spray finishing.



To ensure fine atomization and optimum transfer efficiency, pressure tanks or pump systems should be used.

A custom extension with a small outer diameter (8 mm) can be used for extremely hard-to-reach areas.



The "pipe crawler" is an automatic spray gun for the internal coating of pipes.

of nozzle sizes ensures that spraying can be performed precisely, while at the same time saving material. The new range also includes round jet spraying caps without an adjustor screw, and as well as extensions with internal mixing.

The length of the needle for opening and closing the spraying process is determined precisely for the spray gun model concerned. The material-carrying pipe is screwed in as an extended nozzle and is surrounded by the air pipe. The air therefore flows between the outer wall of the material pipe and the inner wall of the air pipe. The air pipe itself is easily screw-fitted to the spray gun using a retaining nut.

To ensure optimum transfer efficiency, pressure tanks or pump systems should be used.

To ensure fine atomization and optimum transfer efficiency, pressure tanks or pump systems should be used. Gravity feed cups can be used only to a limited extent for spraying with extensions (for pipe lengths up to a maximum of 300 mm). Syphon feed cups are unsuitable due to their lower injector effect.

Customized Extensions

Special extensions also can be manufactured to meet specific requirement profiles, such as extensions with an extremely small outer diameter, or those that can spray backwards. There are also spraying caps that can be fitted with a flat plate. In this case, the material strikes the plate at 90 degrees to produce a fan-shaped spray.

A further speciality is the so-called "pipe crawler," which was designed for the internal coating of long pipes. It is an automatic spray gun with its air and material connections arranged axially, allowing it to be drawn through the pipe on a special carriage.

As finishing professionals search for ways to improve the finish quality on complex-shaped components and in hard-to-reach areas, suppliers will continue to develop new technologies to help them meet their goals.

Walter Kaspers *is marketing director of Walther Pilot, Wuppertal, Germany, a manufacturer of spray guns and spray finishing systems.* **Bill Johnesee** *is president of Walther Pilot North America. For more information call 877.WALTHER, e-mail sales@waltherpilotna.com or visit* **www.waltherpilotna.com**.

Chrome-Free Aircraft Finishing

High-velocity oxygen-fuel and other finishing technologies are providing high-performance alternatives to engineered hard chrome in the aerospace industry.

BY KEITH O. LEGG
Rowan Technology Group

U.S. Environmental Protection Agency regulations for hexavalent chrome (Cr^{6+}) air emissions (regulated under the Clean Air Act) have become increasingly stringent over the last few years . In addition, chrome plating sludge, used maskant, and any other material containing Cr (whether Cr, Cr^{3+} or Cr^{6+}) must be disposed of as toxic waste. The liability risks associated with air emissions, waste disposal and worker health are a major concern for any organization engaged in aerospace manufacturing or overhaul using engineered hard chrome (EHC).

Although the driver was originally regulatory, growth in the use of EHC alternatives has accelerated as original equipment manufacturers (OEMs) and their customers have recognized that alternatives can provide better wear and corrosion performance with faster turnaround in maintenance, repair and overhaul (MRO). Many companies have found that high-velocity oxygen-fuel (HVOF) technology reduces their cost of ownership, even though the process itself is more expensive.

Typical Applications and Requirements

EHC is used for two primary purposes in the aerospace industry: increasing wear resistance and rebuilding worn components.

For wear resistance, a plating thickness of 0.003 to 0.005 in. (75-125 microns) is typical, although there are some applications in bearings and internal diameters that use nodular thin dense chrome (TDC) with a thickness of 0.0003 to 0.0006 in. (7.5-15 microns).

When rebuilding worn components to print specifications (often where EHC had not originally been used),

thicknesses up to 0.015 in. are usually allowed. Sulfamate nickel (Ni) capped with EHC is used for larger buildups.

Figure 1 shows a typical aircraft actuator, which is subject to a variety of wear and damage mechanisms. Surfaces are plated thicker than required and then ground back to the final dimensions and finish. Most aircraft applications are on cylindrical surfaces such as this that are subject to wear, although some are more complex, including landing gear pistons, journals for wheel and engine bearings, hydraulic actuator rods, and flap and slat tracks (a non-cylindrical surface). Additionally, thin EHC and TDC are frequently applied to the internal diameters (IDs) of hydraulic actuator and landing gear outer cylinders and some bearing races. Any alternative must not only match or exceed the performance of EHC, but it also must be compatible with typical substrate materials, and it must fit with manufacturing and overhaul processes. Requirements for these processes include:

- It must be usable on shot-peened high-strength steel, which cannot exceed 375°F (190°C). There are some structural Al alloys that are even more heat-sensitive.
- It must be possible to build up to a thickness of at least 0.015 in. without excessive stress (especially tensile stress, which tends to cause a fatigue debit).
- Its wear resistance should be comparable with or better than EHC.
- Its surface finish should be suitable for use in fluid-wetted wear applications (ideally a smooth bearing surface that traps oil).
- It should be suitable for use in an OEM or MRO plant, or be widely available from aerospace-qualified vendors.
- It must be suitable for MRO, including:
  - able to be deposited at final spec or to be ground or superfinished to the required size and finish,
  - strippable for subsequent repair and overhaul, and
  - suitable for non-destructive inspection (NDI), especially fluorescent dye penetrant inspection (FPI) for substrate cracks.

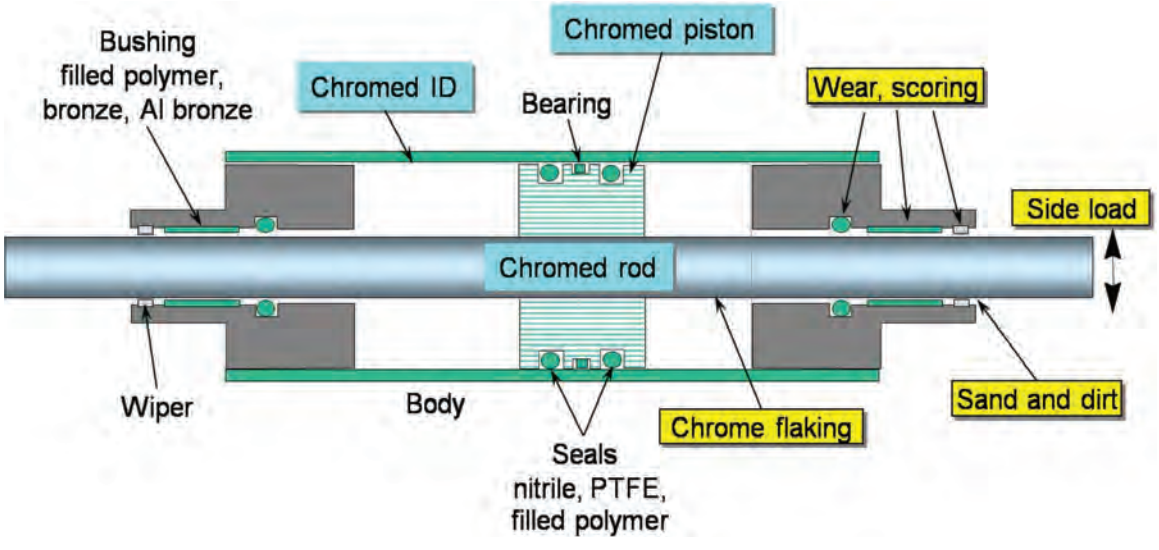


Figure 1. A schematic of a double-ended aircraft hydraulic actuator showing coatings and damage mechanisms.

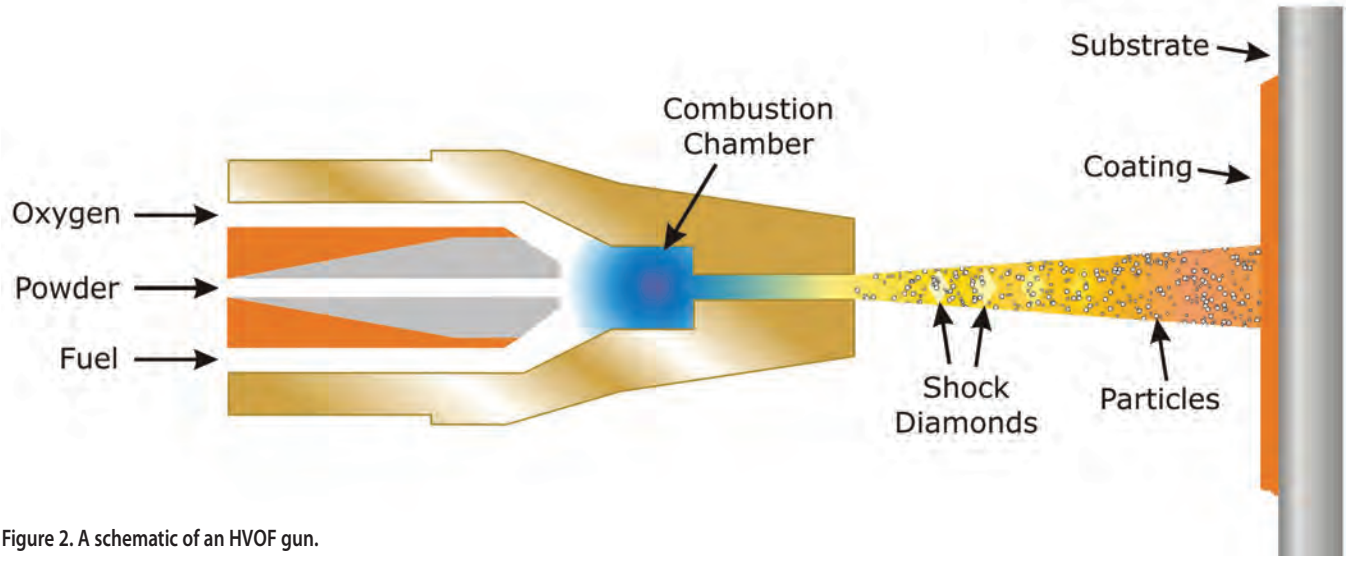


Figure 2. A schematic of an HVOF gun.

Alternatives for Exterior Surfaces

An evaluation of various options for EHC replacement carried out in the 1990s concluded that HVOF thermal spray was the best available option for use by aerospace OEMs, military depots and commercial aerospace maintenance, repair and overhaul (MRO) shops.[1] The Hard Chrome Alternatives Team (HCAT) was formed to generate all the performance data required for validating and qualifying HVOF coatings such as Tribaloy, WC-Co and WC-CoCr, including laboratory testing, full scale rig testing, and flight testing.[2] HCAT is funded by an international partnership between the US Department of Defense (DoD) (primarily Strategic Environmental Research and Development Program [SERDP]/Environmental Security Technology Certification Program [ESTCP]), the Canadian Department of National Defense (DND) and Industry Canada.

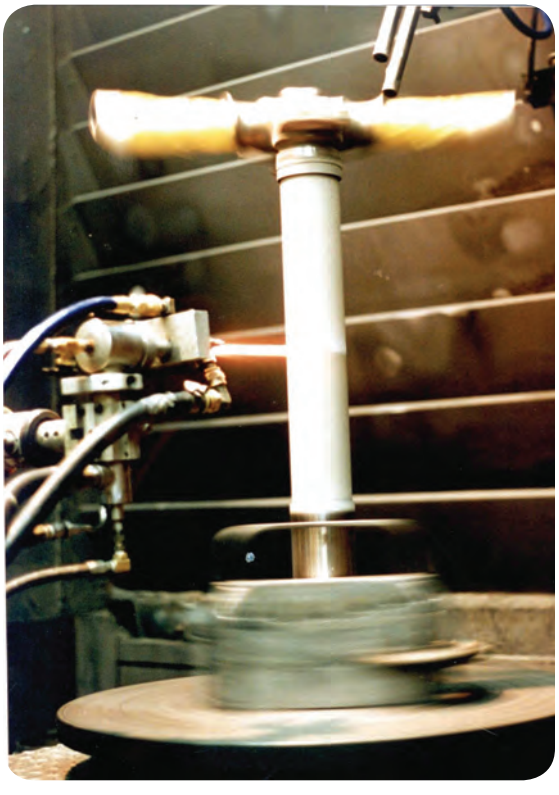


Figure 3. HVOF is sprayed on a nose landing gear piston. The HVOF gun (left) moves up and down as piston rotates.

The HVOF process is entirely different from chrome plating (see Figures 2 and 3). HVOF coatings are deposited with a supersonic oxy-hydrogen or oxy-kerosene torch through which alloy or cermet powder is sprayed, so that it softens or melts, hits the surface and spreads out to form a dense, well-adhered coating. Spraying is done in much the same manner as spray painting, spinning the component on its axis while moving the gun back and forth along its length (or, for non-cylindrical components such as flap tracks, moving the gun back and forth over the area to be coated). This makes it possible to spray the component uniformly without the typical chrome plate dog-bones at the ends. At the same time, however, the painting process means that complex parts are difficult to spray, and while shallow internal diameters can be sprayed, deep IDs cannot.

Unlike EHC, where the sole material that can be deposited is Cr, HVOF is a technology that can deposit hundreds of different alloys and cermets. Although this feature makes it very flexible, it is also far more complicated than simply using hard chrome. The most commonly used alternative is HVOF WC-10Co4Cr (although the Air Force uses WC-Co, and Cr_3C_2-NiCr is used for some applications). When sprayed, this material takes the form of hard carbide particles embedded in an alloy matrix. (Sintered WC-Co is the material used to make highly wear-resistant lathe cutter inserts, drills and other tools.)

HVOF coatings are superior to EHC in many respects:

- Although the material contains Cr, HVOF does not produce Cr^{6+}. Non-Cr alternatives such as WC-Co can be used to avoid Cr-containing materials entirely.
- With a hardness of 1,000-1,500 Vickers hardness number (VHN), WC-CoCr is far more resistant to wear and damage than EHC (800-1,000 VHN).
- When properly superfinished, the leakage rate of HVOF-coated hydraulic rods is well below that of chrome plated rods (see Figure 4). Note that superfinishing is critical to avoid creating an excellent rasp that will destroy seals and bushings.
- The corrosion resistance of HVOF coatings is superior to EHC in service.
- HVOF coated components cause little or no fatigue debit, in contrast with the large debit from EHC.
- The HVOF process is non-embrittling, and environmental embrittlement appears to be less severe than with EHC. Hydrogen baking is not required.
- A typical landing gear cylinder can be HVOF sprayed in 1-2 hours, while EHC typically requires 24 hours for plating and a further 23 hours for hydrogen baking (embrittlement relief). HVOF thus reduces overhaul turnaround time, which is especially important for airlines.

The only performance shortcoming of HVOF is that it can spall at high stress (180 ksi or above) or at high fatigue cycles. The only aircraft application for which this is an issue is the landing gear on carrier fighters, which sees high stresses on both launch and landing. Even there, however, no serious issues exist for thin (0.003 to 0.005 in.) OEM coatings.

HVOF is now being specified for all new landing gear designs (e.g. Airbus 380, Boeing 787, Boeing 767-400, F-35 Joint Strike Fighter) and on many hydraulic rods and some flap tracks. Since most of the world's commercial landing gear components are made in Canada, several new spray shops have been opened in Canada to meet the growing demand.

Although HVOF is the predominant EHC alternative for externals, it is not the only one. While it is an efficient way of coating large components, it is relatively inefficient for small items, and it is especially unsuitable for small components such as brackets that need to be coated all over to provide wear protection in some areas and corrosion protection in others. Such components can be coated simply in a plating bath, but they are complicated to spray. For these types of components, electroless Ni-P (EN) is becoming the chrome alternative of choice. It has the advantage of being a widely available aerospace-qualified material able to coat complex shapes, through holes, blind holes and grooves. It is not as hard as chrome, but its wear resistance can be comparable, although its abrasion resistance would be expected to be lower.

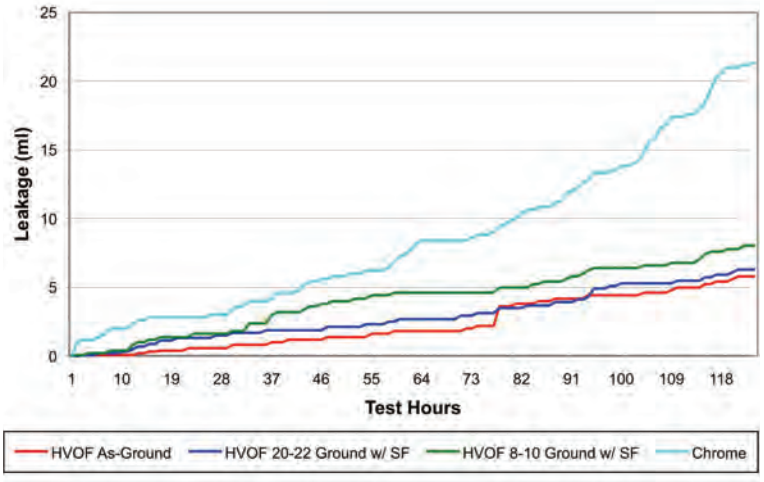


Figure 4. Leakage comparison of coated hydraulic rods, EHC vs. HVOF ground and superfinished.

Because electroless Ni is autocatalytic, it is very sensitive to surface contamination. Surfaces must be clean and properly activated to ensure good adhesion and prevent holes in the coating. Fatigue is also an issue, since the coating becomes more tensile (and the fatigue debit increases) as the plating solution ages. Specifications and quality control measures should take this weakness into account.

Care must be taken when using EN on aerospace components. For most high-strength substrates, the EN must be used as-deposited because the heat treatment needed for hardening it (typically 350°C or 660°F) is above the permissible limit.

The correct choice of EN phosphorus content is always an issue, since it depends on the application and whether or not corrosion is a concern. Low-P Ni has higher hardness as-deposited, but high-P Ni has higher hardness when heat treated. When EN is used as-deposited, high-P Ni has better corrosion resistance than low-P. When EN is to be used on high-strength steels that cannot be heat treated, low-P EN will usually provide better abrasion and wear but worse corrosion resistance. For steels that are able to withstand the heat treatment, high-P Ni is usually preferred.

A number of EN composites are now on the market that incorporate silicon carbide (SiC) or diamond particles for hardness or PTFE for lubricity (or even both). Hard particles allow EN to achieve the hardness of EHC without heat treating, but coating uniformity is difficult to maintain in production, especially for complex shapes.

Alternatives for Interior Surfaces

The major limitation of HVOF is that it cannot be used for most internal diameters. IDs can be coated up to a depth-to-diameter ratio of about 2:1 by angling the gun in from outside.[3] Deeper holes can only be sprayed by inserting the gun and its flame into the hole, which limits the method to holes larger than about 11 in. in diameter (landing gear outer cylinders as large as those used on the A380), or 6 in. with one new gun on the market from Northwest Mettech. It is possible instead to use plasma spray, which can be done on internals as small as 1.5 in., although the coating quality is inferior to HVOF.[4] For any thermal spray, blind holes present a difficult problem because spraying creates a dust storm inside the hole that entrains unmelted powder into the coating, degrading coating quality.

Because of the limitations of thermal spray, the most common alternative for IDs is electroless Ni-P. Because internals generally experience less severe wear than pistons, EN is often a good choice. It is even possible that some of the EN-polytetrafluoroethylene (PTFE) composites may be an option for internals, although they are usually significantly softer than standard EN. However, at this point there does not appear to be any consensus among aerospace users on how well these materials work for internals.

There are other electro and electroless plates, but availability is an issue because most are sole source and are not aerospace-qualified. When the Air Force Research Lab (AFRL) carried out screening tests of a number of Ni-based plates, initial results pointed toward NiPlate 700, a SiC EN composite, as a potential candidate,[5] but detailed testing and validation have not been done. With most EN composites, it is difficult to ensure uniformity over complex shapes, an issue that any qualification testing would need to address. AFRL is now evaluating non-Ni plates for ID coating as an alternative because of uncertainty over the long term regulation of Ni, and some manufacturers have begun to test electroplates such as Ni-W-B.

NanoPlate, a nanophase Co-P electroplate from Integran in Toronto, Ontario, Canada, was developed under DoD SERDP/ESTCP funding specifically as a chrome alternative

for IDs. The process is unusual in that it uses pulse electroplating to deposit Co-3%P as a nanomaterial, which is corrosion resistant and considerably harder and more wear resistant than standard DC-plated Co. Since this coating is still under final development and validation, it is not yet ready for aerospace use. If validation is successful, this material might, in principle, be an option to replace both TDC and EHC on IDs, and could, of course, also be an alternative for externals.

While chrome plating often is applied to an entire component to avoid masking, only the relevant areas should be HVOF coated, since coating non-functional areas is expensive and wasteful.

Note that the need for rebuild means that typical thin physical vapor deposition (PVD) coatings (such as nitrides and diamondlike carbon) are not suitable for most alternative applications, even though they are some of the smoothest, hardest and most wear-resistant materials. In principle, a very hard PVD coating could be a "lifetime finish" OEM chrome alternative, just as it is on consumer plumbing and door hardware. At this point, however, there is no aerospace-qualified PVD material widely available for this type of application.

Requirements and Specifications

From all the testing that has been done, it is clear that we cannot just strike out EHC from drawings and substitute HVOF, EN, or any other material. The specifications for material chemistry, heat treat and surface finish will vary depending on the alternative chosen and the application. This is especially true for HVOF, where the largest amount of data is available.

For example, in EHC plating, labor is the largest cost, whereas for HVOF materials cost predominates. While chrome plating often is applied to an entire component to avoid masking, only the relevant areas should be HVOF coated, since coating non-functional areas is expensive and wasteful.

Additionally, EHC coatings can be as thin as 0.0003 in., but HVOF cannot be continuous at less than about 0.002 in.

While EHC is usually ground with an alumina wheel, HVOF carbides require a diamond wheel, which will load up when grinding metals. Methods have had to be developed to grind both HVOF and the surrounding steel with the same wheel to minimize equipment set-ups.

Finally, EHC coated hydraulic rods are usually specified with an 8 or 16 μ-in. finish. Rough HVOF coatings make excellent cutting tools, however, typically requiring a 4 μ-in. superfinish for seal performance significantly superior to EHC.

There are a number of commercial specifications for hard chrome alternatives,[6] as well as extensive performance data, reports and briefings on HVOF.[7] Despite the large volume of available data, the requirements for designing with these technologies are unfamiliar to

most design engineers. As aerospace companies have begun to replace EHC with HVOF and electroless Ni, experts in the field have developed HVOF guidelines for designers, and will probably need to do so for other chrome alternatives as well.

Future Directions

Spalling remains the primary performance drawback of HVOF. Efforts are under way to resolve this problem through different equipment, coating materials and powder formulations, including nanophase powders. Lower cost is likely to come from the qualification of new guns such as high-energy plasma spray and hybrid guns, which appear to provide coatings with similar performance while avoiding the use of hydrogen fuel.

Thermal spray is not a good method for coating IDs, leaving the industry with different technologies for external and internal areas. Gun sizes are being reduced to accommodate smaller and smaller IDs, but the problem still remains that any internal coating by thermal spray generates non-adhered overspray powder and excess heat, which requires careful attention to gun efficiency and the use of gas jets. The alternative approach is to develop and qualify a plating method with sufficient performance. Any plating that meets the performance of EHC could be a contender for both ID and OD chrome replacement, simply by avoiding multiple coating technologies and vendors, even if it does not match the performance of HVOF.

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Editor's note: *References can be found with this article online at* **www.finishingtodaymag.com**.

The nozzle for the cryogenic nitrogen thermal spray cooling technology can be mounted next to the thermal spray gun on the robotic arm.

Cooling Hot Coatings with Nitrogen

A new cooling solution for thermal spray coating applications uses cryogenic nitrogen to improve quality and reduce costs.

BY DR. THOMAS MEBRAHTU
Air Products

Maintaining the specified part temperature during thermal spray coating applications is crucial to producing on-spec products. Exposing a part to too much heat can negatively impact coating adhesion, substrate and coating hardness, fatigue life, corrosion resistance and dimensional tolerances. With the current industry trend toward more heat-intensive processes, maintaining part temperature is becoming more challenging.

One current process, high velocity oxygen fuel (HVOF) thermal spray, is widely used for coating critical wear parts, such as landing gears, bearing races, valves and turbine components. During this coating process, molten metal, composite or ceramic droplets are sprayed from a gun or torch onto a part. The thermokinetic energy required

to melt the powder, accelerate the molten material in the gas jet and deposit these particles onto the target surface results in significant heat input to the part. In addition, the process must be repeated over and over again to build up the full coating thickness. Efficient removal of this heat load during the thermal spraying process is critical to prevent overheating of both the coating and the substrate.

The primary cooling method for most HVOF thermal spray operations is forced air cooling using compressed air jets. However, the oxygen, residual moisture and hydrocarbons in the cooling air are often detrimental to the coating quality. Because air cooling alone is usually insufficient, interpass cooling breaks must be introduced into the process, which reduces productivity. In addition, when the spray gun is moved away from the part during these cooling breaks, it continues firing, resulting in wasted feed powder and process gases.

Cooling with Cryogenic Nitrogen

One company challenged with maintaining the desired part temperature during HVOF thermal spray process is Delta Air Lines. Delta uses HVOF thermal spray to coat engine parts and landing gear axles, where the part temperature has to be maintained within specified limits. However, with inadequate air cooling systems and low productivity, Delta was looking for a more efficient cooling solution. When Mickey Carroll, lead technician-plasma spray, HVOF at Delta, read an article about a cooling system that Air Products had developed for a related application, he contacted the company and outlined Delta's need for a better cooling approach. After a few months of working with Delta's systems and parts, Air Products further developed its thermal spray cooling system using cryogenic nitrogen and adapted it to Delta's automated thermal spraying process.

Cryogenic nitrogen vapor cooling has been shown to improve productivity significantly over traditional air-cooled processes (see Figure 1). Air Products' new patent-pending cooling technology enabled Delta to reduce by as much as 50% the spraying time and the amount of powder and process gases consumed in the coating of its aircraft landing gear axles. The nitrogen cooling system also allowed for a much tighter temperature control (±20°F) and a significantly smaller standard deviation in part temperature during the coating operation.

With inadequate air cooling systems and low productivity, Delta was looking for a more efficient cooling solution.

The new thermal spray cooling technology is compatible with existing thermal spray systems and offers a variety of system designs for application-specific use. The spray nozzle can be mounted next to the thermal spray gun on the robotic arm. During spray application, the cryogenic vapor jet follows the thermal spray plume to maintain the part's temperature within a preset temperature range. The atomization of the liquid nitrogen and rapid boil-off is designed to prevent part "wetting" and rapid fluctuations in cooling intensity.

The cryogenic cooling system efficiently and uniformly cools thermally sprayed coatings by monitoring the temperature of the coating and varying the cooling intensity to match the heat generated in the spraying process. The tem-

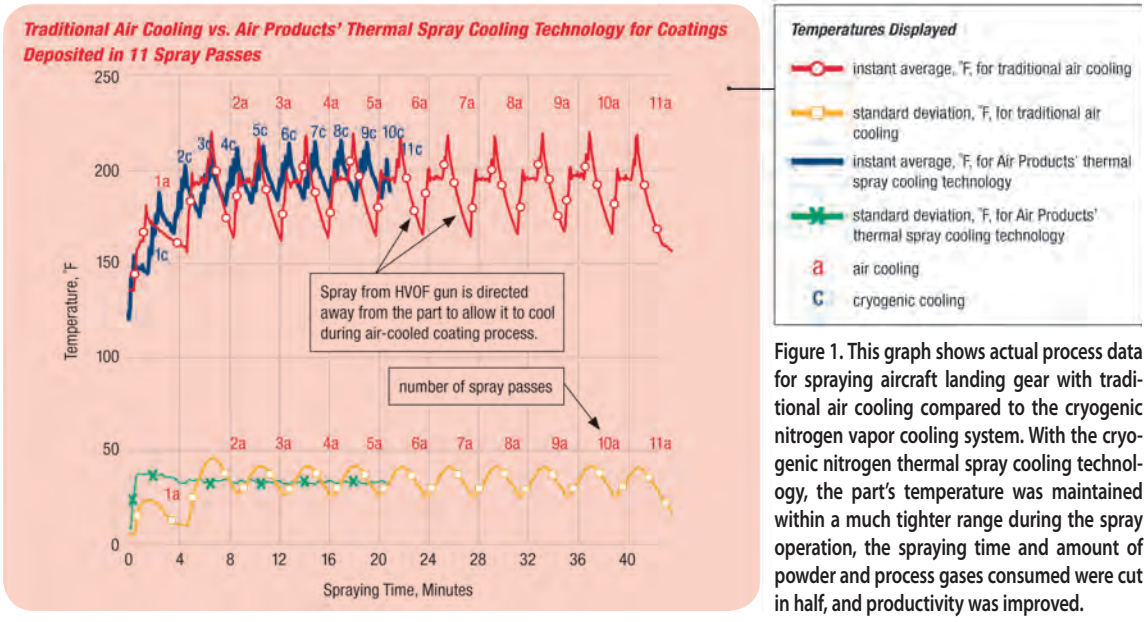


Figure 1. This graph shows actual process data for spraying aircraft landing gear with traditional air cooling compared to the cryogenic nitrogen vapor cooling system. With the cryogenic nitrogen thermal spray cooling technology, the part's temperature was maintained within a much tighter range during the spray operation, the spraying time and amount of powder and process gases consumed were cut in half, and productivity was improved.

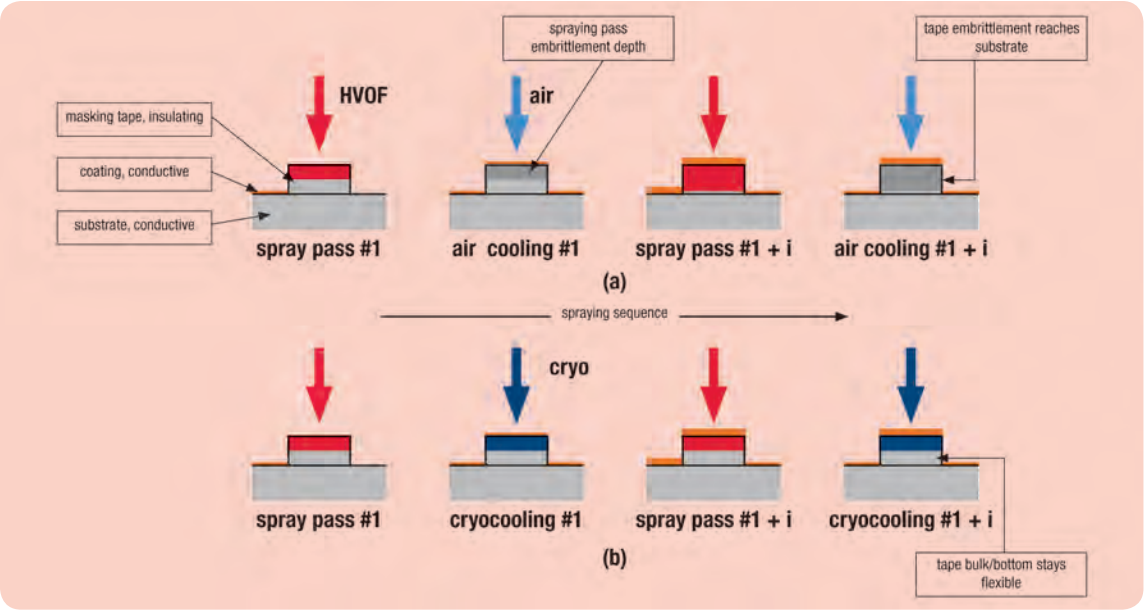


Figure 2. Effects of cooling on silicone-based masking tapes during HVOF spray application, where (a) represents air cooling and (b) represents cryogenic nitrogen vapor cooling.

perature feedback system can use a variety of inputs, including infrared imaging cameras, single-point infrared sensors and thermocouples, which are computer-controlled by a proprietary algorithm. This setup allows the cooling system to maintain the coating temperatures dialed in by the spray booth operator by automatically switching cooling modes between room temperature, nitrogen gas, liquid/gaseous nitrogen mixed flow, and 100% liquid nitrogen.

The system displays real-time vital characteristics of the coating process, such as the instant and time-averaged temperature of the part, temperature distribution in various part areas, and standard deviation of accumulated thermal data. The data can be tracked, recorded and stored for audit purposes.

Improved Quality and Processes

The new cryogenic nitrogen vapor cooling technology has been shown to reduce thermal fluctuations during spray operations. The microstructure, mechanical and physical properties of nitrogen-cooled coatings were tested and proved to be as good as or better than those of air-cooled coatings. Testing of nitrogen-cooled parts showed substrate hardness and microporosity improvement over air-cooled samples, while bond strength, coating hardness, residual stress and surface roughness of the as-sprayed coatings were essentially unchanged. In addition, oxygen pickup and carbon loss in the coating were the lowest for the nitrogen-cooled sample.

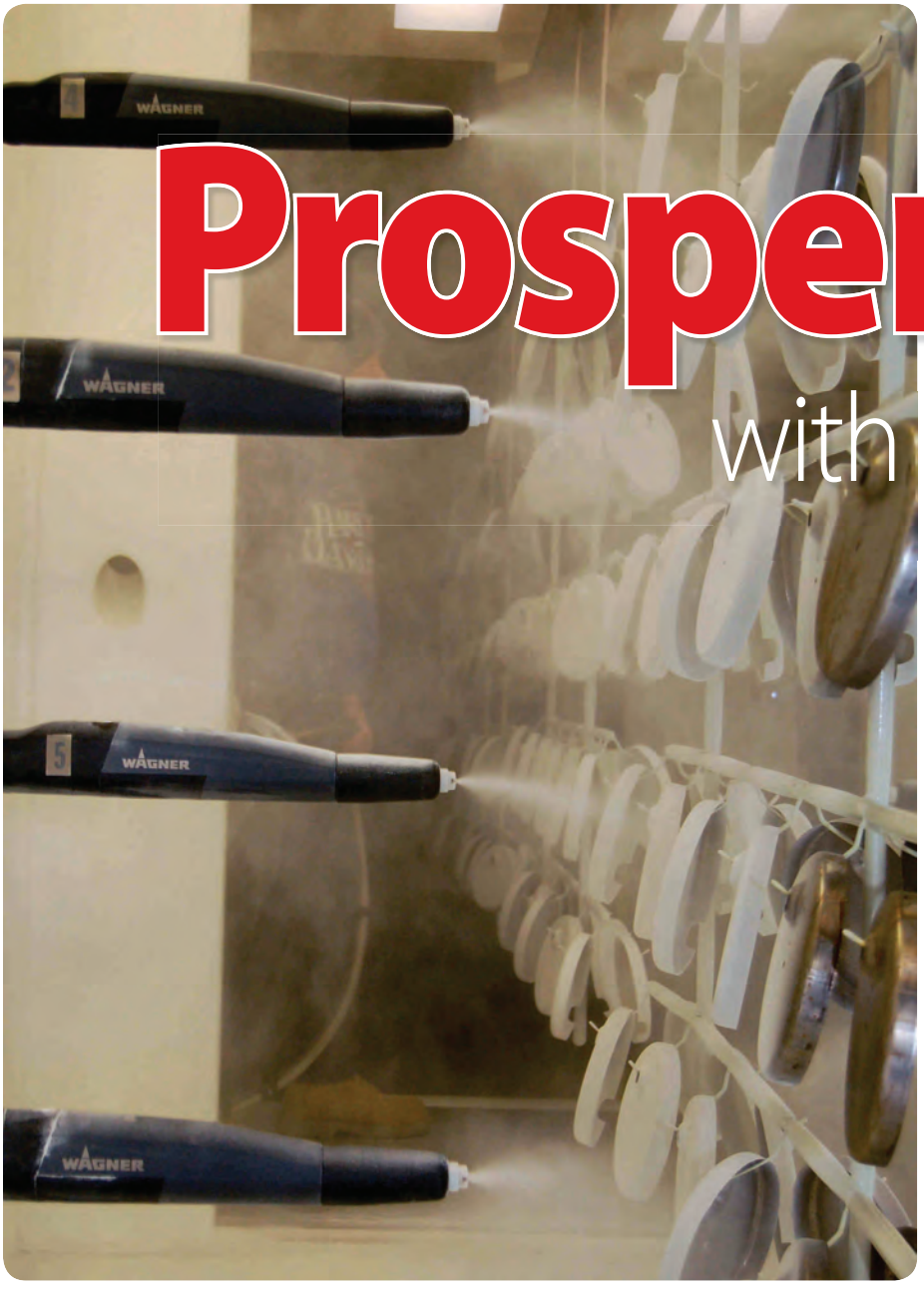
An additional benefit of the new cooling system is the time and cost savings in the masking process. Traditionally, a rigid protective masking that is rugged and resistant to high temperatures had to be applied to areas of a part where coating was not needed. However, inadequate air cooling and buildup of temperature often led to tape degradation, including thermal decomposition, hardening and embrittlement.

The cryogenic cooling technology enables the use of inexpensive, flexible masking tapes that are easy to apply and remove, resulting in radically reduced setup and cleaning times. Because the cryogenic gas provides instant cooling of the top layer of the mask, eliminating heat buildup and preventing the heat from reaching the bottom of the tape, the tape stays flexible and can be quickly removed after spray operation, leaving a clean, residue-free surface (see Figure 2). The tape can even be reused several times.

Future Applications

In addition to aerospace parts, cryogenic nitrogen vapor cooling has provided productivity benefits in a range of HVOF coating applications involving construction equipment and rolls. The success of the work at Delta has led to the exploration of new markets and applications for the technology, and it is expected that additional uses for this new cooling technology will continue to emerge.

Dr. Thomas Mebrahtu *is the global R&D manager for metals processing and atmospheres at Air Products, where he leads the development of gas-based applications for the global metals processing and back-end electronics packaging markets. For more information about the cryogenic nitrogen cooling system, contact Air Products at 800.654.4567, code 579, or visit* **www.airproducts.com/cooling.**



Prospering with Powder

A compact, high-performance powder coating spray booth has allowed a custom coater to increase quality, efficiency and profitability.

If you drive through Lorain, OH, near Cleveland, you might pass the chained gates of a Ford assembly plant. Vast, and deserted, the plant closed in 2005, when it employed more than 2,000 workers turning out the Ford Escape, Econoline and other popular models.

But around the corner in Vermillion, OH, the prospering Architectural & Industrial Metal Finishing Co., LLC (A&I) is busy adding on to its facility, oblivious to a generally slowing local manufacturing economy.

"We are doing great," says Chris Morris the firm's owner and president. "We are even getting business sent to us by competitors."

That's because A&I handles parts that most other custom coaters have trouble with. "We don't have to go head-to-head and dime-to-dime with them," says Morris.

A&I's line design allows the plant to coat larger and heavier parts than most other powder coating lines in the region.

"When Detroit hosted the Superbowl last year, the city renovated everything, including installing new light poles," explains Morris. "We got the job of coating the 22-ft-long poles and 550-lb bases because a lot of other coaters have trouble with parts that long or that heavy. Our system frequently paints parts 30 ft long and longer."

The plant's spray booth also has larger part openings — a full 6-ft high — than many other lines offer.

But capability is only part of the reason A&I has been growing. "Getting the business is important, but then we need make a reasonable profit on those parts," say Morris. "So we have tried to be smart about optimizing things. We spray a lot of powder and change color 12 to 15 times a

day. We have had to both increase our powder coating efficiency and optimize how we do color changes, especially when you consider that a lot of the powder we spray is pretty expensive powder because it meets the AAMA 2603 and 2604 specifications."

A Super Solution

In the plant's effort to improve its bottom line, A&I last year decided to mothball its old powder booth and install a Wagner SuperCube.

"We heard great things about the booth, but what really impressed me was how easy it was to achieve good results," says Morris. "I think there are a few good systems out there. But sometimes making them work takes just too much effort and finesse. The Cube was a system that produced good results right off the bat without lots of hand wringing and tweaking."

The results speak for themselves — A&I has saved more than 5,000 lb a month in powder because of its increased efficiency, while seeing its scrap and rework drop by 90%.

"The new system is two to three times more efficient than our old one," says Morris, "and the only rejects we get from painting usually come from our manually sprayed parts. The vast majority of parts are sprayed automatically, and the throughput is nearly perfect."

"We don't have a huge engineering or technical staff," says plant manager Colleen Black, "so a system that that doesn't tie us up is perfect. Our people need to be focused on getting parts through the shop, not on fiddling with the system. We turn customer orders around within 48 hours and so we're focused on streamlining things."

Black notes that the plant handles a number of architectural extrusions, in which pieces and parts of larger assemblies are painted separately and then assembled. If the finish is not consistent, the aesthetic quality of the assembled product suffers. "The system gives us very reliable consistency. Film build is even, and the way the powder is applied is very repeatable. Customers tell us they have never seen their large panels look so beautiful. That's because of the film build consistency we get from the Wagner guns and controls," says Black.

The A&I system is a fully conveyorized line that includes a seven-stage pretreatment system and a dry-off oven, followed by the Wagner SuperCube booth. The booth is equipped with two manual spray stations and 12 oscillating Wagner C4 automatic guns (six per side). A gas convection cure oven completes the line.

"The manual spray stations on the A&I system are a unique design," says Russ Green of Wagner Powder Coating Systems. "The system allows manual touchup operators to be outside of the main cube booth itself in what resembles front and back porch vestibules. The vestibules provide manual sprayers with much greater freedom of movement for operations like custom coating while still providing the engineered airflow and containment needed for high transfer efficiency."

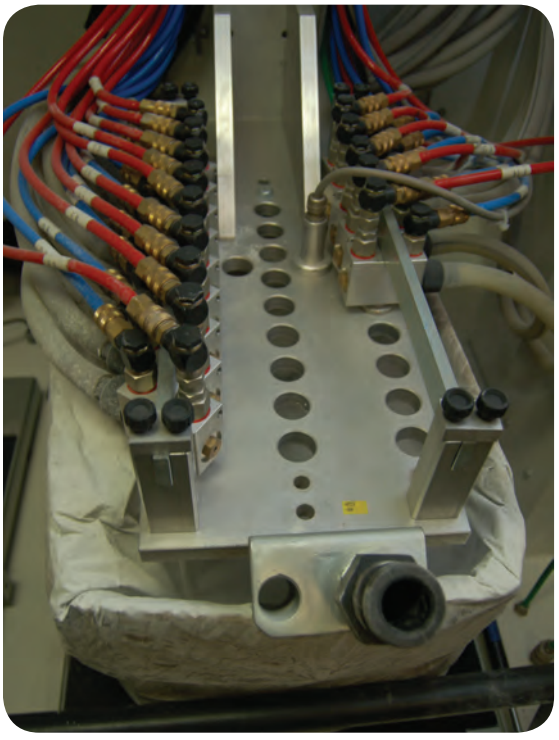
Powder is supplied to the guns by an automated feed center that pumps the powder directly from the box. Feed tubes are automatically lowered down into the powder box as the powder is consumed. "This arrangement not only provides simplicity and speed but helps to maintain an even flow of powder to the guns," notes Green.

A&I has saved more than 5,000 lb a month in powder because of its increased efficiency, while seeing its scrap and rework drop by 90%.

Complete Control

According to James Awcog, the assistant plant manager at A&I, several other features of the revamped line also have increased the plant's quality and efficiency.

"Our use of automatic recipes, along with the laser part sensing capability that makes up the DigiTech control system, lets us dial in the powder application process for a



Powder is supplied to the guns by an automated feed center that pumps the powder directly from the box.

The plant handles a number of architectural extrusions, in which pieces and parts of larger assemblies are painted separately and then assembled. Consistent film build is crucial

wide range of part shapes and styles," he says. "As a custom coater, that kind of flexibility on-the-fly is perfect for us."

Control of literally hundreds of system variables is provided through a centralized computer monitor (or CCM), which provides independent programming of parameters like gun position, reciprocator speed, powder flow, airflow and electrostatics. The system also features a 1,000+ recipe capacity.

"There's one place to go to change anything on the system," says Awcog "The CCM talks to everything else. And we can't touch the capacity of the system to store and control things."

Control of literally hundreds of system variables is provided through a centralized computer monitor.

Another important feature of the system is the ability to change colors rapidly.

"With a dozen or more color changes per shift, saving a few minutes on each color change can mean the difference between getting an extra job through the line each day or not," says Black.

The SuperCube itself is constructed of a non-metallic polymer engineered specifically to provide an easy-to-clean, powder-resistant surface. But some of the magic of the system lies hidden from the eye in the "basement" of the booth, where two parallel downdraft ducts efficiently whisk powder from the booth to the cyclone recovery system

While the SuperCube is able to make color changes in as little as five minutes, A&I takes a few extra minutes to ensure that all color changes provide the plant with no cross contamination. "We reclaim 100% of our powder," explains quality control manager Gloria Snell. "With reclaim-to-reclaim of any two colors, we are cautious not to sabotage ourselves."

"Our customers are big on color," adds Morris, "and we stock literally every RAL color in the deck, so the quality and the simplicity of color change were key factors when we bought the new system. These days you find a lot of technology on powder systems, but often these systems are too complex. We went with an approach that allows us to do it with maximum flexibility and simplicity without sacrificing anything on performance."

Two A&I operators carry out the color change routine, one focusing on the booth and the other on the automated feed center and cyclone recovery system.

"It seems like a big task," says Black, "but the system is highly automated and designed for fast color change."

With the push of a button on the feed center LCD screen, a sequence of purging and cleaning begins automatically. The guns automatically retract and are blown off as a "CleanSweep" automatic floor cleaning system swings into operation. The ergonomic design of the cyclone makes cleanup simple with access doors that make it easy to reach the places that powder is concentrated.

"The reduction we have seen in wasted powder added to our savings in scrap and rework. These savings have literally paid for the system in the year that it's been operating," says Morris.

Not surprisingly, the company's success has prompted A&I to expand its facilities, adding 12,000 ft^2 of warehouse space and breaking ground on a second line slated for startup in April 2008. "We have tripled our business since starting four years ago," says Morris, "and we are well on our way to doubling that again."

For more information about A&I, call 440.493.0410 or e-mail aimetalfinishing@aol.com. More information about the SuperCube can be found at **www.wagnersystemsinc.com**.

Capturing Overspray

Using expanded polystyrene filters in spray booths can eliminate the need for paint filter disposal while providing labor savings and safety benefits.

BY DONNA BOISSONNEAULT
Polyfoam Corp.

With all of the details involved in achieving a high-quality finish, few finishers give much thought to the filters in their spray booths. Conventional filters are inexpensive and do the job, so why look for an alternative? But as companies search for ways to reduce operational costs and improve safety, switching to expanded polystyrene (EPS) foam filters can be one way to achieve both goals.

Developed more than 20 years ago, EPS filters can eliminate the need for paint filter disposal — a major expense for many companies. While other types of filters often need to be placed in a drum of water and disposed of as hazardous waste, a molded EPS filter dissolves in solvent. Once saturated, the filter is placed in the same solvent used to clean the spray booth, and it essentially disappears. The solvent can then be recycled and reclaimed for future use.

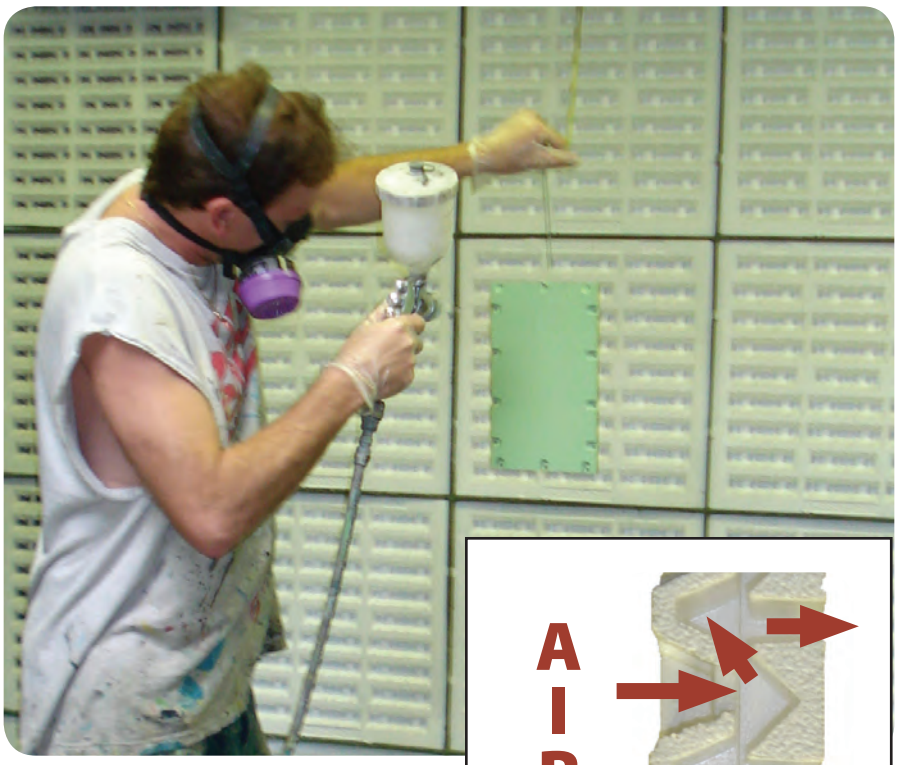
This benefit can provide substantial long-term savings for finishing operations. For example, one company that finishes a variety of metal parts was disposing of approximately two 55-gallon drums of paint-laden filters each week at a cost of $400 per drum. After switching to EPS filters, the plant has seen savings of more than $40,000 per year on its hazardous waste disposal costs.*

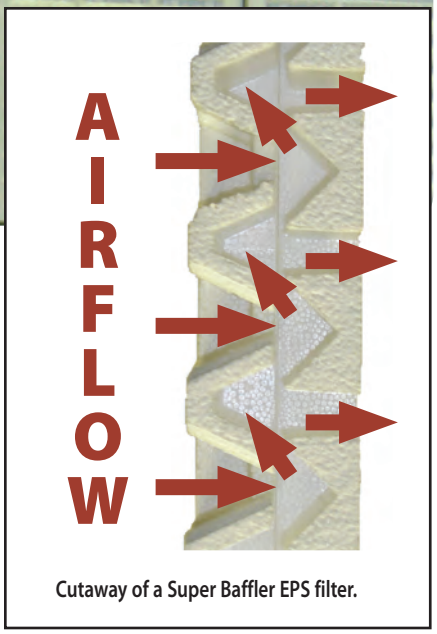
EPS filters also can help improve safety in spray booth painting because they are manufactured with a modified material that is flame-retardant and noncombustible. One wood finisher that had experienced a number of fires with conventional filters was able to eliminate this risk by switching to EPS filters. Additionally, because EPS filters are white, visibility within the booth can be dramatically improved.

ABOVE: EPS filters such as the Super Baffler can eliminate the need for paint filter disposal.

**Hazardous waste disposal costs vary significantly depending on the number of booths, paint volume used, and state and local regulations. This example is not necessarily indicative of the savings that all finishing operations can achieve with EPS filters.*

OVERSPRAY FILTERS





Cutaway of a Super Baffler EPS filter.

ABOVE: Because EPS filters are white, visibility within the spray booth can be dramatically improved. RIGHT: Advanced EPS filters provide multiple changes in the direction of airflow, thereby offering more surface area to collect paint and better overall airflow for an overall efficiency rating higher than 98%.

While the EPS material offers advantages over traditional filters, certain design features can provide additional benefits that further improve the way overspray is collected. For example, some advanced EPS filters† provide multiple changes in the direction of airflow, thereby offering more surface area to collect paint and better overall airflow for an overall efficiency rating higher than 98%. One result of this design is less static resistance, which is another benefit on the safety front. Additionally, this design allows the filter to maintain its high efficiency rating over a longer period of time. Some users have found this style of filter to last up to 20 times longer than other types, which translates directly into labor and filter savings.

Some EPS filters also are designed to fit a standard 20 x 20-ft paint booth frame with an airtight fit. This design can eliminate the need for grids and the occurrence of pull-down as the filters become saturated. These benefits, in turn, eliminate accidental leaks and the need to replace the filters prior to the end of their useful life.

The advantages provided by EPS filters are helping finishing operations save money on hazardous waste disposal, labor costs and filter replacement costs while also improving safety. Clearly, the type of filters used in a spray booth is worth a second look. ft

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Donna Boissonneault *is the marketing manager of Polyfoam Corp., Northbridge, MA, a manufacturer of EPS paint booth filters and other EPS products. For more information, call 877.765.9366, e-mail baffler@polyfoamcorp.com or visit* **www.superbaffler.com** *or* **www.polyfoamcorp.com**.

†These design features are specific to the Super Baffler, manufactured by Polyfoam Corp.

Green is Beautiful

A high-quality waterborne finish is helping Hollman, Inc. expand its wood-products manufacturing business into a line of high-end "green" kitchen cabinets.

BY DAVID KENNEDY
The Sherwin-Williams Co.

Hollman, Inc., of Irving, TX, is a leading manufacturer of lockers in the U.S. It is believed that more than 60% of all wood lockers here are modeled after the company's designs.

Well aware that his company's dominance in the high-end locker market was the result of doing some important things the right way, company President Joe Hollman made the strategic decision to expand the business into new markets.

Hollman had his eye on leveraging the company's wood products manufacturing experience into the market for high-end kitchen cabinetry. At the same time, he was quick to grasp the importance of green manufacturing processes, even before the recent surge of interest in green building. When Hollman made the decision to launch a kitchen cabinetry line, he also made a commitment to dramatically reduce his company's volatile organic compound (VOC) emissions and make other modifications to the manufacturing process so that he could carve out a niche as a producer of a luxury line of eco-friendly kitchen cabinetry.

From Locker Rooms to Kitchens

Boasting more than 300,000 ft^2 of manufacturing space, Hollman sells its custom-built, furniture-grade lockers to top country clubs, fitness centers, spas, athletic facilities, ski lodges, and government and public facilities throughout the country. The company also makes panelized racquetball and squash courts and athletic wall systems.

ABOVE: Hollman's Luxury Cabinetry line is constructed of formaldehyde-free plywood and features waterborne finishes.

Hollman's furniture-grade lockers are studies in high-end, and many are built from exotic woods. From this base of experience, the company drew on German engineering and Italian design to launch its Luxury Cabinetry by Hollman line of kitchen cabinetry. The cabinetry is not only beautifully designed, but it is also sturdily built to resist cracking, warping, fading and contraction.

The Sher-Wood waterborne stains are designed for application with various types of automatic spray equipment.

Hollman sells its custom-built, furniture-grade lockers to top country clubs, fitness centers, spas, athletic facilities, ski lodges, and government and public facilities throughout the country.

In addition to featuring low-VOC, waterborne finishes, Hollman's Luxury Cabinetry line is constructed using PureBond™ formaldehyde-free plywood from Columbia Forest Products of Portland, OR, rather than composite wood. The purpose is to eliminate formaldehyde off-gassing, which occurs even after finished, manufactured-wood products containing formaldehyde leave the plant and arrive at their end-use destinations. By pairing a formaldehyde-free plywood and low-VOC finishing system, Hollman successfully introduced a luxurious green product into a market where there are limited options for eco-friendly cabinetry.

Finishing Green

To help Hollman implement a green finishing system, the company sought a finishing partner with experience working with waterborne finishes. According to Kim Leng, vice president of manufacturing, after a review process, The Sherwin-Williams Co. was chosen both for the quality and durability of its finishes and because of the value-added technical support services the finishing supplier provides. The company offers custom finishes that are low in both hazardous air pollutants (HAPs) and VOCs, and it supports these products with the technical expertise needed for a smooth transition to a waterborne coatings line.

Ultimately, the $5 million investment made by Hollman in its finishing operations has paid off by helping the company multiply its output by more than 10 times that of the previously used method and limiting Hollman's emissions to less than 1,000 lb annually.

The finishing process begins on the first of three dedicated Cefla finishing lines. Sher-Wood® water-reducible stain is applied to door parts using a 20-gun rotating carousel for a complete and even coat. The doors are then sealed with Sherwin-Williams UltraCure® 100% solids ultraviolet (UV) spray sealer. After proper flash-off and cure, they are sanded and topcoated with Sherwin-Williams UltraCure waterborne UV coating. The panels continue on the conveyor belt to the laminar flow oven, where they are warm-air flashed prior to entering the UV oven. UV lamps use significantly less energy than traditional drying ovens — a money-saving advantage and another green plus for Hollman.

UV-Curable Coatings

The waterborne UV coating system used by Hollman is actually a collection of waterborne stains and UV curable sealers and topcoats, all designed for application with various modes of automatic spray equipment. The coatings offer outstanding physical properties along with an ultra-low VOC content. They also have exceptional durability and resistance to abrasion, chemicals and impact. Sherwin-Williams worked closely with Hollman to fine-tune the custom formulation of the coatings to enable higher throughput and increased productivity.

"It's not essential that the finisher understand the ins and outs of UV chemistry," says Jeff Bennett, Sherwin-Williams UV technical director. "But it is essential that the finishing supplier have the knowledge, capability and willingness to customize the chemistry to ensure optimal performance on the finishing line."

As a result of its environmentally responsible manufacturing practices, Hollman's products have been selected for use in LEED-certified buildings.

One of the most significant advantages for Hollman of working with this particular waterborne UV topcoat rather than other UV topcoats is the ease of reclaimability of this product. Hollman reuses all the overspray. Only minor adjustments with water are required before re-spraying. Using water as the reducer instead of solvent means less solvent waste for the finisher. Other UV coatings on the market require more complicated adjustment processes before the material can be reused. Sherwin-Williams also ships materials to Hollman in fiber drums that are recyclable, which further boosts the company's commitment to the three Rs of green: reduce, reuse, recycle.

Advanced Door Manufacturing Processes

Another innovative aspect of Hollman's cabinetry involves the use of a patented bent veneer process to manufacture raised panel doors. Unlike many other cabinetmakers, instead of outsourcing cabinet doors, Hollman produces them at its own door plant to allow for greater quality control, considerable design flexibility and reduced lead times.

Previously, the raised panel doors were made using solid wood materials. They were costly and didn't consistently yield uniform color and grain patterns. In addition, good-quality wood without blemishes or wormholes has become harder to find. When veneers were introduced for the center panel, they exacerbated the color uniformity problem due to the various types of wood and wood patterns.

Today, Hollman's veneer raised panel doors are constructed using CNC equipment to cut, profile and edgeband the different door parts. The patented veneer bending process involves two vertical framing components and two horizontal framing components, all of which are combined with a center panel to create a doorframe. Each exposed edge of the door is layered with an edge banding, which is made of either wood or plastic veneer that covers any joints between the vertical and horizontal framing components. Because the process uses only veneer and engineered board, it reduces the use of solid wood — and trees — significantly.

The $5 million investment made by Hollman in its finishing operations has helped the company multiply its output by more than 10 times that of the previously used method while limiting Hollman's emissions to less than 1,000 lb annually.

LEEDing by Example

As a result of its environmentally responsible manufacturing practices, Hollman's products have been selected for use in Leadership in Energy and Environmental Design (LEED)-certified buildings such as Elliot Hospital in Manchester, NH, Genzyme Research in Cambridge, MA, and the Cascade Ridge residential community at Big Sky, MT. Hollman is a member of the U.S. Green Building Council, and key employees are currently working on their LEED AP certification in "new construction" and "major renovations."

With a solid commitment to green manufacturing and some help from its friends, Hollman is setting an example of how an operation can go green without sacrificing quality or beauty. ft

David Kennedy *is market director-kitchen cabinets for The Sherwin-Williams Co. He can be reached at 800.524.5979. For more information about waterborne coatings, visit* **www.sherwin-williams.com/oem**. *More information about Hollman, Inc., can be found at* **www.hollman.com**.

Acid Gas Protection

Using the right linings and protective coatings, along with the correct application processes, can extend the life of flue gas desulfurization systems and optimize a plant's investment.

BY JEFFREY STEWART, GREG MARSHALL, DANNIE VICKERS AND GARY L. ZIGRANG
ITW Futura Coatings

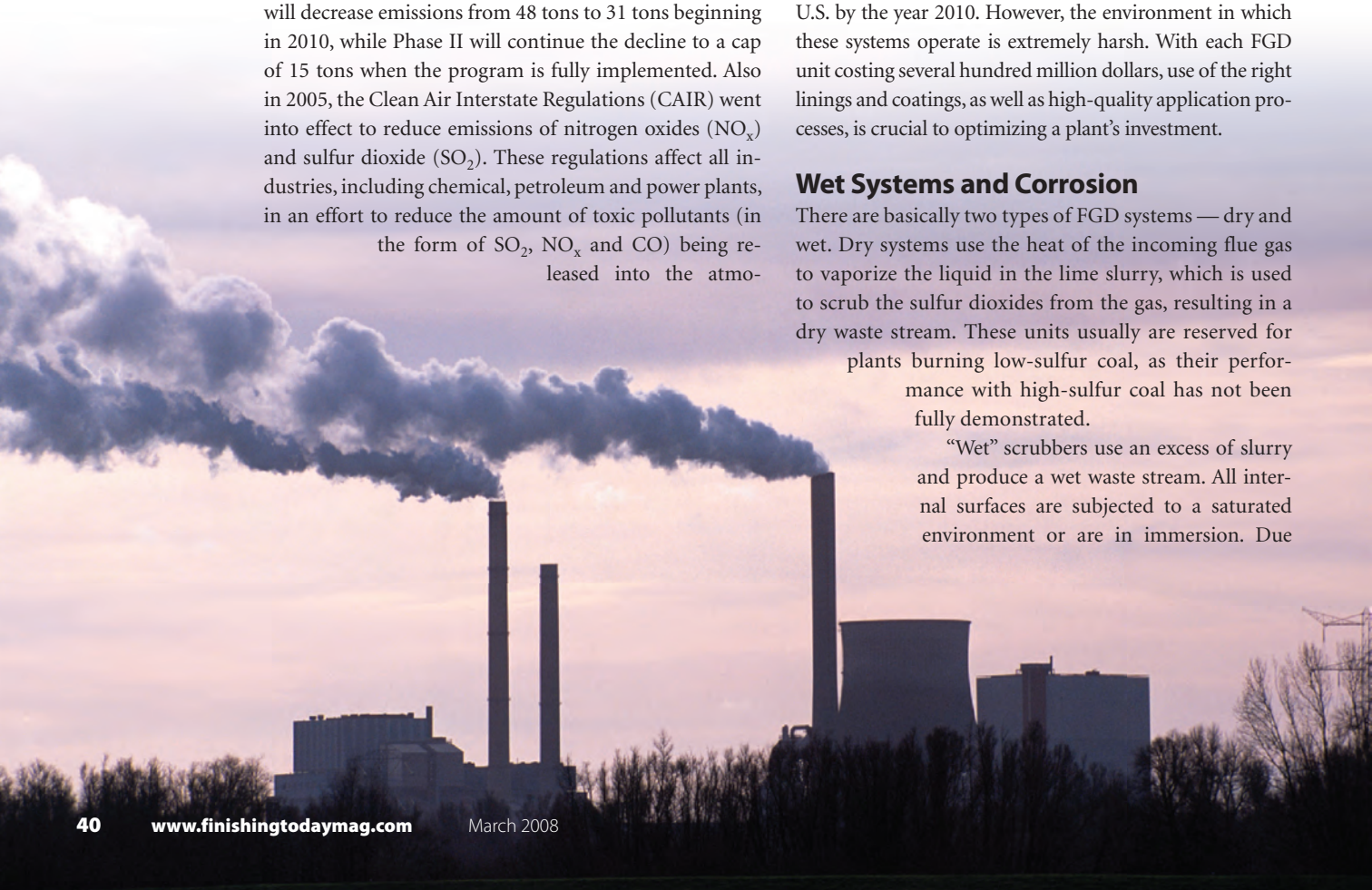
The Clean Air Act of 1992 (Phase I) and 2000 (Phase II) aimed to reduce annual sulfur dioxide (SO_2) emissions by 10 million tons between 1980 and 2010 (almost half the 1980 level). In March 2005, the Clean Air Mercury Rule was enacted to reduce mercury emissions in two phases. Phase I will decrease emissions from 48 tons to 31 tons beginning in 2010, while Phase II will continue the decline to a cap of 15 tons when the program is fully implemented. Also in 2005, the Clean Air Interstate Regulations (CAIR) went into effect to reduce emissions of nitrogen oxides (NO_x) and sulfur dioxide (SO_2). These regulations affect all industries, including chemical, petroleum and power plants, in an effort to reduce the amount of toxic pollutants (in the form of SO_2, NO_x and CO) being released into the atmosphere. By 2012, all power plants will be required to meet the tougher air quality emission standards.

Adding flue gas desulfurization units (FGDs) to clean or "scrub" the exhaust gases can reduce SO_2 emissions by as much as 98%. As a result, more than 300 FGD systems are expected to be built in the U.S. by the year 2010. However, the environment in which these systems operate is extremely harsh. With each FGD unit costing several hundred million dollars, use of the right linings and coatings, as well as high-quality application processes, is crucial to optimizing a plant's investment.

Wet Systems and Corrosion

There are basically two types of FGD systems — dry and wet. Dry systems use the heat of the incoming flue gas to vaporize the liquid in the lime slurry, which is used to scrub the sulfur dioxides from the gas, resulting in a dry waste stream. These units usually are reserved for plants burning low-sulfur coal, as their performance with high-sulfur coal has not been fully demonstrated.

"Wet" scrubbers use an excess of slurry and produce a wet waste stream. All internal surfaces are subjected to a saturated environment or are in immersion. Due



to their higher removal efficiency, wet systems dominate the FGD market, comprising 75-80% of all scrubbers used. Modern systems are smaller and more reliable than their predecessors. While older designs relied on numerous absorber units per boiler, today's absorbers are being designed with one vessel to service one or more boilers, which makes them more efficient.

The purpose of a wet FGD system is to remove sulfur dioxide from the flue gas by creating a chemical reaction with a lime or limestone slurry to form calcium sulfate (gypsum). This process results in an environment that is highly corrosive to carbon steel and most common stainless steels. The internal components of the scrubber are either submerged or are in contact with a warm saturated gas, and the process of combining a gas containing sulfur dioxide with a wet environment produces sulfuric acid. Further, the chloride content of the fuel, combined with the action of recycling the process water, results in elevated chloride concentrations. Other corrosives such as nitric acid and fluorides might be introduced to the system at low levels through coal combustion or water quality. The process operates at elevated temperatures, with inlet temperatures ranging from 280 to 350°F and post-quench-area temperatures between 120 and 140°F. Because of the corrosiveness of the environment, the choices for the materials of construction are limited and are influenced by cost and availability.

Customization Options for Interior Linings

Various options are used to protect the interior of the FGD absorber vessels and auxiliary tanks. Some of the highest-performance linings are based on vinyl ester resins. These resins offer excellent properties for a lining system by themselves, but their performance is greatly enhanced by a mixture of additives, including glass flakes, powdered ceramics, mats and rovings, and paraffin. Using additives allows the lining system to be tailored to a number of distinctly different sets of performance characteristics. Such customization is crucial for FGD applications, which present a number of drastically different application zones.

Glass Flakes. Adding glass flakes improves the product permeation rate or resistance to water penetration. All lining systems are permeable to some extent; however, glass is less permeable than vinyl ester. A layer of vinyl ester resin offers a theoretical pathway equal to the thickness of the lining — for example, a 40-mil-thick coat of vinyl ester resin provides a theoretical path of 40 mils in length for a water molecule to reach the substrate. In a vinyl ester flake glass system, when a water molecule begins to permeate the vinyl ester resin it will encounter a glass flake. Since the glass is less permeable than the surrounding vinyl ester resin, the water molecule will not try to permeate the glass, but will take the path of least resistance and travel along the surface of the glass flake or away from the glass flake. Adding the glass flake therefore creates a tortuous path for the water molecule, which increases the theoretical pathway length by magnitudes (see Figure 1).

The permeation performance of a glass-flake-filled vinyl ester is a function of the performance of the glass flakes. Several factors affect this performance, including the flake size and shape, and the adhesion of the vinyl ester resin to the surface of the flakes. Glass flakes typically are added in a ratio of sizes to provide better stacking and overlapping. Glass flakes should be flat to provide better orientation and overlapping characteristics, and a larger average glass flake size is preferable. The adhesion strength between vinyl ester resin and untreated glass flakes is relatively low. As a result, the glass flake needs to be treated with a surfactant, usually silanes, to improve adhesion.

Adding glass flakes improves the product permeation rate or resistance to water penetration.

Powdered Ceramics. Vinyl ester resin does not provide enough abrasion resistance to handle the high-solids slurries used in FGDs. To improve the abrasion resistance of the lining, the resin is mixed with powdered ceramics at high loading ratios of three to four parts powder to one part resin. As the resin wears away in an abrasive environ-

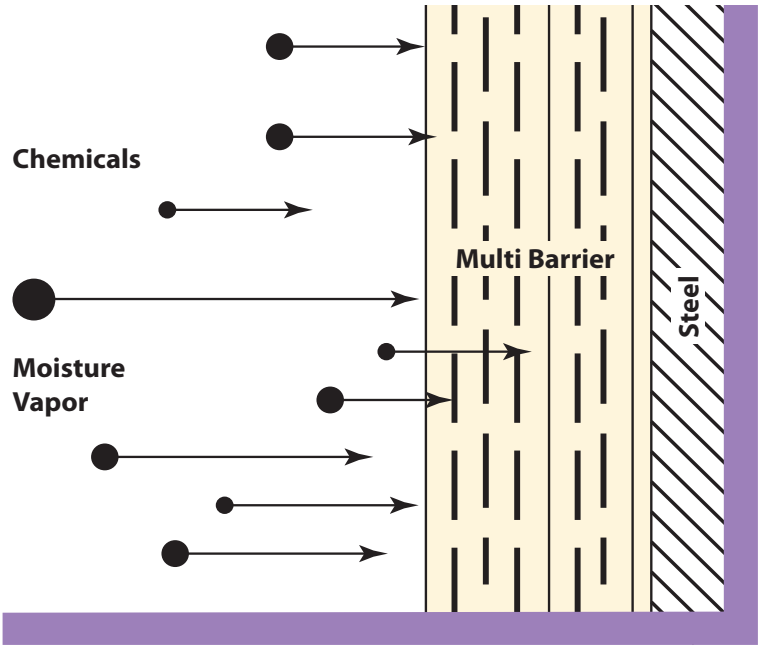


Figure 1. Adding glass flakes to a vinyl ester resin lining system creates a tortuous path for the water molecule, which increases the lining's resistance to water penetration.

ment, it exposes the small ceramic beads until the surface exposed to abrasion consists almost exclusively of ceramics. The vinyl ester resin in this example serves only as a binder to hold the ceramics. With the proper mixture of ceramic powders and resin, it is possible to achieve tough linings that not only hold up to slurry flow and impingement, but also to the mechanical wear and tear to which FGD systems are subjected for scale removal during outages. The abrasion control mortars can hold up to water pressures in the 2,500 to 3,000 psi range and, when used as a flooring material, can withstand the bobcats and shovels typically employed for cleaning.

Mats and Rovings. Glass mats and rovings (woven glass cloth) can be embedded in the resin system to provide additional physical properties. They usually are measured in weight per square foot, as in a 1.5-oz chopped glass mat or a 24-oz roving.

Rovings are embedded between layers of trowel-applied abrasion control mortars to provide physical strength, similar to the rebar used in concrete systems. Mats are much lighter and thinner than the rovings and are used to provide reinforcement for physical strength and improved abrasion resistance. It is common to see multiple layers of mats specified, and these often are used with a surfacing veil. Mats also typically are specified for edges in corners to help overcome the effects of surface tension, which causes a liquid to back away from sharp edges. By using a mat, the fibers of the mat hold the resin in place to ensure the proper thickness across the corner. While this is a recommended practice, it should not take the place of proper steel preparation, which requires that all corners be prepared to a minimum ⅛-in. radius.

Paraffin. Paraffin or wax is added to the topcoat or gelcoat to "seal" the system. Oxygen in the air will inhibit and interfere with the vinyl ester polymerization reaction. Sealing the system with a final paraffin coat allows the system to reach 100% cure. Using a topcoat with paraffin also allows the manufacturer to formulate the build coats with longer recoat windows but a relatively short, 72-hour final cure schedule (depending on the ambient temperatures during cure).

Other Lining Systems. Other lining options include fiberglass reinforced plastic (FRP) on epoxy vinyl ester resin; acid-resistant ceramic-based tile; sheet rubber linings based on compounds such as bromobutyl or chlorobutyl; and "exotic metal" linings, which usually are stainless steel modified with high-nickel bearing alloys or high chromium and molybdenum alloys. However, vinyl esters offer the lowest available life cycle cost compared to all of these systems, as well as a comparatively low initial cost. They have a short lead time, shorter installation schedules, more adaptability for modifications, and greater flexibility and adhesion. They possess excellent resistance to inorganic acids, resistance to chlorides well over 1,000 ppm, good resistance to alkali environments, and temperature resistance that ranges from 190°F in wet environments and 300°F in dry environments for standard bisphenol vinyl ester-based flake glass resin systems, to 260°F in wet environments and 390°F for dry environments for novolac-based flake glass resin systems. The thickness and localized designs of vinyl ester resins can provide the right materials for each zone in the absorber so that plants don't have to overspend for more robust materials where such materials are not required. With the proper design and application, vinyl ester resins are a proven technology that can provide long-term performance.

It is important to note, however, that application is key. Fire safety procedures must be followed, and skilled labor is needed to ensure the proper mixing of components and adherence to temperature guidelines. Detailed engineering is required to ensure that the proper additives are used in high wear and impact areas. Contaminants during installation (water, dust, etc.) can interfere with curing. Vinyl ester resin systems also are susceptible to mechanical damage and therefore require regular inspections and

LININGS AND COATINGS: A TRUE COST COMPARISON

An FGD system and its auxiliary components operate under a wide range of parameters, all of which must be evaluated to tailor the lining system to the required process conditions. A one-size-fits-all approach is a recipe for disaster. At a minimum, the following parameters should be considered: chemical exposure, temperature, immersion, direct impingement, sliding abrasion, substrate, off-line or outage conditions, and desired service life.

In reviewing the various types of lining systems and exterior protective coatings, potential owners of new FGD systems should consider both the initial installation costs and the maintenance/replacement costs, along with the available warranty options.

The initial cost to line the various interior and coat the exterior components of an FGD unit can vary greatly. Each lining system has unique qualities that might make it best for a particular service. However, "lower-cost" systems can require more maintenance, which will increase labor and maintenance costs over time.

Warranties can vary from as little as one year to ten years or more. Owners need to understand what is and is not covered by the warranty, including factors such as wear or abrasion, higher chloride levels, higher operating temperatures, chemical attack, and mechanical damage. The obvious goal is to avoid any unscheduled downtime due to a lining or coating failure. Potential weak spots that invite early failure include sharp edges, openings, corners and severe impingement areas. Proper surface preparation and lining design for these vulnerable areas is essential. A material failure that causes a unit shutdown could easily cost a power generation facility $1 million per day in lost operating revenue. It would be adding insult to injury to learn that the warranty has either expired or offers little assistance in repairing the damage.

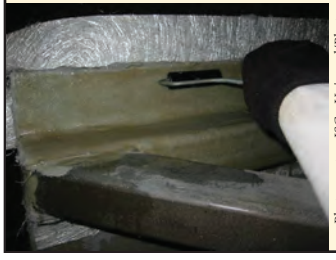


Photo courtesy ISG - Universal/Blastco.

Reviewing the total system and life cycle costs up front can help plant owners maximize both their equipment budget and operating efficiency.

maintenance. Ultimately, the reliability of the lining and the required maintenance costs will depend on the system chosen and on the initial installation methods.

Exterior Coating Systems

Traditionally, three-coat systems consisting of zinc, epoxy and urethane have been specified for FGD exteriors. Zinc coatings are used to provide long-term cathodic protection; however, they have a limited pH range. Epoxy and urethane coatings are required to protect the zinc from atmosphere contaminants.

Recent advances in zinc and urethane technologies have enabled faster production schedules in fabrication shops by eliminating the intermediate epoxy coat on some projects. For example, rapid-recoat reinforced inorganic zincs can be topcoated within one to two hours, and a high-build, quick-cure polyaspartic polyurethane technology allows the fabricator or field applicator to apply up to 9 mils in a single coat. The steel usually can be handled within 8 hours instead of 24 hours, which enables fabrication shops to improve their throughput dramatically without sacrificing coating system performance. While a three-coat zinc/epoxy/urethane systems with a total dry-film thickness of between 12-15 mils is expected to perform for 25 years or more, the service life of inorganic zinc/polyaspartic polyurethane two-coat systems is a competitive 20 years or better.

The savings in labor and application/production time obtained from using a reinforced inorganic zinc/polyaspartic polyurethane two-coat 10 mil system versus the traditional inorganic zinc/epoxy/urethane three-coat system can be substantial.

A Protected System

The three key ingredients for a successful FGD lining and coatings project are a sound system design, an accurate coatings specification, and a high-quality application/installation.

Suppliers of coatings and linings should be consulted early in the design phase to recommend the proper systems based on the FGD design and the owner's project and long-term maintenance objectives. Coatings and linings are an essential part of the FGD system, since they protect this most valuable asset.

Additionally, careful planning is needed to ensure that the products specified will meet the system's designed life and overall cost of the project, including future routine maintenance. Reducing initial lining or coating costs might be detrimental to the long-term performance of the lining and coating system. Using a single source of supply that offers color and design services, coatings specification development, product training, on-site support, lab technical support and warranty protection can reduce administrative costs and eliminate problems due to incompatible lining and coating systems.

Photo courtesy ISG - Universal/Blastco.

A vinyl ester resin lining is applied in a smoke stack.

Finally, it is a good idea to have the coating and lining manufacturer involved with training and monitoring of the application. The manufacturer can work closely with the applicator and project inspectors to ensure that the systems meet the requirements. This is especially true in critical areas that are subject to excessive heat, wear or chemical attack.

Following these guidelines can help plants ensure that their FGD systems provide long-term performance of 20 years or more with minimal maintenance costs. ft

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For Further Reading

- *Davies, Steve and Kaempffer, Max, "The Performance of Resinous and Rubber Linings in FGD Absorbers,"* PCE, *November 1996.*
- *Spires, George, "Monitoring Scrubber Linings to Assess Remaining Useful Life,"* Journal of Protective Coatings and Linings, *July 1993.*
- *Stewart, Jeffrey, P.E., "Vinyl Ester Linings For Flue Gas Desulphurization Systems," Abstract from PACE 2007, The Joint Conference of SSPC (The Society of Protective Coatings) and PDCA (The Painting and Decorating Contractors of America), February 11-14, 2007, Dallas, TX.*

Pat Plater Responds

Dear Pat,

I've heard the terms tin pest and tin whisker. Are they the same?

Dear Friend,

Tin pest, sometimes referred to as tin disease, is an allotrope (a new molecular configuration of an element, with new physical properties) that occurs when tin is exposed to very cold temperatures. Tin is stable in the metallic (beta) form at room temperature, but it will change to the powdery (alpha) form at temperatures below 8.24°F (-13.2°C). This change is said to have made the buttons on Napoleon's troops to turn to dust, causing him to lose the war in Russia — after all, his soldiers couldn't fight and hold up their pants. Though it is unlikely that this situation really happened, it does make a good story. (For more information about changes in tin, you might enjoy *Napoleon's Buttons: How 17 Molecules Changed History*, by P. Couteur and J. Burreson.)

Using tin-silver or other alloys seems to keep the whisker problem in check, but plating might be more difficult.

In plating shops, tin pest is not a concern. Tin whiskers, however, are important.

Tin whiskers are single crystals of tin that grow spontaneously from a tin-plated surface. As they grow, they can cause electrical shorts. Efforts to remove lead from circuit boards and solder have led to an increased occurrence of tin whiskers. It is estimated that this phenomenon has caused billions of dollars in damage to satellites and other electronics.

Some feel that increased stress might promote diffusion within the deposit and lead to greater whisker propensity. Other experiments show the reverse. Also, whiskers may have a long incubation period. Their growth can be quick or very slow. This means that it is difficult to evaluate whether a tin-plated part will produce whiskers. Another theory is that pure tin electroplated surfaces, especially those that employ brighteners in the plating process, are more susceptible to whisker formation. If you are planning to use pure tin, discuss the potential problems with your bath vendor.

Using tin-silver or other alloys seems to keep the whisker problem in check, but plating might be more difficult. According to the NASA Tin Whisker website (http://nepp.nasa.gov/whisker), plating chemistry can influence whisker growth. Pure tin is the most prone, while alloys such as tin-copper (SnCu), tin-bismuth (SnBi) and tin-lead (SnPb) are less susceptible.

Other metals also can grow whiskers, including zinc, cadmium, gold, aluminum, lead and indium. While gold and silver can grow whiskers, a bigger problem with precious metals is that they can grow "legs" and walk away from plating facilities if they are not properly secured, particularly as these materials increase in market value. Copper has this problem as well.

It is interesting to note that whiskers rarely are found in tin-lead or solder plating. Theories suggest that any or all of these might be involved: brighteners, incorporated hydrogen, co-deposited carbon, pH, current density, bath temperature and agitation. Other possible suspects include the substrate material; stresses induced by stamping, etching and annealing; the formation of intermetallic compounds; and substrate element diffusivity into tin.

With the potential for tin whiskers should you plate tin? Sure, just be aware of the possible problems and try to find an appropriate alloy for your project. Some research has been done using foam-type coatings over the tin, but these coatings have not completely resolved the problems. Generally, working with your bath vendor and your customers should produce satisfactory products with limited tin whisker growth.

Pat Plater *(Kathe Mayer) has been involved with the plating industry for more than 20 years in a variety of capacities, including selling equipment and supplies. She has served as chair of the AESF X-Ray Fluorescence Committee and was the editor of* XRF Shop Guide Quality Control with X-Ray Fluorescence*, published in 1999, which discusses thickness measurement in plating quality control. She also has given public presentations on this topic. Pat Plater is a regular feature of* Finishing Today *magazine. Send your questions to patplater@yahoo.com.*

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www.molectrics.com

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www.rksplating.com

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pH
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GOAD Company
◗ **Herr Industrial Inc.**
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  Martron Inc.

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Technic Inc., Equipment Div.
Vulcanium Corp., Vulcanium Plating Systems

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Mighty Hook Inc.
Technic Inc., Equipment Div.
Vulcanium Corp., Vulcanium Plating Systems

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Conveyors, Belt
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Conveyors, Other
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- **KMI Systems Inc.**
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  Richards-Wilcox

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Cooling Equipment for Plating and Anodizing Solutions
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Vulcanium Corp., Vulcanium Plating Systems

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Plating Process Systems, Inc.
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Craftsman Plating & Tinning
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Automotive Waterborne Paint System

SHERWIN-WILLIAMS AUTOMOTIVE FINISHES CORP.: AWX™, a new waterborne basecoat/clearcoat system, uses a proprietary resin system that behaves like a modern solventborne system. The product is designed to meet the strict volatile organic compound (VOC) emissions limits soon to be adopted in California and Canada. The new system doesn't require new or specialized equipment in order to use it effectively. Additional benefits of the product reportedly include fast dry time; a simple, compact toner line that is easy to mix; superior color match and blending properties; quick flash times between coats; short bake clearcoats with seven- to 10-minute cure cycles; a sandable basecoat that repairs quickly to remove imperfections; and a blending process that produces consistent, mottle-free finishes. Visit www.sherwin-automotive.com.

Water-Based Topcoat

ICA GROUP: LA409I, a new water-based topcoat specifically designed for use on outdoor products, incorporates nanomaterials to deliver a high level of transparency and excellent resistance to external agents. The coating can be applied either horizontally or vertically using a spray gun with canister or airmix, airless or electrostatic techniques. During application, the coating reportedly enables finishers to achieve a film with uniform thickness, even in hard-to-reach places, thanks to its electrostatic covering power. The company reports that it is also possible to achieve a noticeable reduction in overspray, which equates to lower consumption and allows for excellent recovery on cold walls. Call 519.768.0732, e-mail markl@icaamerica.biz or visit www.icaspa.com.

Environmentally Friendly Stripper

APPLIED CHEMICAL LABORATORIES, INC.: ACL-707 Green Piranha from is a high-performance, environmentally friendly stripper for removing otherwise permanent paints from metallic surfaces. According to the company, the new formulation quickly and easily strips polymer coatings such as epoxy, polyester, urethane, TGIC and hybrid powders; as well as military epoxies, high and low baked water, Teflon, Xylan, Halar and other liquid and dry industrial coatings. The product is 100% compatible for use with sensitive alloys, including aluminum and magnesium. Tenacious coatings are quickly removed without damaging the substrate or changing critical dimensions or tolerances. Visit www.appchem.com.

MATERIALS & EQUIPMENT

Touch-Up Coatings for Plastics

THE RAABE CO., LLC: Precision Color touch-up coatings now can be ordered in a lacquer for plastic surfaces. The new platform reportedly combines fast dry times and toughness with exterior durability. It adheres well to thermoplastic polyolefin (TPO), polypropylene (PP), sheet molding compound (SMC) and fiberglass-filled nylon. The lacquer also adheres to traditional substrates such as metal, wood and coated finishes. The new product is available in a range of custom-matched gloss and color combinations, including very low gloss. Visit www.raabeco.com.

Antifouling Coatings

BASF COATINGS: RELIUS coatings provide corrosion protection for steel ships and prevent algae, mussels, barnacles, and microorganisms from adhering to the hull. This "antifouling" capability

helps ensure smoother, faster sailing and lower fuel consumption, and is especially beneficial when ships and boats have long lay times or are cruising on lakes and inshore water. The coatings also can be used to coat ballast tanks and non-skid deck surfaces for passenger, vehicle, and helicopter decks. Visit www.basf-coatings.com.

Ballistics Protection Coating

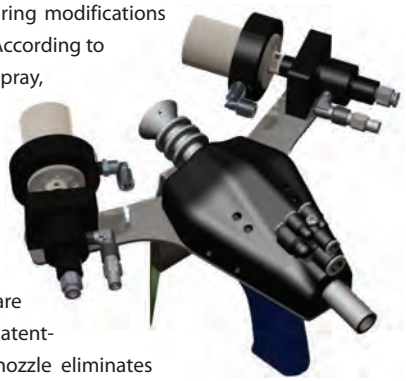
LINE-X® FRANCHISE DEVELOPMENT CORP.: PAXCON PX-2100 is a high-performance chemical formulation developed to protect against spalling and fragmentation during a ballistic attack. The product encapsulates bullets and other ballistic objects, which will remain intact and pose no secondary damage. The coating can be sprayed over any surface hard enough to cause a projectile to spall, such as aluminum, ceramic or steel. In 2007, the product was certified by H.P. White Laboratory, Inc., one of the oldest and most respected ballistic and research centers in the nation. It was also selected for anti-spalling protection by MRAP (Mine Resistant Ambush Protected) vehicle manufacturers, the Pentagon's top military personnel protection initiative. Visit www.PAXCON.com.

EQUIPMENT

Fast Powder Spray Gun

XIOM CORP.: The new Xiom 5000 Scorpion powder spray gun features a patent-pending triple venture that allows the gun to spray at up to five times the rate of the Xiom 1000. The new gun connects to the existing Xiom 1000

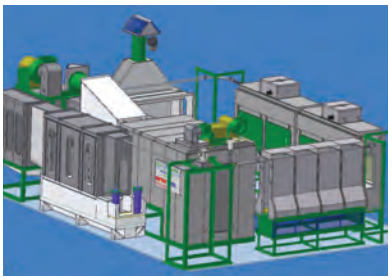
EQUIPMENT



control console without requiring modifications and has the same portability. According to the company, the new wide-spray, high-rate gun is economical to use, substantially cutting labor costs by covering larger areas in less time and by eliminating most of the need for preheating under normal ambient conditions. Parts are not subject to wear, and the patent-pending wide-spray-pattern nozzle eliminates the clogging that results when the polymer material melts in the nozzle. The gun uses only propane and air rather than the more costly oxygen. Visit www.xiom-corp.com.

Compact Powder Coating System

INFRATROL MFG. CORP.: The ecoflex is a compact, energy-efficient, low-environmental-impact powder coating system designed for coating small parts. There are four standard sizes with the smallest requiring only 700 ft^2 of floor space. The system is all electric and the company reports that the energy cost to operate the entire system is approximately $3/hr. The system generates no sludge or hazardous waste, no hazardous air pollutants, no ozone depleting substances and requires no drains. Visit www.infratrol.com.



Electric Walk-In Curing Oven

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Ask Joe Powder

Dear Joe,

About a year ago I powder coated some large aluminum gear housings for geared windlasses on a sail boat. The castings had become corroded, with several bare aluminum spots where the original coating was gone. For preparation, the castings were sandblasted to white and outgassed for two hours at 450°F. After cooling, the castings were acid etched and DI (deionized water) rinsed for any oxidation that may have occurred with the heating. They were then preheated and epoxy primered while hot so that the powder gelled on contact. After partial curing, they were then topcoated with polyester powder and fully cured. The total DFT (dry film thickness) was 5 mils or more. Now, after a little more than a year back in service (on salt water) some blisters are developing. If I were to start over is there anything that could be done to prevent coating failure?

Larry Johnson

Hi Larry,

On the surface it appears that everything was done right during the first powder job. Here are a few issues to ponder:

- Were the corroded spots completely cleaned — even inside the pits?
- What type of acid etch process did you use? Was it specifically formulated for aluminum?
- Did the DI rinse completely rinse all the acid away?
- 450°F seems high for aluminum. Did this affect the temper of the aluminum alloy?
- Were the powder coatings thoroughly cured? Undercured powders can blister in the field.
- Was the epoxy a high- or low-gloss product? Some low-gloss epoxies possess reduced corrosion resistance compared to higher-gloss formulas.
- Was the final coat a polyester/TGIC or polyester/urethane product? Polyester/urethane powders can sometimes develop voids when applied at thick films (>4.0 mils).

You probably want to look first at your pretreatment scheme and then be meticulous about the powder materials and process.

Dear Joe,

What is the best way to fluidize powder without fluidizing membranes/plates?

Elvis

Hello Elvis,

Here's some insight from Gary Bullard, technical service representative at Hentzen Coatings:

"Fluidizing membranes is recommended for fluidizing powder properly. Some coaters will drill small holes in PVC pipe that has an air fitting attached to the end of the pipe. The pipe is set in the bottom of the hopper, and the air is turned on. This solution typically works well. However, please be aware that if the steel air attachment is located inside the hopper, it could potentially create an unsafe environment. Some coaters ground the air fittings and others make the pipe long enough so that it is located outside of the hopper."

Send your questions to **askjoepowder@yahoo.com.** *Additional questions and answers can be found online at* **www.finishingtodaymag.com**.

CHROME WHEEL SOLUTIONS

After reading the question about chrome powder in the December 2007 issue of *Finishing Today* ("Is it possible to achieve a chrome finish on wheels with powder?"), two suppliers wrote in to recommend products.

Spectrum Metalworks has a product called PermaChrome™ that uses a chrome/nickel chrome physical vapor deposition followed by a clearcoat painting process. The product is a chrome wheel, but it reportedly has three primary advantages over conventional chrome:

- The durability of the wheel will not be impacted by salt or other contaminants on the road; the wheel will last like a painted wheel.
- The process used to coat the wheels is environmentally friendly.
- Finishers get to keep their OE wheels and therefore can avoid issues commonly associated with aftermarket wheels (like sizing, fitment, quality, unsprung mass, etc.).

Alcoa offers a surface treatment called Durabright® that is designed to keep aluminum wheels shiny. The patented treatment penetrates the aluminum, forming a protective barrier that becomes an integral part of the wheel. According to the company, it completely eliminates the cracking, peeling and filiform corrosion common in coated wheels. Wheels treated with the product can be cleaned with soap and water.

For more information about PermaChrome, call **888.PERMAChrome**. *More information about Durabright can be found at* **www.alcoa.com/alcoawheels**.

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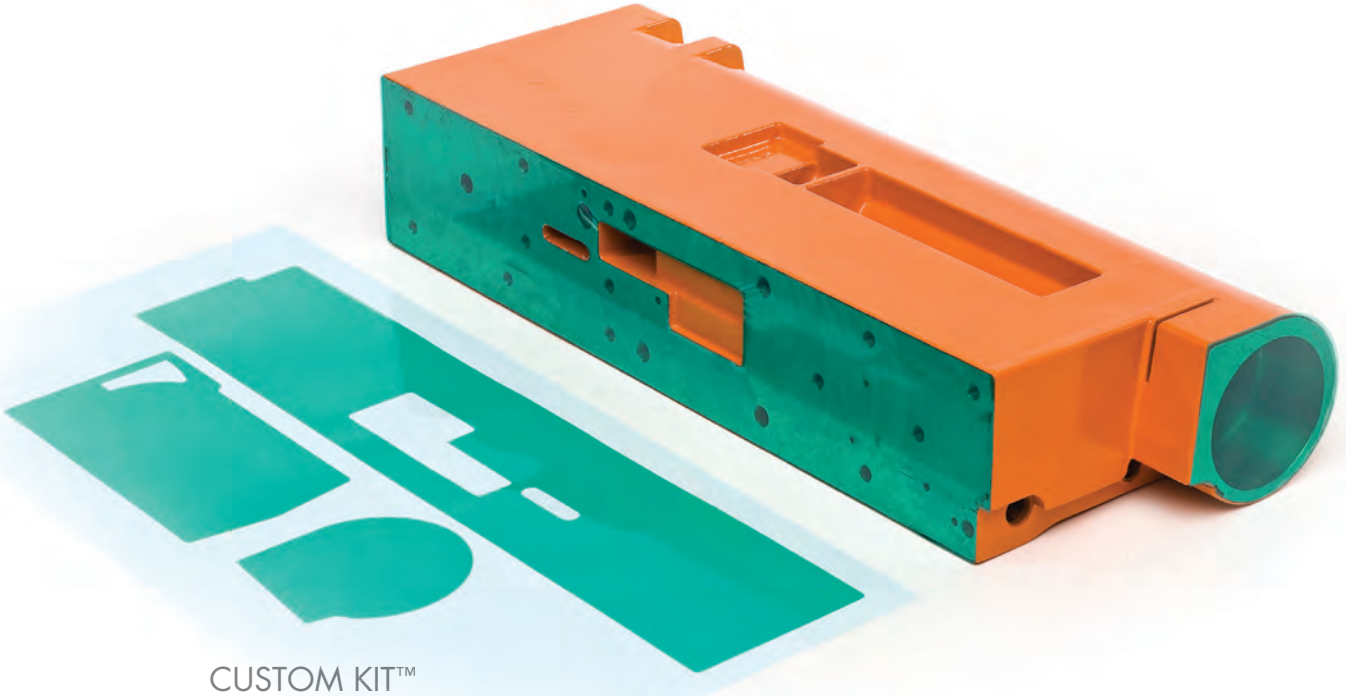

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