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It's Time to Protect all of the Surfaces

People outside of the coatings industry rarely understand two things about our industry. One, we are called the coatings industry, not the paint industry. Two, the main reason to coat/paint something is to protect it, not just improve the appearance.

Those of us who believe in science know that there is one major surface that needs protection. And that is quite simply, our planet.

By most scientific accounts, our planet is on a trajectory to heat up beyond a level that would sustain the ways we are accustomed to living and prospering. That heating, in significant part, is due to excess carbon dioxide in the atmosphere. If the experts are right, and there is no reason to believe they are not, then we have only a short time to counteract the most dire consequences of the excess of greenhouse gases causing it.

What if I told you that there are coatings that appear to be capable of drawing very large amounts of carbon dioxide from the atmosphere?

In this issue, we are publishing the technical descriptions of the first one of such mass produce-able coatings. Perhaps, there are others of you working on other solutions to this worldwide problem. There is no doubt that such coatings can be improved upon in the capable hands of our industry. There is no doubt that such coatings will be morphing in myriad ways to address diverse surfaces, to overcome differing environmental conditions, and to meeting unique requirements of localities across the globe. But, we must start now if we are to avoid the most extreme impacts of man-made climate change.

Coatings World challenges our industry to create a global consortium to utilize such carbon capture coatings to drawdown significant portions of the vast amounts of excess atmospheric carbon dioxide, to do so quickly, and to do so in a collective manner in order to prevent life-altering global warming.

To do this, we must communicate with one another quickly and openly. If you want to help, contact us here at *Coatings World*. I hope you will take up the challenge and join us.

Dale Pritchett
Publisher
dpritchett@rodmanmedia.com

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A Rodman Media Publication
25 Philips Parkway, Ste. 200 • Montvale, NJ 07645 USA
(201) 825-2552 • Fax: (201) 391-1008
Web site: www.coatingsworld.com

EDITOR
Kerry Pianoforte • kpianoforte@rodmanmedia.com
VICE PRESIDENT/EDITORIAL DIRECTOR
Tom Branna • tbranna@rodmanmedia.com
ASSOCIATE EDITOR
Anthony Locicero • alocicero@rodmanmedia.com
TECHNICAL EDITOR
Darlene Brezinski
ART DEPARTMENT
Michele Catalano • mcatalano@rodmanmedia.com
INTERNATIONAL CORRESPONDENTS
Sean Milmo (Europe)
Charles W. Thurston (Latin America/Americas)
CONTRIBUTING EDITORS
Phil Phillips • Steve McDaniel
EDITORIAL ADVISORY BOARD
Jim Berry (Berry Environmental)
Joseph Cristiano (consultant)
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Joseph Prane (consultant)
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Richard M. Tepper (PPG Industries)
Shelby F. Thames (University of So. Mississippi)

RODMAN MEDIA
PRESIDENT
Rodman J. Zilenziger, Jr.
rzilenziger@rodmanmedia.com
EXECUTIVE VICE PRESIDENT
Matthew J. Montgomery
mmontgomery@rodmanmedia.com
GROUP PUBLISHER / ADVERTISING SALES
Dale Pritchett • dpritchett@rodmanmedia.com
ADVERTISING SALES (U.S.)
Kim Clement Rafferty • krafferty@rodmanmedia.com
Donna Campbell • dcampbell@rodmanmedia.com
ADVERTISING SALES (Europe)
Ria Van den Bogaert, BVBA Vandenbo
Karmelietenstraat 24 C, Box 56, 1000, Brussels, Belgium
Tel.: +32 2 569 8905 • Fax: +32 2 569 8906
Mobile: +32 497 05 0754 • ria@rodmanmedia.com
ADVERTISING SALES (Hong Kong, Taiwan & China)
Ringier Trade Publishing Ltd
401-405 4/F New Victory House
93-103 Wing Lok Street, Sheung Wan, Hong Kong
(852) 2369 8788 • Fax: (852) 2869 5919
mchhay@ringier.com.hk
CLASSIFIED ADVERTISING SALES
Patty Ivanov • 631-642-2048; Fax 631-473-5694
pivanov@rodmanmedia.com
PRODUCTION MANAGER
Patricia Hilla • philla@rodmanmedia.com
AUDIENCE DEVELOPMENT MANAGER
Joe DiMaulo • jdimaulo@rodmanmedia.com
CIRCULATION MANAGER
Richard DeVoto • rdevoto@rodmanmedia.com
MARKETING MANAGER
Paul Simansky • psimansky@rodmanmedia.com

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How do you improve your dispersion process?

And make the correct raw material selections to go from ingredients to final product?

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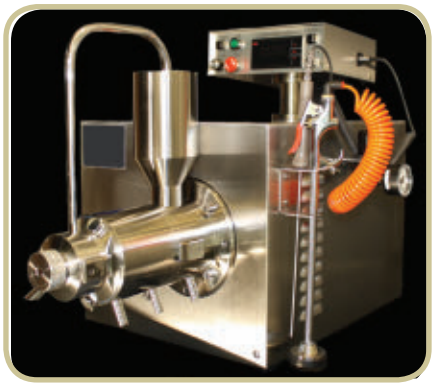
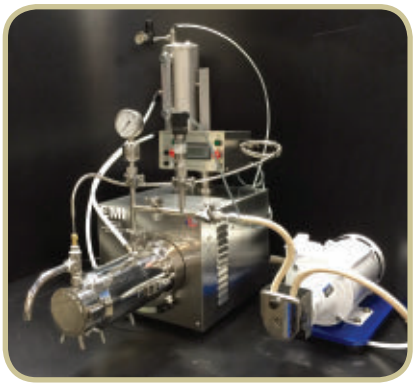


Small Sample Milling



Pilot Scale Milling

Production Milling

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Nouryon Completes Expandable Microspheres Expansion in Sweden

Nouryon completed a €20 million project at Sundsvall, Sweden that significantly raises production capacity for its Expancel expandable microspheres. These are used to enhance the properties of products ranging from shoe soles and food packaging to wind turbines.

"Expancel demand is growing fast as we develop new applications to fulfil customer needs," said Sylvia Winkel Pettersson, director Expancel at Nouryon. "Examples include underbody coatings, weather strips and repair putty for the automotive market, and sealants, floorings and elastomeric cool roof coatings for the construction market."

Expancel microspheres are used as a lightweight filler and a blowing agent to make end products lighter, create attractive textures, protect against damage or shield against the elements. At the same time it also reduces costs as less raw material is needed.

Nouryon is the leading producer of expandable microspheres. The company recently announced that it would invest in a new world-scale Expancel plant in the US, subject to final board approval. *CW*

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Axalta Announces Growth Strategy for Powder Coating Business in China

Axalta announced a new growth strategy for its China powder coatings business.

The new strategy positions the company to more effectively unlock value in the high-end Chinese powder coatings market in the next three years.

"China is one of the largest markets in the global powder coatings industry and continues to grow," said Rajeev Rao, Industrial Coatings VP of Axalta Global Powder and Business Development and Strategy. "Our new growth strategy aims to enable Axalta to seize opportunities in the high-end market and gain market share by leveraging our innovative powder coatings solutions."

Axalta will focus on developing the high-end powder coating market, introducing new product lines and service models. Its flagship brands, Alesta, Abcite and NapGard are well known in China in a variety of end-user applications such as transportation, architecture, oil and gas pipelines, rebar, appliances, general industrial and many other segments.

These leading global brands will be relaunched with new Chinese names.

Axalta will also be introducing other high-quality brands, Plascoat, Wireguard and Talisman, commonly used in the decorative and functional industries.

"China's powder coating market has undergone tremendous changes in the last 20 years with the most significant being the increasing demand for high-end powder coatings," said Willie Wu, president of Axalta Greater China. "Axalta has a stable customer base and has established itself as one of the leading companies in this market. We're committed to bringing global technology and services to China's customers to meet their growing demand for high-quality powder coating solutions using sustainable business practices."

Axalta will enhance the local powder coatings R&D capacities by leveraging global R&D processes technology, application experience, and technical service resources.

Axalta is the world's second largest powder coatings company with 15 powder plants worldwide, including three in Asia Pacific.

Teknos Acquires Finnproduct s.r.o.

Teknos made an agreement and closed the deal to acquire Czech paint distributor Finnproduct s.r.o.

Finnproduct has been a Teknos dealer since 1992.

"Our aim is to provide our customers with the best solutions to their needs. We want to further develop our offering to Czech customers in utilizing the best competence and knowhow we have in Teknos group," said Marcel Dissel, chief commercial officer.

Teknos has operations in more than 20 countries in Europe, Asia and the US.

"We have had success in introducing Teknos products to the Czech market and been able to establish long term customer relationships," said the previous owner of Finnproduct s.r.o. Ivanka Cieslová, who is retiring. "After 25 years, it is time to leave for my retirement. Now that Teknos takes over the business, we are convinced that the business will continue to develop positively."

AkzoNobel Announces Dave Smith Achievement Award

Nearing the one-year anniversary of his passing, AkzoNobel has chosen to memorialize respected industry leader Dave Smith by creating the Dave Smith Achievement Award.

The inaugural award was presented to Catherine Mathewson, an aspiring collision repair professional, at the 2019 Skills Canada National Competition, held May 28-29, 2019, in Halifax, Nova Scotia.

The $2,500 award will be presented annually to the Gold Medalist in the Car Painting, Post-Secondary category, at the Skills Canada National Competition, a multi-trade and technology competition for students and apprentices in Canada.

AkzoNobel has made an initial five-year commitment to Skills Canada in sponsoring the award.

"Dave was an inspiration to our team and the industry," said Doug Holmberg, AkzoNobel's Automotive & Specialty Coatings regional commercial director for North America. "This award is a great tribute to keeping Dave's memory alive and supporting both an industry and a professional development program he was so passionate about."

"I know how bittersweet this is to the AkzoNobel team to be giving this award away," added Mathewson. "Knowing how much it means to them makes me even more thankful to be awarded this. I cannot thank everyone enough for giving me the opportunity to be a part of this industry. I have worked so hard and dedicated so much to better myself and become the best painter I can be."

Smith began his career with AkzoNobel in 1993. Over his 25 years with the company, he played key roles throughout the North American Automotive & Specialty Coatings sales organization, distribution network and collision repair businesses. He held numerous positions within AkzoNobel, including country manager for Canada and North American industry relations and network manager.

The Skills Canada Collision Repair Program was created to address the skills shortage within the industry by raising awareness of career opportunities at Skills Canada Competitions across the country, by showcasing the exciting opportunities that are available for young people. The

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program also provides students who compete in the competitions from across Canada with hands-on training opportunities and the chance to enhance their skills and knowledge during their experience as a competitor.

The Skills Canada Collision Repair Program is completely funded by donations from industry leaders who believe in investing in the future of Collision Repair.

BASF Named a General Motors Supplier of the Year for 14th Time

BASF was named a 2018 General Motors Supplier of the Year for the 14th time since 2002. The award is presented to suppliers who distinguish themselves by meeting performance metrics for quality, execution, innovation, and total enterprise cost.

"We hold our suppliers to a high bar," said Steve Kiefer, GM SVP, Global Purchasing and Supply Chain. "They went above and beyond to deliver the innovations and quality that will help us earn customers for life."

Award winners represent companies who provide products and services to General Motors in the areas of vehicle components, supply chain and logistics, customer care and aftersales, and indirect services.

With its broad array of color solutions, modern paint processes, engineering plastics advancements and polyurethane technologies, BASF helps GM improve productivity and environmental performance.

"This award is a result of strong customer focus from the whole organization. Our business relationship with GM is centered around innovation, performance and continuously enhancing the customer experience," said Dirk Bremm, president, BASF's Coatings division.

PPG Completes COLORFUL COMMUNITIES Project at SOS Femmes en Détresse

PPG recently completed its first COLORFUL COMMUNITIES project in Algeria that helped revitalize the SOS Femmes en Détresse (Women in Distress) women's shelter in Algiers.

The project brought together more than 20 PPG volunteers, who spent 10 days beautifying the facility's exterior. Each year, the shelter provides a safe haven for more than 200 women and their children who are going through difficult life transitions due to homelessness and domestic abuse.

PPG provided nearly 325 liters (85 gallons) of SEIGNEURIE paint products and 10 beds with mattresses to help the shelter accommodate more women in need.

The Colorful Communities program provides PPG volunteers and products along with financial contributions to bring color and vitality to communities where the company operates around the world, such as in Algiers, where PPG has administrative offices.

vSOS Femmes en Détresse helps the women in its care rebuild their lives so they can transition to full independence. Nassiba Hebbache, PPG marketing manager, Algeria, discovered the shelter in 2017 when she helped train its residents on how to create a vegetable garden as part of her volunteer work with another nonprofit organization.

"At first sight, I knew that we could bring some joy and happiness to everyone in this rather gloomy shelter with PPG's soothing colors," said Hebbache. "As soon as we had the opportunity to organize a Colorful Communities project in Algeria, we chose to refresh the SOS Femmes en Détresse shelter."

The PPG volunteers painted the facility's exterior walls in a color palette that included violet, rose, green and blue hues. These colors were chosen in coordination with the shelter's director to create a calm and soothing space that promotes healing.

"I am feeling like I am in another place," said Meriem Belaala, director, SOS Femme en Détresse. "Color really is therapeutic, with some of our residents saying the shelter's new colors calm their minds. Many thanks to the PPG volunteers, whose actions will bring peace and happiness to all the

women and children who will stay here."

"I would like to thank the PPG volunteers for their commitment to making a difference in the daily lives of women and children facing temporary difficulties," said Jean François Lemaire, PPG country general manager, Algeria. "The before and after is amazing."

GMM Nonstick Coatings Announces SDK's Acquisition of ILAG

Showa Denko K.K. (SDK), the parent company of Chicago-based GMM Nonstick Coatings, announced that it acquired all shares of the ILAG Group, a specialty non-stick coating chemicals manufacturing company headquartered in Zurich, Switzerland, and concluded a stock purchase agreement with Helvetica Capital, the owner of ILAG.

Non-stick coating chemicals are used on consumer goods such as cookware, bakeware, and home electrical appliances, and also on industrial goods including automotive parts and other industrial equipment. The global market for non-stick coating chemicals is USD $1.2 billion a year.

ILAG supplies its non-stick coatings in both the field of consumer goods and industrial goods.

The acquisition of ILAG follows SDK's recent purchase of GMM Nonstick Coatings.

GMM and ILAG will operate as sister companies under a newly formed coatings business unit. GMM Nonstick Coatings CEO Ravin Gandhi will lead GMM, and ILAG CEO Hans-Georg Geisel will lead ILAG.

PPG Opens New Distribution Center in Flower Mound, Texas

PPG announced that it opened a new, nearly 450,000-square-foot (41,800-square-meter) facility in Flower Mound, Texas, making it the largest distribution center for architectural paints and coatings in the company's U.S. and Canadian network.

"PPG is committed to making significant strategic investments in the architectural coatings business," said Tim Knavish, PPG SVP, global architectural coatings and president, Europe, Middle East and Africa "This facility is another example of our dedication to growing the business and strengthening our overall distribution strategy."

Centrally located in the Lakeside Ranch Business Park in the Dallas-Fort Worth metropolitan area, the distribution center serves more than 1,000 PPG PAINTS stores, national retailers and independent retailers in the southwest U.S. region. It can store in excess of 4 million gallons (15 million liters) of more than 4,500 unique paint and coatings products.

"At PPG, meeting our customers' needs is our top priority," said Don Donatelli, PPG director, distribution and logistics, architectural coatings. "This new facility will allow PPG to provide faster, more efficient service to a number of national retailers, PPG Paints stores, and independent retailers throughout the southwest U.S."

RPM Acquires Manufacturer of Commercial Joint Sealants

RPM International Inc. announced that its Tremco business acquired Schul International Co., LLC, a manufacturer of joint sealants for commercial construction, and Willseal LLC, a business that markets and sells Schul products.

Both companies are headquartered in Hudson, New Hampshire, and have combined annual net sales of approximately $15 million. Terms of the transaction, which is expected to be accretive to earnings within one year, were not disclosed.

Schul's product line primarily consists of pre-compressed, self-expanding foam tapes, which are used for sealing vertical and horizontal joints in

applications that include window seals, precast concrete, modular construction and concrete façade restoration. They are sold under the Sealtite and Willseal brands.

Schul and Willseal will be integrated into RPM's Tremco Commercial Sealants & Waterproofing business, which specializes in the manufacture of sealants and waterproofing products for commercial, residential, industrial and infrastructure markets. The companies' entrepreneurial leaders, Steve Robinson of Schul and Brian Iske of Willseal, will continue in their current roles with the business units as part of Tremco.

"The acquisition... puts RPM in a leading position for impregnated foam tape technology," RPM Chairman and CEO Frank C. Sullivan said. "Through this transaction, we are creating a platform for North American-based production, augmenting our product development capabilities and leveraging other synergies that will be further enhanced by our MAP to Growth operating improvement initiative."

PPG Launches PPG ASSET INTEGRITY MANAGEMENT System in U.S., Canada

PPG announced that its protective and marine coatings business (PPG-PMC) introduced the PPG ASSET INTEGRITY MANAGEMENT (PPG AIM) system in the U.S. and Canada.

This software-based asset management system assists facility owners, managers and maintenance engineers in scheduling, budgeting and optimizing the corrosion protection of metal structures, buildings and equipment under their care for up to 20 years in the future.

The PPG AIM system is based on proprietary algorithms developed by PPG from NACE 509 and ISO 12944 corrosion-forecasting standards. Using data collected by PPG personnel during an initial mapping and field assessment procedure, the system predicts how quickly assets will corrode and helps identify the optimal time to recoat those assets before corrosion can occur.

The collected information is cataloged in the PPG AIM asset management tool, which asset owners and maintenance engineers can use to proactively rank and prioritize maintenance spending over multiple years. The result is a comprehensive, plant-wide maintenance planning, scheduling and budget strategy.

Acting as the user interface, the asset management tool provides daily access to asset-related details. These include time-stamped photos, condition analyses, plots, documents, inspection reports and other relevant attachments and information.

The PPG AIM system also delivers a range of ancillary benefits, including reducing the need to inventory and field assess assets every few years. Another is adding the ability to estimate the costs associated with deferring maintenance on specific assets when funds are not allocated for them.

"Asset owners and maintenance engineers are often forced by budget constraints and other circumstances to repair or replace equipment when the cost is highest and the risk to operate is greatest," said Scott Doering, PPG director of sales, protective and marine coatings USA. "The PPG AIM system assists customers in replacing expensive 'run-to-failure' maintenance schemes with proactive planning that can lower overall cost and greatly extend asset service life."

The system has a schedule manager function that enables customers to run multiple maintenance-cost scenarios to see how they are impacted by budget cuts, weather delays or other variables. *CW*

AkzoNobel Launches Interpon Structura Flex Powder Coatings Range

AkzoNobel has launched Interpon Structura Flex and, according to the company, it is the first and only powder range on the market to combine the weatherability of superdurable powder coatings with the mechanical performance advantages of standard durable systems.

It's a major development for customers, because prior to this latest example of AkzoNobel's vision on innovation, the higher the durability of a coating, the lower the flexibility. So if a piece of metal was pre-coated and then needed to be bent or formed into shape, a standard durability powder coating would often be used, because they offer higher flexibility (to prevent cracking).

Ten Interpon Structura Flex products are available, all in a stylish and on-trend color range. It means window and door manufacturers can now upgrade to superdurable level – without compromising on flexibility – and extend the lifetime and warranty of their finished products.

Interpon Structura Flex meets Qualicoat Class 2 weathering requirements and Qualicoat Class 1 mechanical performance requirements, the industry-wide quality label for liquid and powder coatings on aluminum for architectural applications.

Hempel Launches Highly Efficient, Antifouling Coating

Hempel launched Globic 7000, a new antifouling coating with enhanced operational flexibility for all vessel types and a speed loss of 4.5 percent, on average (according to ISO 19030).

Specifically designed to deliver effective protection for up to 60 months, Globic 7000 incorporates an optimum biocide mix to guard against both hard and soft fouling. With an improved performance against slime and algae, Globic 7000 is suitable for wide operational conditions including slow steaming and long idle periods.

Globic 7000 is built on Hempel's Globic technology that has been applied to more than 10,000 vessels since its launch in 2002, ensuring uniform and effective biocide release and a clean hull over the entire dry-docking interval.

"Our Globic range is one of our most successful as they offer an excellent return on investment," said Davide Ippolito, head of Marine Group Product Management, Hempel A/S. "Globic 7000, our latest addition, has been designed to offer customers full operational flexibility. In support of the industry's current move towards slow steaming operations this new coating delivers significant fuel savings and exceptional protection for up to 60 months, for all vessel types and a wide range of operational conditions. The high-volume solids in the coating mean that it can be applied more quickly to deliver further cost reductions whilst the vessel is in dry dock."

Hempel's patented Nano acrylate technology is the strength behind the Globic range and provides a fine polishing control mechanism to bring the integral biocides to the surface at a stable rate to ensure a clean hull over the entire service life period.

Globic 7000 incorporates Hempel's patented microfibres giving the coating best-in-class mechanical strength. The microfibres increase the coating's resistance to abrasion and impact damage often incurred during daily operations and protects against cracking and peeling. This strengthening of the coating minimizes the area required for blasting and so significantly reduces maintenance costs during dry docking.

Rust-Oleum Launches Metallic Concrete Floor Paint

Rust-Oleum is rolling out a line of Metallic Garage and Concrete Floor Paint + Primer for homeowners looking to inexpensively refresh their concrete floors with a brilliant, decorative look.

The new metallic, ready-to-use interior/exterior coatings are specially formulated for use on garage floors, carports, driveways, patios, basements and more.

The advanced water-based acrylic technology will resist damage from hot tire pick-up and other harsh chemicals. It's a durable, UV and weather-resistant finish that's easy to maintain and won't fade or peel when applied properly.

Rust-Oleum Metallic Garage and Concrete Floor Paint + Primer comes in three, on-trend metallic colors: Gunmetal, Cobalt and Copper. One gallon covers approximately 200 square feet with two coats and has a drive-on time of five days.

Jotun Unveils Next Generation of SeaForce Biocidal Antifouling Range

Jotun unveiled the next generation of its SeaForce biocidal antifouling range, with three new products featuring Hydractive technology. The new solution provides predictable, long-term performance for diverse vessel needs.

The range features three core products: SeaForce Shield, offering effective protection; SeaForce Active, actively working to safeguard hulls even when vessels are not in use; and SeaForce Active Plus, delivering premium protection at an affordable price.

SeaForce Active and SeaForce Active Plus also feature a triple biocide package, one of which is the same biocide combination used in the top of the range SeaQuantum product portfolio. ***CW***

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The Economics of Carbon Capture Coatings

by Phil Phillips, PhD
Contributing Editor
phillips@chemarkconsulting.net

I have been writing this column for 14 years. A guiding principle to which I have always attempted to apply to is giving the best business advice I could, based upon 40 years in the coatings, paints, adhesives and sealants industry. That advice from time to time has focused on disruptive technology that tends to evolve more quickly and somewhat uncontrollably than more mainstream advances stemming from mature technology. Even so, disruptive technologies must be prudently "rolled out," meaning, of course, that while they necessarily do stir up the ROI opportunity (that's why they are deemed disruptive), it is important to place the disruption into a reality framework. Typically, it is critical, even if on an accelerated timeframe, to carefully consider and thoroughly discuss political and industry headwinds in combination with realistic boundary guardrails. For readers of this column, I always want to avoid leaving them (you, my colleagues who must form the operational vanguard if this is to timely succeed) with any feeling of doubt that the key success objectives are possible to achieve.

That would be what I would normally advise. But, we are ***not in normal times.*** Regardless of why it's happening or what's causing it to happen, the amounts of greenhouse gases in our atmosphere are dramatically rising, and have not been at the level they are today (415 ppm atop the Maui observatory on March 2019), for over 800,000 years (yes, I'm that old and can remember those days). And, if the *experts are right*, there is very little time left to tackle this existential threat – that extremely limited *rollout-time* is measured in *years* at best, and is certainly *not* measured in *decades*.

So, when I was recently shown an albeit *fledgling* coatings technology with the potential to mitigate a large portion of the excess carbon dioxide being added annually to our atmosphere, I felt compelled to force myself out of my historically conservative and prudent comfort zone and into giving advice to my readers that breaks all my historic molds. When I realized that despite the critically short time left to mitigate the worst outcomes of this staggering excess of carbon dioxide, it is, in fact, specific types of coatings that have the almost entirely unique characteristic to be thinly applied over vast amounts of surface area and it is only that capacity of coatings that stands a chance of quickly defeating the huge task in front of us.

So, that's what I'm going to do. I'm gonna stick my professional neck way, way out.

I have tried to tackle the job of projecting a business approach to such a huge venture. From the first, I could tell it was not a profits-and-losses calculus like I am used to conducting. For one thing, these new coatings produce products themselves – they literally capture and amass carbon dioxide – part of which is the very raw ingredients from which they themselves are made. They are in a very real sense the world's first self-replicating paint. They don't only protect and beautify the underlying surfaces, they make stuff that people will buy, including more binder raw materials from which they themselves are comprised.

When I began to dig deeper into the numbers and the logistics, I was pleasantly surprised to find out that these coatings had the potential not only to turn a profit upon their sale to the ultimate applicator/consumer as a classical coating, but to have potential beyond that to numerous markets for the products that they could themselves manufacture. These were intangible things like carbon offsets, but also tangible goods like carbohydrates, cellulose and high-end cosmetics and coating binders, fuel, animal feed, fertilizer...at this writing we are just now uncovering the multitude of potential byproducts and markets which lie before our industry.

In this first Business Corner column devoted to the economics of carbon capture coatings applied over massively iterated vertical surfaces, I will describe my

analytical approach, to be followed in a second such column by real dollar and cents analyses. This is my initial contribution to the industrial consortium we must form if we, as an industry, are going to kick carbon dioxide's behind.

The approach I will take is to first do a standard supply-chain analysis similar to many I have discussed with you in the past. I will necessarily have to throw in a wrinkle or two due to the fact that these coatings once fixed to surfaces amenable to sustaining the living organisms inside the film, in fact, begin making bi-products themselves thereby adding to the value chain.

In the end, however, I hope to take my conclusions and compare them to approaches being taken by other technologies to achieve similar drawdowns of greenhouse gases from our atmosphere. In particular, I will try to do an apples-to-apples comparison of my analyses with those used to rank carbon-removing technologies already being ranked by Project Drawdown, as recently summarized in the *New York Times* bestseller *"Drawdown"* edited by Dr. Paul Hawken.

The approach used in the analysis by *Project Drawdown* features a ranking of solutions according to their emission-reduction potential.

The analysis concludes how many gigatons of greenhouse gases are avoided or removed from the atmosphere, as well as the total incremental cost to implement the solution, and the net cost or – in most cases – savings. Because of the fact that 2050 has been estimated the year that we will cross over the 2 degree Celsius increase in global temperatures if we don't reduce our carbon output leading to potentially catastrophic weather, loss of species, drought and global food shortages, the solutions are evaluated for their potential to impact that rise from over the next 30 years. Thus, the degree to which a given solution has a bearing on greenhouse gases is translated into gigatons of carbon dioxide removed between the years of 2020 and 2050. And what is a gigaton? To appreciate its magnitude, imagine 400,000 Olympic-sized pools. That is about a million metric tons of water, or one gigaton. Now multiply that by 36, yielding 14,400,000 pools. Thirty-six gigatons are the amount of carbon dioxide that was emitted in 2016.

Taking all this into consideration and by comparing Carbon Capture Coatings technology on the same basis as *Drawdown* to determine how it stacks up economically and feasibly to other Drawdown solutions, I hope to point to a near-term profitability path for the consortium partners. If you would like to discuss this with me, please contact me, Phil Phillips, at www.chemarkconsulting.net. **CW**

Peru Market Strengthens on Private Investment

Much of the new construction in Peru will surround infrastructure and industry, the demand for architectural paint and coatings should follow as the housing and tourism industries pick up speed.

by Charles W. Thurston
Latin America Correspondent
thurstoncw@rodmanmedia.com

The Peruvian market is strengthening, with its estimated four percent gross domestic product growth rate steady, and a rising count of international investments in major projects. While much of the new construction in the country will surround infrastructure and industry, the demand for architectural paint and coatings should follow as the housing and tourism industries pick up speed. Overall, the paint market in Peru including all segments is estimated at around $375 million.

Infrastructure Programs to Transform the Country

Despite ongoing natural disasters like last year's El Niño and a recent 8.0-grade earthquake, Peru's construction industry grew by 4.5 percent in 2018 and is predicted to increase at an annual rate of about five percent between 2019 and 2023, according to GlobalData.

The U.S. International Trade Administration (ITA) in October estimated that Peru's general infrastructure needs by 2025 will require an investment of close to $160 billion, involving an annual investment of 8.3 percent of GDP for nine consecutive years. To help fund the initiative, Peru's government is rapidly engaging public-private partnerships (PPPs) to increase private investment in infrastructure from a current 4.5 percent of GDP to six percent by 2021.

"With this increased funding comes a host of new opportunities for the Peruvian construction industry," the ITA Peru Country Commercial Guide stated.

A key agency in the Peruvian infrastructure program is the national reconstruction authority, the Autoridad para la Reconstrucción con

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Cambios. Its 2018 mandate was "to initiate projects on the rehabilitation of over 540 bridges, 6,000 kilometers of national roads, 30,900 kilometers of rural roads and 45,000 kilometers of irrigation canals affected by the floods and mudslides during the early months of 2017, although many projects are not yet ready for public tender," the ITA report detailed.

"Additionally, a reform package for the health sector, introduced in late 2013, was launched to include rehabilitation, construction, and equipment of 206 primary care centers, construction of 170 provincial hospitals, construction of 23 regional hospitals and construction of 13 national hospitals," the ITA report added.

Similarly, the Ministry of Housing, Construction and Sanitation (MVCS) estimates that the total housing deficit in Peru is around two million homes, the ITA report specified. In addition to the goal of the construction of 500,000 new homes, the country needs to renovate another 1.5 million to close the housing infrastructure gap, the report said.

Private sector investors also have plans to build more hotels in Peru over the next several years, like Hilton, which has announced two new hotels by 2021. The new investments could double the value of hotel investments over the past five years, according to one industry estimate.

Private Investment Flowing

One of the largest construction projects about to start is the new $3 billion Port of Chancay for Hong Kong's Cosco Shipping Ports. A financial transaction with Peruvian mining company Volcan was signed in May for the new port, to be located about 40 miles north of Lima. The port will include a container terminal, as well as bulk cargo, general cargo and rolling cargo facilities.

Chancay, a natural port with a depth of up to 45 feet, is located about 40 miles north of Lima. It will be able to receive the world's largest Triple-E-type vessels, Cosco said.

Another transportation mode investment is underway at Lima's Jorge Chavez International Airport, a $1.5 billion expansion aimed at building a second runway, a new terminal and aircraft slots. The Ayacucho, Arequipa and Tacna airports also will undergo an expansion of terminals and runways. A consortium that includes Italian builder Salini Impregilo SpA, Spain's FCC Construccion and AECOM won a contract for expanding the airport, according to Reuters.

Toronto's Polaris Infrastructure, engaged in the operation, acquisition and development of renewable energy projects in Latin America, is completing the construction of 28 MW of run-of-river hydroelectric projects in Peru. The company now operates a 5 MW run-of-river project in the country.

Similarly, Madrid's Grupo Ibereolica's plans to build the $300 million,186 MW Apurimac hydroelectric plant in Peru's Cusco region. Among future projects for the company is the 392 MW Huánuco hydroelectric project. The company is targeting regional growth in the Brazil-Chile-Peru triangle.

The potential for the Chinese government and private investment in Peru is enormous. Chinese involvement in the region is increasingly being managed through China's Belt and Road Initiative, China's ambitious global infrastructure development and investment campaign, according to Marsh & McLennan. One Peru project under consideration by China is a rail line over the Andes to Brazil, with an estimated cost of $35 billion.

Paint and Coatings Grow with GDP

The consumption of industrial paints is clearly poised for growth in Peru, which should help entrenched suppliers like PaintPeru and Renner. But architectural consumption is also expected to grow, possibly more rapidly than the GDP rate. With a total consumption of 40 million gallons of paint and coatings, the per capita consumption was calculated at about 1.3 gallons, according to one estimate by Grupo Codelpa, the Chilean paint company that owns Cerecita in Peru.

Pinturas Ceresita, now being manufactured in Peru, is a rising player in the market. The company recently launched two new products in the country, Esmalte al Agua Cerecita (a water-based enamel), and Esmalte al Agua Semibrillo Ceresita (a semi-gloss).

Company stores operated by Sherwin-Williams should gain sales this year, as will domestically-owned Pinturas Vencedor – owned by Croma Color, distributed within the Sodimac home improvement chain.

Among recent paint and coatings investments, Sika Peru opened its new headquarters in Lima and opened a new plant for the production of concrete admixtures, mortar products, and acrylic liquid applied membranes. The new plant is expected to triple Sika production capacities in the country.

Finally, a dedicated paint and coatings trade show in Lima is being launched this year in August, the Feria Internacional de Pinturas y Recubrimientos Industriales Fiprec 2019. As the economy expands, the paint and coatings industry in Peru is growing more mature and more global. ***CW***

Construction is booming in Peru. Source Agencia Peruana de Noticias.

AkzoNobel Fuels Innovation with Paint the Future Competition

AkzoNobel has staged a global competition among start-ups, academic research units and similar entities. The winners have been awarded collaboration agreements with AkzoNobel on the development and/or commercialization of their innovation.

by Sean Milmo
European Correspondent
milmocw@rodmanmedia.com

Pressure on coatings producers in Europe to generate a continuous flow of innovative technologies and products has never been more intense.

In response to the needs of customers, coatings are becoming more complex with multipurpose functional properties, whose technologies have first to be discovered and then developed.

Big Data and artificial intelligence (AI) are seen as opportunities for providing platforms for innovations.

Looming over the coatings and other sectors is the threat of global warming, rapidly diminishing biodiversity and other environmental dangers which will have to be combatted with technological advances.

Also, the portfolios of a growing number of coatings companies, especially the larger ones, contain specialty, niche products which yield high margins but which require the support of extensive research and development.

However, even big international companies do not have the research power, particularly in terms of highly qualified staff and internal expertise, to generate their own innovations.

They have had to resort to what has become to be known as open innovation – looking outside the company for ideas through means like constant literature searches, attendance at conferences and seminars, networking and collaborating closely on the development of new products with customers and suppliers.

Now the conventional ways of conducting open innovations are becoming less effective.

New methods have had to be found for making contacts with sources of inventiveness and using them to forge long-term ties.

''The world is moving so fast you have to introduce new schemes for working with start-ups and other small companies and with academia," said Klass Kruithof, chief technology officer at AkzoNobel, market leader in European coatings, whose portfolio covers both decorative and industrial coatings for segments like automobiles and aerospace.

AkzoNobel has staged a global competition among start-ups, academic research units and similar entities. The winners have been awarded collaboration agreements with AkzoNobel on the development and/or commercialization of their innovations.

''These types of competitions have been used in the pharmaceuticals sector as a means for building links with start-ups, especially in biotechnology," said Kruithof.

AkzoNobel's competition, called Paint the Future, attracted 160 participants from around the world – including 40 percent from Europe, 24 percent from North America and six percent from China.

Each had to submit an innovative solution covering one of five themes – smart applications, circular solutions, predictable performance and life science infusion like the use of enzymes.

At the final stages of the competition, 21 solutions were shortlisted.

These included technologies for reuse of ingredients and pigments as circular solutions, benign biocides as a life science infusion, self-cleaning and air purification as enhanced functionalities and with predictable performance imaging analysis and detection.

AkzoNobel sees the five winners, selected from the shortlist who received their Paint the Future awards at an event in Amsterdam in mid-May, as the basis for an innovation ecosystem.

The winners – all start-ups – were SAS Nanotechnologies of U.S.-based specialist in smart anti-corrosion coatings; QLayers of the Netherlands, a developer of automated printheads for coating large surfaces; Interface Polymers, a UK producer of di-block polymers providing anti-fogging properties to coatings on packaging and other surfaces; Apellix of the U.S., a developer of automated drones for spray painting; and Alucha Recycling Technologies, a Dutch supplier of a solution for turning waste into bio-oils and minerals.

SAS Nanotechnologies and Apellix were offered joint development agreements with AkzoNobel for the improvement and commercialization of their products.

QLayers and Interface Polymers, whose solutions were ready for market launch, were presented with business deals under which AkzoNobel will help with the commercialization of their products. Alucha was granted a supply agreement for its solution.

For these small companies, the main benefits of the awards included the support of a leading global coatings producer and opportunities for using the award for further expansion of their businesses.

''It gives us a chance to carry on the development work we are doing," said Tim Clayfield, application development director at Interface Polymers. ''We want to go out now and get more funding with the power of this agreement behind us."

The scheme has coincided with an expansion of AkzoNobel's international R&D operations.

Paint the Future has raised the collaborative efforts of its research to new levels.

Among its more radical recent innovations has been the introduction of a coating based on ultra-violet light emitting diodes for the prevention of fouling of ships hulls. This is derived from a technology of Royal Philips of the Netherlands, a specialist in UV-LED lighting and electronics.

The company is already among the biggest spenders worldwide in coatings research with R&D expenditure of €1.2 billion ($1.4 billion) over the last five years, while it employs 3,000 research scientists.

Amongst its international research operations, it opened in Shanghai in 2016 a new €6.5 million technology center whose marine and protective development lab was extended last year.

Also in 2016, a $10 million R&D center was opened in Strongsville, Ohio, with a focus on coil, extrusion and packaging coatings.

Earlier this year, a €12.6 million research and innovation hub was inaugurated in Felling, northeast England, with 100 scientists and technical specialists.

The Paint the Future project has laid a pathway to a more structured approach to the use of open innovation as a way of finding new ideas.

''What's important about the scheme is that it allows us to start a dialogue with its participants, which should lead to a more permanent relationship," explained Thierry Vanlancker, AkzoNobel's CEO, after the awards ceremony. ''It should be the start of a series of innovations coming from the networks linking their laboratories and scientists with our own."

In its effort to create strong relationships with the Paint the Future participants, AkzoNobel will not be confining itself to the five winners or the 16 who reached the shortlist.

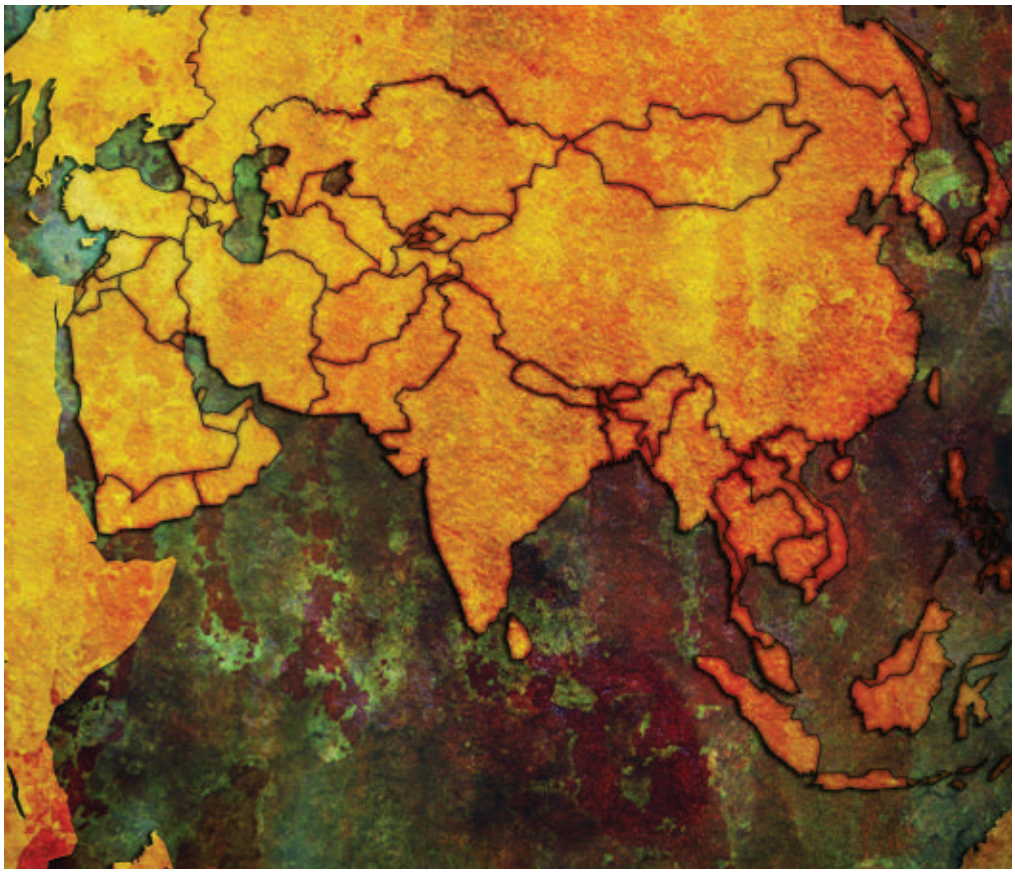
''The others have exciting ideas as well," said Vanlancker. ''Some of them are developing innovations which are clearly related to areas we are interested in."

The procedure for drawing up the shortlist involved meetings with these participants. So the dialogue with them has already begun

For AkzoNobel, the scheme has opened up a whole new dimension to open innovation.

''With the power of an entire (new innovation) ecosystem behind us, big things are on the horizon," said Kruithof. **CW**

Expansions in India Paint & Coatings Industry



Four major paint producers, who account for more than 60 percent of the total output of the Indian paint and coatings industry, have either added significant production capacity or are in the process of adding additional capacity to their operations.

by Yogender Singh
India, Asia-Pacific Correspondent

Indian paint and coatings producers added significant production capacities in 2018. Currently, there are a number of ongoing expansions in the paint and coatings sector by major producers in the country.

Overview of the Indian paint industry

Estimated at $7.26 billion at the end of financial year 2018-19, the Indian paint industry registered modest growth in the just concluded financial year. The decorative paint category constitutes almost 75 percent of the overall market. The decorative paint market includes multiple categories, including exterior wall paints, interior wall paints, wood finishes and enamels, as well as ancillary products like primers, putties, etc.

The industrial paint category constitutes the balance 25 percent of the paint market and includes a broad array of segments like automotive, marine, packaging, powder, protective and other general industrial coatings. The domestic paint industry still continues to have a 32-35 percent share of unorganized players which primarily cater to the low-end of the market.

Slew of capacity expansions by Indian paint majors

Four major paint producers, who account for more than 60 percent of the total output of the Indian paint and coating industry, have either added significant production capacity or are in the process of adding additional capacity to their operations to aid in meeting the growing demand of paint and coatings in the country. This is set to be the biggest addition of capital expenditure seen in the industry ever.

MANUFACTURING FACILITIES OF MAJOR INDIAN PAINTS & COATING PRODUCERS

Company	Number of Manufacturing Plants	Locations
Asian Paints	10 (domestic)	**Decorative Paints-** Rohtak (Haryana) Kasna (Uttar Pradesh), Ankleshwar, (Gujarat), Khandala (Maharashtra), Patancheru, (Telangana) Visakhapatnam (Andhra Pradesh), Mysuru (Karnataka) and Sriperumbudur (Tamil Nadu) **Industrial Paints -** Sarigam (Gujarat) and Taloja (Maharashtra)
Berger Paints	12	Howrah, Rishra, Tezpur, Nalbari, Hindupur, Jejuri, Janmmu, Puducherry and Udyognagar
Kansai Nerolac	5 (2 upcoming plants)	Lote, Bawal, Jainpur, Hosur and Sayakha Upcoming- Amritsar and Vishakhapatnam
Akzo Nobel	6	Hyderabad, Mohali, New Mumbai, Bengaluru, Bhind and Thane
Shalimar Paints	4	Howrah, Nashik, Bulundshahar and Chennai

Asian Paints

Among the big four of the Indian paint industry, Asian Paints, the leader in the decorative paints segment, operates 27 manufacturing facilities both in the country and in foreign markets. In financial year 2018-19 (April 2018- March 2019), the company commissioned two large paint manufacturing units of 300,000 KL/annum each at Mysuru (state of Karnataka) in September 2018 and Visakhapatnam (state of Andhra Pradesh) in January 2019. Both these plants will be scaled up in the second phase of expansion, taking the overall installed capacity of each plant to 6,000,000 KL/annum.

Coming up with an investment of $579 million, both of these plants are fully automated with world-class automation systems in all their operations. Newer technology has been tested and successfully implemented on the packing floor and their finished goods warehouses as well. With these two capacity additions, the company has an overall installed capacity of 17,300,000 KL per annum of installed capacity of decorative paints and 14,000 KL and 7,200 MT per year of industrial paints installed capacity.

Kansai Nerolac

The country's second largest paint producer (in terms of sales revenue for the year 2018-19), Kansai Nerolac has been aggressively augmenting capacity to match its expanding portfolio of offerings. In the last financial year, the company commenced commercial production at its new state-of-the-art industrial coatings plant at Sayakha, Gujarat.

Gujarat manufacturing plant is Kansai Nerolac's fifth production facility in the country. Kansai Nerolac, the leader in the industrial paints segment, has four other manufacturing facilities in the country located at Lote in Maharashtra, Bawal in Haryana, Jainpur in Uttar Pradesh, and at Hosur in the state of Tamil Nadu.

The company is also in the process to set up two state-of-the-art new plants equipped with modern production technologies at Amritsar in Punjab and Visakhapatnam in Andhra Pradesh.

Kansai's upcoming manufacturing plant in the state of Punjab with an installed capacity of 52,800 KL per annum is being constructed at Goindwal Sahib near Amritsar in Punjab. Coming up with an investment of $28 million, this plant is expected to commence commercial production in early 2020. The company's seventh manufacturing unit is coming up in the Achutapuram, Vishakhapatnam district in the coastal state of Andhra Pradesh. The plant will have a capacity of 60,000 KL per year, which is expendable in phases, at an estimated cost of $43 million. Timeline of commencement of commercial production from this plant has not been announced by Kansai Nerolac.

AkzoNobel India

AkzoNobel, the owner of brands such as Dulux and Sikkens, operates six plants across India. In early 2018, AkzoNobel India commenced commercial production at its new powder coatings facility at Thane, near Mumbai. Coming up with an investment of $10 million, this is AkzoNobel's sixth manufacturing facility in the country. The new facility complements AkzoNobel's existing plant in Bangalore, adding new product lines in bonded metallic powder and pipe and rebar coatings.

Speaking at the inauguration ceremony, Jayakumar Krishnaswamy, managing director, AkzoNobel India said, "AkzoNobel India Powder Coatings has been delivering strong profitable growth. The new facility plays a critical role in AkzoNobel India's expansion plans and provides a boost to our access to the markets located in Northern and Western parts of India."

Berger Paints India

Berger Paints has lined up an investment of $39 million over two years to expand capacity in the states of Uttar Pradesh and Maharashtra.

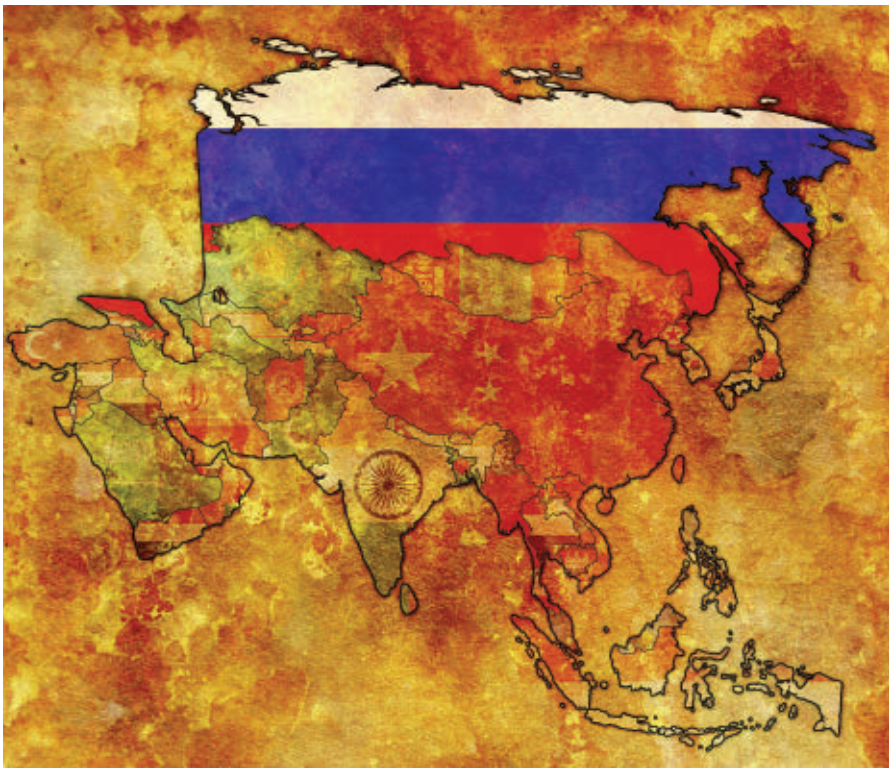
The company is coming up with a greenfield unit at Sandila industrial area in the state of Uttar Pradesh at an investment of $28 million and another $11 million is earmarked for expansion at the company's existing unit at Jejuri in the state of Maharashtra.

"We will soon commence work for the installation of water and solvent-based decorative, industrial and protective coatings, resin, putty, emulsion and construction of chemical manufacturing facility at an estimated investment of $28 million at Sandila in Uttar Pradesh. The project is likely to be completed in 2021, subject to the availability of approvals," according to a statement from Berger Paints Chairman Kuldip Singh Dhingra at a recent annual general meeting of shareholders.

Berger Paints is present in the decorative, industrial paints, protective and powder coating categories. It has 12 paint manufacturing units now (including its latest unit in Assam) with an annual installed capacity of 720,000 tons. **CW**

Uzbekistan Set to Become Coatings Exporter

by Vladislav Vorotnikov
Russia Correspondent



Uzbek President Shavkat Mirziyoyev has instructed the national government to boost the production of the domestic coatings by a factor of four times roughly to 600,000 tons per year in the next few years. With these production quantities, Uzbekistan targets to become the biggest coatings exporter in Central Asia.

This is a part of a comprehensive program of the building industry development in Uzbekistan, Mirziyoyev signed early June 2019. In addition to expanding coatings production, Uzbek President ordered to raise the production of wallpapers by a factor of 47 times, parquet by a factor of 19 times from the current level as well as to significantly boost the production of other building materials. Basically, under this program, the production quantities must be raised in every particular segment of the domestic building industry.

The government will fully reimburse the interest rate on loans taken under the new investment projects in the coatings industry before July 1, 2022, the program stipulated. Aside from this, all coatings plants in Uzbekistan would be exempted from the payment of import duties on imported raw materials at least until Jan. 1, 2021.

To supervise the project the Uzbek government plans to create a Science and Engineering Board jointly with the national building industry association O'zsanoatqurilishmateriallari. The new body among others is called to propose adjustments to the national legislation that would give an additional growth impetus to the industry.

Basically, over the past two years there was a 70 percent hike in operations in the domestic building industry, the national government estimated. Although there were some major achievements in the area of import-replacement, a broad range of construction materials, including coatings, is still being imported into the country.

"Giving the gradually increasing amount of creative efforts [construction operations] in Uzbekistan, the building materials industry should become a leading industry, one of the points of economic growth in the country. Through the introduction of energy-efficient technologies at industrial facilities, it is possible to save our natural wealth and reduce the cost of materials," Mirziyoyev said.

The state aid to the industry in the next several years is expected to be approximately $2 million, Mirziyoyev added. The main emphasis should be made not only on increasing the production quantities, but also on making production highly efficient, including through the introduction of the energy saving solutions and promoting products of the Uzbek origin on the foreign markets.

In particular, the Uzbek government is currently considering subsidizing logistics costs associated with the delivery of construction materials, including coatings to the non-Uzbek customers, O'zsanoatqurilishmateriallari said in a statement on its website May 14.

In addition, in order to fuel the growth in the industry the government targets to stimulate the expansion of the raw material base. So far Uzbekistan has been primarily importing almost all raw materials for the coatings industry, but the country has huge resources and huge plans to boost production in the chemical industry.

Economy crisis takes a toll

The overall sales of coatings in Uzbekistan ranged between 240,000 and 290,000 tons per year over the past decade. The country meets the domestic demand by slightly more than 50 percent, producing from 140,000 to 150,000 tons per year. The average coatings consumption in 38-million Uzbekistan is nine kg per capita, which is lower as compared to Russia, Belarus or Ukraine, but noticeably higher than in neighboring Central Asian countries.

Coatings production in Uzbekistan has

been steadily growing at least until 2014, said Tohtasyun Jalilov, a spokesperson for O'zsanoatqurilishmateriallari. It was estimated that the overall sales on the market were increasing by nine percent per year, and the domestic production was growing even faster.

In 2011, the Uzbek government has adopted a new importing policy, subjecting imports of a broad range of different coatings to a protective import duty of $0.5 per kg. This was called to ensure that all market players, both importers and local manufacturers, had equal opportunities, Jalilov said. At that time, the coating industry in Uzbekistan was considered to be investment-attractive with numerous foreign companies were mulling plans to build coatings plant in the country, Jalilov said.

It is believed that the Uzbek coatings industry has been heavily impacted by the economic crisis in the post-Soviet space in 2014. The country experienced certain difficulties associated with the fast devaluation of the national currency and the shrinking flow of money transactions of Uzbek citizens living and working in Russia.

For instance, in 2013 these transactions accounted for 12 percent of Uzbekistan GDP. In 2015, they collapsed by 54 percent as compared to 2013 to $3.06 billion, Russian Central Bank estimated. This proved to be a major blow for the Uzbek economy and lowered the demand for a broad range of different goods on the domestic market.

The economic difficulties in the country were among the factors that had put an end to the Tashkent Coatings Plant, one of the oldest coatings manufacturers in Central Asia. Production had been stopped in 2015 reportedly because it was running old equipment and was manufacturing coatings that were not matching the modern requirements on the market.

The Tashkent Coatings Plant was occupying the territory of around 20 ha, according to Bahadyr Bakiev, a spokesperson for the regional government. From that space, 2 ha have been purchased by the Uzbek-Polish joint venture Tehnocolour that planned to begin producing coatings, Bakiev said.

Although there is no official statistical data, it is believed that several other coatings manufacturers in Uzbekistan ceased to exist. Prior to the 2014 crisis, there were 10 major coatings plants in the country, with the biggest being Lok Kolor Sintez, Tashkent Lok Buek Savodi, East-Kolor and Link Paints Trading, O'zsanoatqurilishmateriallari reported. In addition, roughly 20 percent of coatings in the country were manufactured by small-scale companies.

Achieving the declared goals Uzbekistan would be able to not only fully meet the domestic demand on coatings, but also to establish some export supplies.

The country has been importing coatings primarily from Russia and the European Union, with small quantities have been also supplied by South Korea, O'zsanoatqurilishmateriallari estimated. All imported production in Uzbekistan is considered to be of premium quality and the imported coatings are not an exception.

"Uzbekistan could really take advantage from exporting coatings to Kyrgyzstan, Tajikistan and Turkmenistan and possibly to Afghanistan," commented a source in the Uzbekistan government. "In truth, we are not expecting to export a lot, since the main goal of the [new government] program is to meet the domestic demand, and, which is also very important, to increase the domestic demand by increasing the volume of affordable products on the market".

"We believe that export supplies could be of interest primarily to the non-Uzbek investors who would opt to open their production facilities in our country," the source added.

Over the past few years, Uzbekistan has been putting a lot of efforts to attract some foreign investors into the domestic economy. In February 2019, the national government announced that the Malaysian coatings manufacturer KCC Paints Sdn. Bhd. might invest some money into building a coatings plant in the country.

KCC Paints Sdn. Bhd was going to send an expert team to Uzbekistan to consider building the plant, the government reported. Although no additional details have been given the government noted that the plant may be built at a territory of Hazorasp free economic zone.

Hazorasp was established by Shavkat Mirziyoyev in 2017 with the main objective to attract direct foreign investments and to create some modern production capacities and for import-replacement of the products with high added value.

The idea of the project was that in exchange for investments the foreign company could get residency status in the free economic zone, which involves some substantial tax breaks and other bonuses.

In addition, starting from 2019 Uzbekistan reduced the income tax for the companies exporting more than 15 percent of the products manufactured in the country.

Mirziyoyev has also established a National Export Agency with the main goal to promote products of the Uzbek-origin on the foreign markets. The new body began operating in early 2019 and has an annual budget of $15 million.

Uzbekistan took a course towards an increase in export supplies in all possible directions in 2017 when the exchange rate of the national currency slumped by nearly 100 percent. Giving this, export supplies are believed to be of a great benefit for the local companies. ***CW***

Uzbekizstan targets to get rid of the import dependence on coatings

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Exhibitors as of May 1, 2019

1st Source Research
3M
Aal Chem
ACT Test Panels LLC
AlberdingK Boley USA
Allnex
American Coatings Association
American Colors, Inc.
Applied Graphene Materials UK Ltd.
Arkema Coating Resins
ArrowPoint Corp.
Austin Chemical Company, Inc.
BASF/Azelis
Birla Corporation
Borchers
Breckenridge Technologies
Brenntag North America
Buhler Inc.
Burgess Pigment Company
Cardolite Corporation
Chitec Technology Co., Ltd.
Chromaflo Technologies
Clariant
Coatings World Magazine
Covestro LLC
Croda
CVC/Emerald Performance Materials, LLC
DataPhysics Instruments USA Corp.
DCC Lansco
DKSH North America
Dorsett & Jackson
DOW
Dowd and Guild Inc.
DURA - Jesons
Elementis
Elevance Renewable Sciences
EMCO Chemical Packaging
Emerald Kalama Chemical
EPS
Essential Polymers
Ethox Chemicals
Evonik CAD
FlackTek, Inc.
Formulaction Inc.
FP-Pigments, Inc.
Gelest, Inc.
Heubach/Heucotech
Hexion Inc.
Hockmeyer
Horn, an IMCD Company
ICL / HALOX
IGM Resins
Imerys
Interpolymer Corp.
JF Shelton Company
keim additec surface USA
KH Neochem Americas, Inc.
King Industries, Inc.
Lanxess IPG
LANXESS MMP
Lintech International
Lonza
Lubrizol Advance Materials
Mallard Creek Polymers, Inc.
Maroon Group LLC
Michelman
Micro Powders, Inc.
Montello / DKS
Morehouse Cowles
MXD Process
Omya Inc.
OPC Polymers
Orion Engineered Carbons
Palmer Holland
Pan Technology Inc.
Paramount Colors Inc.
PATCHAM USA LLC
Peninsula Polymers
Pilot Chemical Co.
PQ Corporation
Radia Products
Ravago Chemicals
Reinsate Materials Group
Reitech Corporation
S.E.O. (Surface Electro Optics)
Sasol Performance Chemicals
Scott Bader Inc.
Shamrock Technologies
Shin-Etsu MicroSi, Inc.
Shrieve Miami Chemical
Siltech
Silver Fern Chemical
Solvay
Specialty Polymers
Stepan Company
Stonebridge Coatings Laboratory, Inc.
Tarr LLC
TCR Industries
Tempo Chemicals and Solutions
The Terra Firma Company LLC
Thor Specialties
Trans Western Chemicals
TRiiSO
Trinseo
Troy Corporation
Union Specialties Inc.
United Soybean Board/Omni Tech Intl
Univar Solutions
Venator
Vencorex US Inc.
Vinavil
WAB US Corp.
Wacker Chemical Corp.
Wanhua Chemical (America) Co., Ltd.
X-Rite Pantone

COATINGS WORLD
The Resource for the Global Coatings Industry

Top Companies Report

Coatings World is proud to bring the industry our annual Top Companies Report – the only truly global ranking of the top manufacturers of paint and coatings. Our editorial staff has spent many hours researching the industry to provide our readers with the most accurate ranking of paint and coatings manufacturers operating in the global industry. Rankings are based on annual sales in U.S. dollars. For companies based outside the U.S., sales are translated into U.S. dollars using exchange rates from the company's fiscal closing date. For privately held companies who choose not to disclose sales figures, our staff interviews different industry sources coupled with our own research to come up with an accurate estimate of annual sales. We profiled 82 companies in this year's report. All have sales of $100 million or more annually. Companies marked with an asterisk in the ranking on the following page represent *Coatings World* estimate. Bold companies are those making their first appearance as a Top Company. Two companies have been removed from the list this year: J.W. Ostendorf, which was acquired by Hempel and Whitford, which was acquired by PPG. This year we have added six companies to the list: three from Germany, one from the U.S. and two from China.

The Top Companies Report is intended to provide our readers with a snapshot of the industry's most influential players. We hope you will come away with a clearer insight into the future of this truly global and always evolving industry. If you are a paint and coatings manufacturer with sales of $100 million or more for fiscal 2018 and would like to be included in our Top Companies Report, contact me and I will add your company to the online version.

- Kerry Pianoforte, *Editor*

First Timers

Bardese • Dold • ICP Group • MIPA • Remmers • Xiangjiang Paint Group

Take-out Companies

J.W. Ostendorf • Whitford

2019 Top 20

01 PPG • 02 Sherwin-Williams • 03 AkzoNobel • 04 Nippon Paint • 05 RPM • 06 Axalta • 07 BASF • 08 Kansai Paint • 09 Asian Paints • 10 Jotun • 11 Masco • 12 Hempel • 13 DAW • 14 Berger Paints • 15 Benjamin Moore • 16 Ace Paint • 17 DuluxGroup • 18 Kelly-Moore • 19 SK Kaken • 20 Chugoku

2019 Top Companies

01. PPG (USA)	$15.4 billion
02. Sherwin-Williams (USA)	$12.1 billion*
03. AkzoNobel (The Netherlands)	$10.36 billion
04. Nippon Paint (Japan)	$5.6 billion
05. RPM (USA)	$5.3 billion
06. Axalta (USA)	$4.7 billion
07. BASF (Germany)	$4.3 billion
08. Kansai Paint (Japan)	$3.9 billion
09. Asian Paints (India)	$2.75 billion
10. Jotun (Norway)	$2.1 billion
11. Masco (USA)	$1.8 billion*
12. Hempel (Denmark)	$1.49 billion
13. DAW (Germany)	$1.447 billion*
14. Berger Paints (India)	$1.080 million
15. Benjamin Moore (USA)	$921 million*
16. Ace Paint (USA)	$900 million*
17. DuluxGroup (Australia)	$899 million
18. Kelly-Moore (USA)	$860 million*
19. SK Kaken (Japan)	$830 million
20. Chugoku (Japan)	$802 million
21. Shawcor (Canada)	$700 million*
22. KCC (South Korea)	$700 million*
23. Beckers Group (Germany)	$670 million
24. Dai Nippon Toryo (Japan)	$661 million
25. Tikkurila (Finland)	$650 million
26. Shangahia Huayi Fine Chemical (China)	$585 million*
27. Brillux (Germany)	$558 million*
28. Xiangjiang Paint Group (China)	**$538 million**
29. Nihon Toksuhu (Japan)	$536 million*
30. Fujikura Kasei (Japan)	$502 million
31. TOA Group (Thailand)	$484 million
32. Noroo (South Korea)	$482 million
33. Teknos Group (Finland)	$457 million
34. Cromology (France)	$452 million
35. National Paint Factories (Jordan)	$427 million
36. Mankiewicz (Germany)	$395 million
37. Musashi Paint (Japan)	$375 million*
38. Carpoly (China)	$373 million
39. Betek Boya (Turkey)	$360 million
40. Origin Electric (Japan)	$344 million
41. Ennis Flint (USA)	$340 million*
42. Tiger Coatings (Austria)	$330 million
42. Bardese Chemical (China)	**$330 million**
44. Pacific Paint Boysen (The Phillipines)	$290 million*
45. Cloverdale Paint (Canada)	$284 million
46. Karworwag (Germany)	$277 million
47. CIN (Portugal)	$277 million
48. Flugger Group (Denmark)	$272 million
49. Lanco Paints (USA)	$270 million
50. Taiho Paint (China)	$263 million
51. Meffert (Germany)	$254 million*
52. ICP Group (USA)	**$250 million**
53. Samhwa (South Korea)	$247 million
53. Daoqum (China)	$247 million
55. SKSHU Paint (China)	$243 million
56. Yasar (Turkey)	$238 million
57. Grebe (Germany)	$237 million
58. Pintuco (Colombia)	$233 million
59. Bauhinia (China)	$232.6 million
60. Remmers (Germany)	**$226 million**
61. Rock Paint (Japan)	$222.9 million
62. Kikusui Chemical (Japan)	$205 million
63. Tambour (Israel)	$200 million*
64. MIPA (Germany)	**$199 million**
65. RAR Holdings (UAE)	$198.3 million
66. Kapci Coatings (Egypt)	$180 million
67. Frei Lacke (Germany)	$171 million*
68. Natoco (Japan)	$162 million
69. Dold Gruppe (Germany)	**$155 million**
70. Sniezka (Poland)	$153 million
71. Diamond Vogel (USA)	$150 million*
72. ICA Group (Italy)	$132 million
73. Shinto Paint (Japan)	$130 million*
73. Industrias Titan (Spain)	$130 million*
75. Kangman Jevesco (South Korea)	$129 million
76. Adler-Werk Lackfabrik (Germany)	$129 million
77. Asahipen (Japan)	$125 million
78. Tnemec (USA)	$124 million
79. Kayalar Kimya (Turkey)	$123 million*
80. Russian Coatings (Russia)	$110 million
81. Tohpe (Japan)	$107 million
82. WEG (Brazil)	$100 million*

2019 Top Companies

ALPHABETICAL LISTING

16 ACE PAINT
75 ADLER-WERK LACKFABRIK
3 AKZONOBEL
77 ASAHIPEN
9 ASIAN PAINTS
6 AXALTA
42 BARDESE CHEMICAL
7 BASF
59 BAUHINIA
23 BECKERS GROUP
15 BENJAMIN MOORE
14 BERGER PAINTS
39 BETEK BOYA
27 BRILLUX
38 CARPOLY
20 CHUGOKU
47 CIN
45 CLOVERDALE PAINT
34 CROMOLOGY
24 DAI NIPPON TORYO
53 DAOQUM
13 DAW
71 DIAMOND VOGEL
69 DOLD GRUPPE
17 DULUXGROUP
41 ENNIS FLINT
48 FLUGGER GROUP
67 FREI LACKE
30 FUJIKURA KASEI
57 GREBE
12 HEMPEL
72 ICA GROUP
52 ICP GROUP
74 INDUSTRIAS TITAN
10 JOTUN
75 KANGMAN JEVESCO
8 KANSAI PAINT
66 KAPCI COATINGS
46 KARWORWAG
79 KAYALAR KIMYA
22 KCC

18 KELLY-MOORE
62 KIKUSUI CHEMICAL
49 LANCO PAINTS
36 MANKIEWICZ
11 MASCO
51 MEFFERT
64 MIPA
37 MUSASHI PAINT
35 NATIONAL PAINT FACTORIES
68 NATOCO
29 NIHON TOKSUHU
4 NIPPON PAINT
32 NOROO
40 ORIGIN ELECTRIC
44 PACIFIC PAINT BOYSEN
58 PINTUCO
1 PPG
65 RAR HOLDINGS
60 REMMERS
61 ROCK PAINT
5 RPM
80 RUSSIAN COATINGS
53 SAMHWA
26 SHANGAHIA HUAYI FINE CHEMICAL
21 SHAWCOR
2 SHERWIN-WILLIAMS
73 SHINTO PAINT
19 SK KAKEN
55 SKSHU PAINT
70 SNIEZKA
50 TAIHO PAINT
63 TAMBOUR
33 TEKNOS GROUP
42 TIGER COATINGS
25 TIKKURILA
78 TNEMEC
31 TOA GROUP
81 TOHPE
82 WEG
28 XIANGJIANG PAINT GROUP
56 YASAR

01. PPG

Pittsburgh, Pennsylvania/USA
www.ppg.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1883

REVENUE: $15.4 billion ▲ (2017: $14.8 billion)

MARKETS SERVED

Aerospace; Architectural coatings - Americas and Asia Pacific; Architectural coatings - Europe, Middle East and Africa; Automotive OEM coatings; Automotive Refinish; Industrial coatings, Packaging coatings; Protective and Marine coatings; Specialty coatings and materials

KEY EXECUTIVES:

Operating Committee Michael H. McGarry, chairman and CEO; Anne M. Foulkes*, senior VP and general counsel; Vincent J. Morales*, senior VP and CFO; Juanjo Ardid, VP, Protective and Marine Coatings, United States and Canada; David S. Bem*, VP, Science and Technology and chief technology officer; Gregory B. Benckart, VP, Automotive Refinish, Americas; Karl H. Bergström, VP, PPG Architectural Coatings, Latin America and President, PPG Comex; Kevin D. Braun, VP, Industrial Coatings, Americas; Donna J. Broome, VP, Architectural Coatings, Trade, United States and Canada; Mark Cancilla, VP, Environment, Health and Safety; Christopher R. Caruso, VP, Information Technology; David J. Cole, VP, Architectural Coatings, United States and Canada (retiring July 31, 2019) to be succeeded by Jaime Irick, VP, Architectural Coatings, United States and Canada; Gary R. Danowski*, VP, Global Automotive Refinish; Jeffrey C. Davies, VP, Corporate Development; Amy R. Ericson*, senior VP Packaging Coatings and Specialty Materials; Chancey E. Hagerty*, VP, Global Industrial Coatings; Bryan N. Iams, VP, Corporate and Government Affairs; Anup Jain, VP, Specialty Coatings and Materials; John A. Jankowski, VP and Treasurer; Roald Johannsen, VP, Automotive OEM Coatings, Europe, Middle East and Africa; Diane M. Kappas, VP, Automotive OEM Coatings, Americas; Timothy M. Knavish*, senior VP, Architectural Coatings and president, PPG Europe, Middle East and Africa; Daniel G. Korte*, global VP, Aerospace; Raj Lall, VP, Strategic Manufacturing, Industrial Coatings; Rebecca B. Liebert*, senior VP Automotive Coatings; Adriana Macouzet, VP, PPG Latin America and GM, Protective and Marine Coatings, Latin America; Kumar Nandan, VP, Tax; Vincent Robin, president, PPG Asia/Pacific and vice president, Automotive Coatings, Asia/Pacific; Devashish Saxena, VP and chief digital officer; William E. Schaupp, VP and controller; Hervé Tiberghien*, VP, Human Resources; Ram Vadlamannati*, senior VP, Protective and Marine Coatings; Jane N. Valenta, VP, Global Technical Architectural Coatings; Max Wetzel, VP, Business Transformation and Consumer Brands, Architectural Coatings, United States and Canada; Pauline Yuen, VP, Refinish Coatings, Asia/Pacific; Jérôme Zamblera, VP, Automotive Refinish, Europe, Middle East and Africa.

PPG is recognized and respected around the world as a leading paint, coatings and specialty materials manufacturer, providing technologically advanced solutions. PPG helps customers in industrial, transportation, consumer products, and construction markets and aftermarkets to enhance more surfaces.

PPG reported net sales of $15.4 billion in 2018. In 2018, Industrial Coatings comprised 41 percent of net sales, with Performance Coatings comprising 59 percent of net sales.

McGarry

PPG's Performance Coatings and Industrial Coatings reportable segments supply coatings and specialty materials for customers in a wide array of end-use markets, including industrial equipment and components, packaging material; aircraft and marine equipment; automotive original equipment; as well as for other industrial and consumer products. In addition to supplying coatings to the automotive OEM market, PPG supplies refinishes to the automotive aftermarket. PPG also serves commercial and residential new build and maintenance markets by supplying coatings to painting and maintenance contractors and directly to consumers for decoration and maintenance.

PPG operates in more than 70 countries worldwide. Its key global technical facilities include:

- Allison Park, Penn., USA: Global Coatings Innovation Center;
- Oak Creek, Wisc., USA: Industrial Customer Application Lab;
- Milford, Ohio, USA: Packaging Research;
- Burbank, Calif., USA: Aerospace Research;
- Mexico City, Mexico: Comex Research;
- Sumare, Brazil: Customer Application Lab;
- Marly, France; Ingersheim, Germany; Quattordio, Italy Automotive OEM Research Centers
- Amsterdam, the Netherlands: Architectural/Protective and Marine Coatings Research Center;
- Milan, Italy: Automotive Refinish Research;
- Busan, South Korea: Customer Application Lab;
- Tianjin, China: Global Competitive Sourcing Lab and Customer Application Lab;
- Clayton, Australia: Customer Application Lab

Key Happenings in 2018

- Jan. 2018: Acquired ProCoatings, a leading architectural paint and coatings wholesaler located in The Netherlands;
- Jan. 2018: Acquired Paintzen, a technology platform that facilitates residential painting transactions;
- Oct. 2018: Acquired Hodij Coatings, a leading distributor of well-known professional paint brands based in The Netherlands;
- Dec. 2018: Completed the acquisition of SEM, a U.S.-based manufacturer of specialized automotive refinish products;
- March 2019: Completed the acquisition of Whitford Worldwide Company, a global manufacturer that specializes in low-friction and nonstick coatings for industrial applications and consumer products;
- April 2019: Completed the acquisition of Hemmelrath, an automotive coatings manufacturer

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02. Sherwin-Williams

Cleveland, Ohio/USA
www.sherwin-williams.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1866

REVENUE: $12.1 billion ▲ (2017: $11.5 billion)

(Note: Sherwin-Williams reported total revenue of $17.53 billon for fiscal 2018. However, for purposes of this report, sales of painting tools and equipment are not reported as part of coatings revenue. The above is *Coatings World's* estimate.)

MARKETS SERVED

Architectural coatings; Industrial coatings; Protective and marine coatings; OEM product finishes; Wood finishes; Aerospace coatings

KEY EXECUTIVES:

John Morikis, chairman and CEO; David B. Sewell, president and COO; Allen J. Mistysyn, senior VP – finance and CFO; Mary Garceau, senior VP, general counsel and secretary; Jane Cronin, corporate controller.

The Sherwin-Williams Company reported $17.53 billion in net sales for 2018. Minus the sale of painting tools and equipment, *Coatings World* estimates the company's paint and coatings sales to be approximately $12.1 billion.

Sherwin-Williams manufactures products under well-known brands such as Sherwin-Williams, Valspar, Dutch Boy, HGTV HOME by Sherwin-Williams, Krylon, Minwax, Cabot, Thompson's Water Seal and more. With global headquarters in Cleveland, Ohio, Sherwin-Williams branded products are sold primarily through more than 5,100 company-operated stores and facilities, while the Company's other brands are sold through leading mass merchandisers, home centers, independent paint dealers, hardware stores, automotive retailers and industrial distributors.

The company is comprised of three reportable segments. The Americas Group comprises 55 percent of total sales and operates the exclusive outlets for Sherwin-Williams branded paints, stains, supplies, equipment and floor covering in the U.S., Canada and the Caribbean. The Americas Group also manufactures and sells a wide range of architectural paint, industrial coatings and related products across Latin America through company-operated stores and dedicated dealers. Consumer Brands Group comprises 16 percent of total sales and sells one of the industry's most recognized portfolios of branded and private-label products through retailers across North America and in parts of Europe, Australia, New Zealand and China, and also operates a highly efficient global supply chain for paint, coatings and related products. Performance Coatings Group comprises 29 percent of total sales and sells a wide range of industrial coatings and finishes to general industrial, industrial wood, protective and marine, coil & extrusion, packaging and automotive customers in more than 120 countries.

In the company's annual report CEO John Morikis reported that Sherwin-Williams delivered record performance across many measures in 2018, including sales, earnings before interest, taxes, depreciation and amortization (EBITDA), and net operating cash. "Our success stems from our continued focus on innovative products and services to help our customers improve their productivity, profitability and projects.

Leadership changes

The company's Board of Directors recently elected David B. Sewell to serve as president and chief operating officer.

Sewell has served as Sherwin-Williams' president, Performance Coatings Group, since August 2014. Sewell will report to John G. Morikis, who will continue as chairman and CEO.

Morikis

Sewell has held numerous key leadership positions since joining Sherwin-Williams in February 2007. He previously served as president and GM, Product Finishes Division, Global Finishes Group from July 2012 to August 2014. Sewell joined Sherwin-Williams after spending 15 years at General Electric Company.

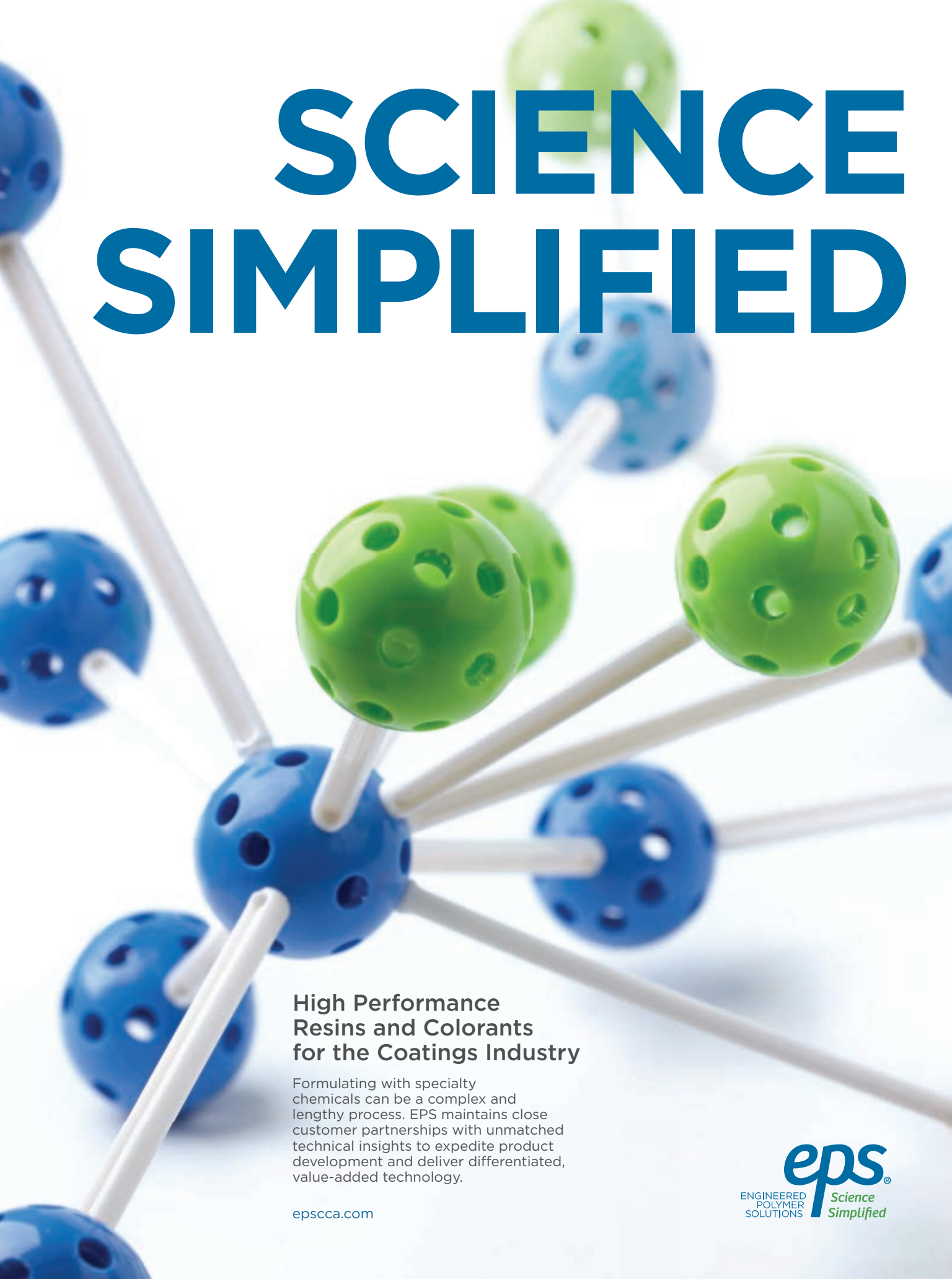
In his new role, Sewell will be responsible for all of Sherwin-Williams' operating segments, which includes The Americas Group, the Performance Coatings Group and the Consumer Brands Group.

"David has served as an important member of our senior leadership team for many years and is ideally suited to lead our global operations based on his deep industry knowledge and commitment to operational excellence and delivering value to our customers," Morikis said. "David's leadership capabilities and long record of consistently delivering strong results will help Sherwin-Williams continue focusing on our long-term objectives with the goal of creating exceptional value for all of our stakeholders."

Sherwin-Williams also announced that the Board has elected Aaron M. Erter as president, Performance Coatings Group, succeeding Sewell, and Robert F. Lynch as president, Consumer Brands Group, succeeding Erter. Both positions are also effective March 1, 2019.

Erter joined Sherwin-Williams in June 2017 in connection with the Valspar acquisition. He has served as president, Consumer Brands Group since August 2017. Erter held the position of president and GM, Consumer Division, Consumer Brands Group from June 2017 to August 2017. Prior to joining Sherwin-Williams, Erter served as SVP of Valspar from December 2015 to June 2017 and VP and GM, North America of Valspar from November 2011 to December 2015.

Lynch has been employed with Sherwin-Williams since October 2000. He has served as president and GM, retail – North America, Consumer Brands Group since August 2017. Lynch held the position of SVP, sales, Automotive Finishes Division, Global Finishes Group from August 2012 to July 2017 and president and GM, Paint and Sundries, Diversified Brands Division, Consumer Group from November 2008 to August 2012.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03. AkzoNobel

Amersterdam, the Netherlands
www.akzonobel.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1994

REVENUE: $10.36 billion ▼ (2017: $11.46 billion)

MARKETS SERVED

Decorative paints; Marine and protective coatings; Auto and specialty coatings; Industrial and powder coatings

KEY EXECUTIVES:

Thierry Vanlancker, CEO, chairman of Board of Management and Executive Committee; Maarten de Vries, CFO and member of the Board of Management and Executive Committee.

AkzoNobel reported paint and coatings sales of $10.36 billion for 2018. The company has approximately 34,500 employees and more than 200 manufacturing facilities. North America comprises 12 percent of sales, mature Europe 34 percent, emerging Europe nine percnet, Asia Pacific 31 percent, South America nine percent and other five percent.

The company recently made a multi-million-dollar investment to its wood coatings facility in High Point, North Carolina. The transformation will involve reorganizing manufacturing operations at the site and will include the addition of automatic dosing unit technology to produce paint more efficiently. A new raw materials warehouse, research lab and technical application center are also being built. Construction is due to begin in April 2019, with rolling projects expected to be completed by 2020.

The High Point facility covers 30 acres and employs more than 250 people. The site produces a wide range of products, including UV, solvent-based and water-based wood coatings, such as paints, stains and lacquers.

Vanlancker

Business Highlights for 2018

- Working with the world's coolest innovators AkzoNobel created a major buzz in the coatings industry with the launch of its Paint the Future startup challenge. AkzoNobel wants to combine its global scale, know-how and expertise with the ingenious solutions of startups and scale-ups across the planet. According to the company it's all about connecting with new disruptive technologies and accelerating innovation in the dynamic world of paints and coatings. www.letspaintthefuture.com
- Asian acquisitions underline commitment to key markets. Two transactions in the final months of 2018 highlighted AkzoNobel's continued focus on further strengthening its positions in Asia. In December, the company acquired the minority interest share to obtain full ownership of the AkzoNobel Swire Paints joint venture, giving it greater control over its future growth and direction. A month earlier, the company acquired Colourland Paints in Malaysia, which will boost its growth ambitions in the country itself and throughout South-East Asia.
- Awlgrip HDT offers extreme performance for yacht owners. Yacht owners can now benefit from advanced coatings technology, which passed the ultimate test during the latest edition of the Volvo Ocean Race. AkzoNobel's new Awlgrip HDT (high definition technology) polyurethane clearcoat is not only more durable and abrasion-resistant than current market offerings, but it's also repairable and lower in VOCs.
- Boeing partnership reaches milestone Special aircraft livery was developed to mark a major milestone in our paint partnership with Boeing. To celebrate the delivery of Boeing's 787th 787 aircraft, AkzoNobel's industry-leading "base coat/clear coat" system was used as part of a one-off design painted onto the landmark plane, which was ordered by China Southern Airlines. Boeing also hit another milestone recently, delivering its 1,000th new aircraft to have been painted with our unrivalled Aerodur 3001/3002 paint system.
- AkzoNobel has reinforced its commitment to customers in India, following the inauguration of a new €9 million facility in Mumbai for the production of Powder Coatings
- Consumers in Pakistan now have access to Dulux Promise. AkzoNobel has launched a decorative paints product for the mass market segment
- Dulux Weathershield was relaunched in Asia featuring Smart Release Technology. This protects homes and buildings with even longer lasting protection against algae and fungus
- The most eye-catching car of the new Formula 1 season – McLaren's MCL33 – features innovative coatings supplied by AkzoNobel's Sikkens brand. This reduces the total weight of paint and decreases processing time by more than 50%
- AkzoNobel is developing a new high-performance antifouling technology, which uses ultraviolet light-emitting diodes to prevent marine growth. It features underlying technology developed by Royal Philips.

Recent acquisitions/divestitures

- The acquisitions of Xylazel in Spain and Doves Decorating Supplies in the UK were completed in September 2018.
- The acquisition of Fabryo Corporation S.R.L., was completed on Oct. 1, 2018
- The acquisition of Colourland Paints Sdn Bhd and Colourland Paints (Marketing) Sdn Bhd in Malaysia was completed in November 2018
- The acquisition of the minority interest share to obtain full ownership of the AkzoNobel Swire Paints joint venture in China was completed in December 2018
- The sale of the Specialty Chemicals business in October 2018.

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Basic & New
NIPPON PAINT HOLDINGS

04. Nippon Paint Co., Ltd.

Osaka, Japan
www.nipponpaint.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1881

REVENUE: $5.6 billion ▲ (2017: $5.4 billion)

MARKETS SERVED

Automotive coatings; Industrial coatings; Decorative coatings; Marine and Protective coatings

KEY EXECUTIVES:

Kenji Sakai, chairman of the board; Tetsushi Tado, president, representative director of the board; Manabu Minami, VP, representative director of the board; Hup Jin Goh and Kanji, directors of the board; and Nishijima, Mitsuo Yamada, VP, Nippon Paint Holdings.

Nippon Paint manufactures a wide variety of paints and coatings including those for automobiles, construction, architecture,wood, steel structures, ships, metal, electrical equipment, machinery, roadways and household appliances among others. Nippon Paint is one of the largest paint manufacturers in Asia and has 33 manufacturing plants and produces more than one million tons of paint and coatings annually.

Nippon Paint Marine introduced what is believed to be the world's first biocide-free, low friction self-polishing copolymer antifouling technology.

Aquaterras – a name derived from the Japanese word for shining and the Latin for water – is an entirely new type of marine coating developed using neither biocide materials nor silicone.

"Typically ships' antifouling paints have contained some form of biocide – copper, tributyltin, co-biocides. But the use of biocides today is strictly controlled by both national and international regulations such as the BPR in the EU," Nippon Paint Marine Director John Drew said. "And while there are no immediate plans to further regulate the use of approved biocides, we cannot rule out the possibility that copper in antifouling will be regulated in the near future.

"Nippon Paint Marine has always looked to develop systems that go beyond the regulations. And with Aquaterras our chemists have achieved the impossible – a truly effective and efficient long-life, self-polishing antifouling paint without the use of biocides," he added.

The technology adopts an advanced antifouling mechanism based around the anti-thrombogenic polymers used in the construction of artificial hearts and blood vessels in the medical sector.

The medical polymeric material was designed so that no biological substances or life would or could adhere to the surface so as to prevent blood clots (thrombosis). Using the technology in marine pants allows the new hydrolysis polymer reaction developed at Nippon Paint to continuously self-polishes. It also exposes active micro-domain structures to seawater ensuring that Aquaterras provides long-term antifouling performance.

Tado

"Biocides are normally comparatively heavy and rough in paint formulations but since Aquaterras is without such heavy pigments, we can achieve a remarkably glossy and smooth film is achieved," said Drew. "This smoothness is further enhanced by its in-service self-polishing. Unlike silicone types, Aquaterras can be applied simply without the need for costly and time-consuming masking. It can also be overcoated in the same way as today's SPC's and can even be applied onto existing SPC's if they are in good enough condition."

Registered as a tin-free antifouling paint, Aquaterras has received approvals from all the major classification societies and is certified with no active ingredients in its Type Approval Certification.

A full and comprehensive technical Dossier has been compiled to demonstrate the testing carried out by Nippon Paint over years of research.

Nippon Makes Two Major Acquisitions

Nippon Paint is acquiring Turkish paint manufacturer Betek Boya.

Betek Boya, known in Turkey for its "Filli Boya" brand of paint, was expected to see sales of 1.6 billion lira ($303 million) last year.

The value of the deal was not disclosed.

According to Turkish regulatory filings, German firm DAW holds nearly 25 percent of Betek's shares, while the majority stakeholder is the Akpinar family of Turkey.

Nippon also plans to acquire Australia's biggest paint maker, DuluxGroup, for $2.6 billion.

DuluxGroup is the top paint maker in Australia and New Zealand, with revenue totaling $1.3 billion in the year ending September 2018.

In a statement, DuluxGroup Chairman Graeme Liebelt said: "The board has carefully considered the strategic options available to DuluxGroup to maximize value, including continuing to pursue domestic and global growth as a stand-alone company, and we have unanimously concluded that the transaction with Nippon is in the best interests of our shareholders."

The acquisition will allow Nippon Paint to expand its global footprint, specifically in Oceania. The company generates 60 percent of its sales from Asia outside Japan, mainly in China.

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Lubrizol

05. RPM International Inc.

Medina, Ohio/USA
www.rpminc.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1947

REVENUE: $5.3 billion ▲ (2017: $5 billion)

MARKETS SERVED

Roofing systems; Caulks and sealants; Flooring systems; Corrosion control coatings; Primers-sealers; Specialty paints; Hobby and craft paints; Wood stains and finishes; Rust-preventative paints

KEY EXECUTIVES:

Frank C. Sullivan, chairman and CEO; Terry Horan, Consumer Products Group; John McLaughlin, Specialty Products Group; Paul Hoogenboom, Construction Products Group; David Dennsteadt, Performance Coatings Group.

RPM International Inc. is a multinational holding company with subsidiaries that manufacture and market high-performance coatings, sealants, and specialty chemicals, primarily for maintenance, repair and improvement applications. RPM reported revenue for 2018 of $5.3 billion. The company employs approximately 14,500 people and has 145 facilities in 26 countries. In fiscal 2018, the company's industrial products accounted for 53 percent of its total coating sales, consumer products represented 33 percent and specialty coatings represented 14 percent. The Industrial segment's operating groups include Tremco, Stonhard, Carboline and Tremco illbruck. The Specialty segment's operating groups are Day-Glo, Dryvit, Mohawk, and Petit. The Consumer segment's operating groups include Rust-Oleum Group, DAP, Varathane, Zinsser, and Testors.

RPM has a diverse portfolio with hundreds of brand name products, many of which hold the leadership position in terms of market share and sales in the markets they serve.

According to the company, brand leadership affords RPM's operating companies a number of advantages, including the ability to command premium pricing, shorten sales cycles and gain repeat purchases due to brand loyalty. The following products were recently launched:

- Factor 4 by Rust-Oleum is a new synthetic car wax system with superior protection delivers a showroom shine that protects up to three years;
- Modern Masters has rolled out a line of Exterior Metallics for professional painters and serious DIYers.The Exterior Metallic Paint program offers excellent durability, easy application and fast dry times.

Carboline has launched Carbomastic 615 MC, an outstanding surface tolerant epoxy mastic with low VOC's. It cures fast, at low temperatures, with ultra-low VOC and ultra-low HAPs emissions. It's ideal for industrial maintenance and new construction for customers where VOC limits are below 100 g/l. Carbomastic 615 MC has outstanding tolerance for marginal surface preparation and provides superb corrosion protection.

Key Brands:

- Rust-Oleum: No. 1 brand recognition and market share position in the U.S. and Canada in the rust-preventative, decorative, specialty and professional segments of the small-project paint category;
- Varathane: No. 1 market position in Canada and No. 2 in the U.S. offering interior wood stains, finishes, wood repair and maintenance products;
- Zinsser: A leader in brand recognition and market share position in the U.S. market for specialty primers and sealers and wallcovering sundries;
- Pettit: The global market leader in water-based antifouling paints for the marine industry;
- Stonhard: No. 1 global supplier of industrial, high-performance polymer flooring systems;
- Carboline: Leading global supplier of industrial, high-performance corrosion control coatings

Fiscal 2019 acquisitions:

- Mean Green branded line of specialty cleaning products;
- Exclusive North American licensing for Roto-Rooter branded drain care products;
- Nudura Corporation, the leading manufacturer and distributor of insulated concrete forms (ICF) in North America;
- Siamons International Inc., provider of the Concrobium brand of non-toxic specialty mold cleaners.

RPM Announces Three Senior Promotions as Part of Organizational Realignment

RPM International Inc. has promoted Lonny DiRusso to vice president and chief information officer, Matthew Franklin to vice president – information technology, and Gordon Hyde to vice president – operations.

In his new role, DiRusso will be responsible for ensuring that RPM's corporate-wide IT program aligns with its overall strategic vision. He will report directly to Frank C. Sullivan, the company's chairman and chief executive officer. Prior to this promotion, DiRusso held the position of vice president – information technology at RPM for the past 13 years and, before that, the titles of director – information technology and management information systems manager.

As VP – IT, Franklin will be responsible for day-to-day IT support at RPM's corporate headquarters, providing senior oversight of IT initiatives companywide and managing its information security program. Having joined RPM 20 years ago, he previously held the position of senior director – IT operations. Franklin is a member of The Conference Board's CISO Council, where he serves on its executive committee.

In his new role, Hyde will be joining colleague Timothy Kinser, also recently appointed as vice president – operations, to team together to lead RPM's manufacturing, supply chain and procurement improvement initiatives. He will primarily be focused on driving manufacturing efficiencies, asset optimization and inventory improvement. Hyde began his career at RPM more than 20 years ago as vice president – operations for Zinsser, a former RPM operating company, and subsequently held similar positions at RPM and its Wood Finishes Group before joining RPM Specialty Products Group in 2015.

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06. Axalta Coating Systems

Philadelphia, PA/USA
www.axaltacoatingsystems.com

PUBLICLY HELD; YEAR ESTABLISHED: 2013

REVENUE: $4.7 billion ▲ (2017: $4.4 billion)

MARKETS SERVED

Automotive OEM; Collision repair; Industrial Coatings; Commercial Transportation

KEY EXECUTIVES:

Robert Bryant, CEO; Sean Lannon, SVP and CFO; Lynne Sprinkle, SVP and CHRO; Barry Snyder, SVP, CTO and interim chief supply chain officer; Michael Cash, SVP & president, Industrial; Eduardo Nardinelli, VP & president, Global Commercial Vehicle Coatings; Rajeev Rao, VP, Global Powder and Business Development/ Strategy, Industrial; Tabitha Oman, interim general counsel - VP, deputy general counsel and chief compliance officer; Michael Carr, VP & president, Americas; Steve Markevich, EVP & president, Transportation; Willie Wu, president Greater China; Sobers Sethi, VP & president, Emerging Markets; Dave Heflin, VP, Global Industrial Coating Systems; Ashish Jawadiwar, VP, chief information & digital officer; Yves Kerstens VP, & president, EMEA.

Axalta Coating Systems is a global supplier of coatings to the transportation and industrial sectors. The company posted sales of $4.7 billion for 2018. Transportation Coatings (light vehicle OEM and commercial vehicles) comprised $1.7 billion of sales and Performance Coatings (industrial and refinish) comprised $3 billion. The company currently employs approximately 14,000 people and has 50 manufacturing locations globally, producing liquid or powder coatings. Axalta has a total of 47 customer training facilities globally

During the year ended Dec. 31, 2018, Axalta successfully completed seven strategic acquisitions, including two based in Asia Pacific, two based in North America, and three based in Europe, all of which benefited its Performance Coatings segment.

State of the Coatings Industry – Autonomous Vehicles

Barry Snyder, SVP, CTO and interim chief supply chain officer.

Axalta is fully invested in building the autonomous future, and reflective coatings serve as a key enabler of getting us there.

Reflectivity is a key component behind LiDAR, a crucial technology used to power self-driving cars. Self-driving cars use laser lights that bounce off objects to detect them – like radar or sonar. Different colors have different levels of reflectivity. True white is 100 percent reflective, meaning all the light bounces back, and true black is zero percent reflective, meaning all the light is absorbed by the object.

According to Axalta's 2018 Global Automotive Color Popularity Report, solid white and pearl or effect white coatings are the world's most popular colors at 38 percent of all cars painted. This number has grown over the past seven years, where in 2012, only 23 percent of the world's cars were white shades. This data led to the selection of our 2018 Automotive Color of the Year, StarLite, a light and reflective shade of white formulated with synthetic pearl flakes to create an eye-catching pearlescent effect, and 100 percent compatible with the needs of an autonomous vehicle future.

While the data shows promising growth, our report ultimately shows that customers care about the color of their vehicles. This sacrifice of color choice may impact the adoption rate of self-driving cars in the future. Of the 263 million vehicles in the United States, we believe that more than 60 percent of them are not 100 percent reflective.

In fact, 18 percent of the world's cars are black. Colors that contain black pigments are thought to be very aesthetically pleasing. But black coatings are less than two percent reflective and the sensors on an autonomous car 200 meters away would not be able to detect a black vehicle. Currently, the minimum "sight" distance for LiDAR to achieve safe autonomy at highway speeds is 200 meters. The current technology is good but not perfect – and it may take 15-20 years before fully autonomous.

2018 Success Story:

In November 2018, Axalta celebrated the opening of its Global Innovation Center (GIC) in Philadelphia, PA, the largest color and coatings R&D center in the world. The 175,000-square-foot Center is now the central hub for Axalta's global research, product development, and technology initiatives. At the GIC, more than 200 engineers and scientists develop Axalta's most innovative coatings products in the world for automobiles, buildings, motorcycles, football helmets, appliances, trucks, and many other items used in people's lives every day. The company's innovative coatings are virtually everywhere.

Axalta's GIC is in Philadelphia's historic Navy Yard, which is the City's hub for innovation. The GIC's proximity to other of Axalta's key local sites, including the company's global and North American headquarters, enables collaboration among Axalta employees, business partners, and customers throughout the Philadelphia area, the country, and the world.

"Axalta's team of scientists and technicians at the Global Innovation Center will develop next-generation coatings products and keep pace with emerging application needs," said Barry Snyder, Axalta's chief technology officer. "Regulations and customer demands call for newer, technologically advanced coatings. The increasing use of lightweight plastic and composite materials in vehicles to save fuel requires new coatings formulations. Developing products to suit these and other needs will be the mission of the Global Innovation Center and Axalta's worldwide research and development network."

Whether in color technology, polymer and formulation chemistry, or application knowledge, the world-class capabilities and talent at Axalta's GIC will fuel new products and deliver the solutions necessary to delight customers and drive growth at Axalta.

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Performance Chemicals Business Unit is responsible for developing, manufacturing and marketing high performance chemical products. The production sites are located in Yantai, Ningbo and Czech Republic. Currently the portfolio includes aliphatic products (HDI, HDI adducts, HMDI, IPDI, H_6XDI), special amine products (MDA, MDBA, H_{12}MDA, IPDA and PU catalyst), silicone and special performance chemical products (IP, MIBK, CDT).

Wanhua Chemical Group Co., Ltd.

Add: No.17, Tianshan Road, YEDA, Yantai, 264006, China Tel: +86-535-3388000 Web: www.whchem.com/en/

07. BASF Coatings

Muenster, Germany
www.basf-coatings.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1865

REVENUE: $4.3 billion ▼ (2017: $4.6 billion)

MARKETS SERVED

Automotive OEM; Automotive refinish; Commercial vehicles; Industrial coatings

KEY EXECUTIVES:

Dirk Bremm, president BASF Group`s Coatings division; Thomas Kloster, Automotive OEM Coatings Solutions Europe; Katja Scharpwinkel, Automotive Refinish Coatings Solutions Europe; Chris Toomey, Coatings Solutions North America; Marcos Allemann, business management Decorative Paints Solutions South America; Patrick Zhao, Coatings Solutions Asia Pacific; and Martin Jung, Surface Treatment.

With an investment of approximately €34 million, the new 5,000-square-meter facilities include the Automotive Application Center and the Process Catalysis Research & Development (R&D) Center.

BASF Coatings is a division of BASF SE. BASF's Coatings division is a global expert in the development, production and marketing of innovative and sustainable automotive OEM and refinish coatings, decorative paints as well as applied surface treatments for metal, plastic and glass substrates in a wide range of industries. BASF shares skills, knowledge and resources of interdisciplinary and global teams for the benefit of customers by operating a collaborative network of sites in Europe, North America, South America and Asia Pacific. In 2018, the Coatings division achieved global sales of about €3.86 billion. Europe represents 38 percent of total sales, Asia Pacific 26 percent, North America 22 percent and South America, Africa and the Middle East 14 percent.

With AUROOM, BASF's Coatings division introduced a digital platform which enables OEM designers to access a database of photo-realistic virtual car colors. BASF's virtual colors capture all facets of automotive coatings including lightness flop, color flop and sparkling. By mapping these colors on car models, OEM designers can virtually paint every color proposal and gain realistic impressions of colors and effects on a complete car already in an early design phase. AUROOM will be a valuable tool for OEM designers to speed up and perfect the overall color design process as they are no longer solely dependent on physical samples that need to be painted and shipped. In the startup phase, BASF's virtual color solution will first be introduced to OEMs in EMEA.

BASF is enhancing its regional innovation capabilities with new facilities at the Innovation Campus Shanghai, to further strengthen collaboration with the automotive industry and to offer new process catalysts to the chemical industry. With an investment of approximately €34 million, the new 5,000-square-meter facilities include the Automotive Application Center and the Process Catalysis Research & Development (R&D) Center. At the inauguration, the company also presented a range of locally-developed innovations which support customers in industries like automotive, construction and consumer goods, and which address important market trends to reduce emissions, increase energy efficiency and enhance performance. BASF launched an innovative waterborne coating system on the same occasion.

"China's most important growth industries can benefit enormously from innovations in chemistry. Thanks to continuous investment in research and development over the past several years, we are able to support our customers in China and the entire Asia Pacific region as they strive to improve consumers' quality of life, address challenges of rapid development and meet their sustainability goals," said Dr. Stephan Kothrade, president Functions Asia Pacific, president and chairman Greater China, BASF.

Equipped with a spray booth for electrostatic applications, a physical testing lab and a 3D robot, the BASF Automotive Application Center, Asia Pacific is designed to enable customer-oriented R&D activities. The 3D robot can simulate nearly any situation on a paint line, anywhere in the world; enabling the new center to optimize application processes and products. It can apply the automotive coatings not only on horizontal and vertical surfaces, but also on three-dimensional objects such as car doors and bumpers. The robot allows BASF to develop new products for customers in the automotive industry. It provides design solutions for automotive products as well as potential new trends and developments in the automotive coatings industry. The expanded capacities also feature laboratories for sustainable painting applications.

Located at the same premises, the new Process Catalysis R&D Center will focus on the development of new process catalysts to meet the specific needs of BASF customers in Asia Pacific.

The center hosts highly specialized testing units for evaluating solid catalyst performance, and state-of-the-art facilities for solids processing. Scientists will develop new catalytic materials for both new and existing process catalysis applications. Solid processes such as solid formation, separation, formulation, thin film coating, drying and solid handling will be designed and optimized at the facility. The new R&D center will also scale up tailor-made process catalysts and adsorbents for the regional catalyst market, adding additional value through close cooperation and proximity to BASF's customers and partners in Asia Pacific. It will complement BASF's world-scale process catalyst manufacturing site, located in Caojing, Shanghai.

Solutions address sustainability challenges

For the first time, BASF presented a range of innovations developed locally at the Innovation Campus Shanghai. From new polymer dispersions to sustainable paints, BASF helps drive innovations that support sustainability and enhance quality of life.

• ColorEco is a novel waterborne Monocoat and waterborne integrated paint system. The solution is first applied on light commercial vehicles from JAC, a leading commercial vehicle manufacturer based in Anhui Province, China. It helps automotive manufacturers meet strict regulations for emissions of volatile organic compounds (VOCs), especially in the light commercial vehicle and compact multi- purpose vehicle segments. The conventional system requires four coating layers. With the Integrated Process 2 for metallic colors, the first layer primer is integrated into the basecoat with better functionality. With Monocoat, it is even possible to integrate three steps into one – saving time, energy, and materials.

A new polymer dispersion Styrofan PLUS 7552 has been developed enhancing the performance of waterproofing membranes that are used in harsh or wet areas such as kitchens, bathrooms and swimming pools. The mechanical strength and resistance to detergents have been improved, to enable a longer service life. Styrofan PLUS 7552 also has an environmentally friendly profile: it is APEO Free and offers lower emissions.

BASF's global supercomputer, "Quriosity", has enabled new customized color care formulations in laundry applications. New detergent formulations are designed by Quriosity at an accelerated pace. Customized formulations reduce

problems with color bleeding and dye transfer, meeting requirements of the next product generation for convenience-driven customers.

• Innovative engine covers offer quiet and comfort for vehicles. Polyurethane (PU) integral foam solutions with an open cell structure offer unique performance as they are light-weight, with excellent sound insulation and flame resistance. Elastofoam PU solutions helps to make vehicles quieter and provide riders with a better experience inside the cabin.

Key Happenings in 2019

- BASF named a General Motors Supplier of the Year for 13th time
- BASF's coatings solutions help NIO shape new generation of smart electric cars in China
- BASF invests in a state-of-the-art surface treatment site for its Chemetall brand in Pinghu, China
- BASF opens modular lab for automotive OEM coatings at its Münster site
- BASF introduces AUROOM, a platform for the digital visualization of automotive exterior colors
- Ten years of the Color Design Studio at BASF's Münster site: Creative center for automotive colors of the future celebrates anniversary
- BASF and TGPM set new industry benchmark with premium Automotive Refinish Competence Center in Foshan, China
- BASF supports next generation of automotive refinishers at the global WorldSkills competition.

08. Kansai Paint Co., Ltd.

Osaka, Japan
www.kansai.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1918

REVENUE: $3.9 billion ▲ (2017: $2.943 billion)

MARKETS SERVED

Automotive coatings; Decorative coatings; Industrial coatings; Marine and protective coatings

KEY EXECUTIVES:

Hiroshi Ishino, president, CEO; board of directors: Kunishi Mouri, Masaru Tanaka, Koji Kamikado, Hidenori Furukawa, Jun Senoo. Shinji Asatsuma.

Operating in Japan, Europe, the U.S., Southeast Asia, India and China, Kansai Paint Co. Ltd. offers a broad range of coatings solutions for various markets. It divides its business into automotive (38 percent), industrial (25 percent), decorative (25 percent), and marine and protective (seven percent) segments.

Kansai Paint operates three automotive paint plants from its headquarters in Osaka, Japan and is the leading supplier of automotive coatings to Toyota, Suzuki, Nissan, Honda, Peugeot and Renault worldwide. The company employs 15,731 people.

Kansai Paint celebrated its 100th anniversary in 2018.

Since it was founded in 1918, Kansai Paint has grown over the past 100 years to become a company which conducts business globally. Going forward, the entire group is united in its resolve to continue as a corporate group which contributes to the development of people and societies around the world through business. To achieve this idea, Kansai Paint used its centennial as an opportunity to further strengthen the corporate DNA and established a new group company philosophy.

"We leverage superior technology to contribute to our customers and society, in a sustainable manner, with innovative products and services, through a competent workforce, built on a culture of customer focus, integrity and respect to our stakeholders," company President and CEO Hiroshi Ishino said.

Kansai Paint Philippines, Inc. (KPPI), one of the country's growing paint suppliers, recently announced the appointment of Akiyoshi Watanabe as KPPI president and GM.

Watanabe takes over from outgoing president Takushi Yamamoto, who started his Philippine assignment in April 2015. Under Yamamoto's leadership, the company saw steady growth in sales and client base. He also spearheaded the company's foray into the Protective and Decorative paint business, which was bolstered by the KPPI partnership with Japanese contractors for the construction of the newly opened Bohol Panglao International Airport.

Upon his return to Japan, Yamamoto will assume the position of manager at Kansai Paint's Kyushu Office.

9. Asian Paints Limited

Mumbai, India
www.asianpaints.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1942

REVENUE: $2.75billion ▲ (2017: $2.59 billion)

MARKETS SERVED

Architectural coatings; Industrial coatings; Automotive coatings

KEY EXECUTIVES:

K.B.S. Anand, MD and CEO; Amit Syngle, COO and president architectural coatings, India; Jayesh Merchant, CFO and company secretary, president, industrial JVs India.

Asian Paints had sales of $2.75 billion for 2018. Architectural/decorative coatings comprised 90 percent of sales and industrial and automotive coatings comprised the rest.

Asian Paints is one of the leading paint companies in India, with 7,500 employees worldwide. Along with its subsidiaries, it has operations in 19 countries with 25 paint manufacturing facilities, serving consumers in more than 65 countries.

Key brands in India include for exterior walls: Apex, Ace, Apex Ultima, Apex Ultima Protek and Apex Duracast; interior walls: Royale, Royale Aspira, Royale Play, Tractor, Premium Emulsion, Apcolite and Utsav; metal surface: Utsav, Premium Enamel and wood: PU, Touchwood and Polyester.

Asian Paints most recently launched products are Apex Shyne and Ace Shyne. Apex Shyne is a smooth, water based exterior finish with specialty modified acrylic emulsion with tailored silicone stitch technology which provides protection to exterior walls against harsh climatic conditions, yet providing a good sheen on wall. Ace Shyne is a water-based exterior emulsion that imparts a hi-sheen finish to the exterior walls. It is suitable for dry to moderately humid climatic conditions

Asian Paints commissioned two new paint manufacturing facilities in South India. The paint plant at Mysuru (Karnataka) was commissioned in Sept 2018 with an initial capacity of 300,000 KL/annum (scalable to 600,000 KL/annum) and the plant in Vizag (Andhra Pradesh) was commissioned with an initial capacity of 300,000 KL/annum (scalable to 500,000 KL/annum).

Asian Paints Expands Deployment of o9's Artificial Intelligence to Procurement

Asian Paints has successfully transformed its procurement planning by implementing o9 Solutions' cloud-based, artificial intelligence platform. o9 and Asian Paints partnered to engineer the "Purchaser's Workbench" platform specifically for the latter's unique business needs.

The Purchaser's Workbench provides Asian Paints with advanced exception based coverage monitoring and visibility to potential stockouts, which are determined by intelligent rules that vary by raw material categories. With full visibility into inventory, planners can run what-if scenarios, and determine prescriptive options, such as expediting a purchase order, creating a new purchase requisition, or directing an inter-plant transfer of material. The options selected are communicated back to the ERP system in real time.

"Like so many other areas of our platform, the Purchaser's Workbench puts the right information in front of the right people, at the right time, so that they can make smarter decisions faster than ever before," said Chakri Gottemukkla, CEO and co-founder of o9 Solutions. "It provides essential decision-management support that ensures adequate coverage of raw materials and facilitates discussions with suppliers."

Prior to its go-live with Purchaser's Workbench, Asian Paints successfully implemented the o9 platform for a sales intelligence program that supported more than 1,000 mobile users, as well as a demand planning process that refined statistical forecasts by incorporating market intelligence from the sales people geographically dispersed in the field. Because of this bold expansion, Asian Paints now has real-time visibility into all of its key data points, sales personnel can have more informed conversations with their dealers, and those personnel are achieving a new level of trust in their market.

"Asian Paints selected us for three reasons: They are a technology leader that selects best-of-breed vendors, o9 delivers next-generation planning capabilities, and our track record of wide user adoption instilled them with a sense of trust for this deployment," said Sanjiv Sidhu, chairman and co-founder of o9. "Doing business with Asian Paints is thrilling and I wish them continued success in their digital transformation journey."

10. Jotun AS

Sandefjord, Norway
www.jotun.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1926

REVENUE: $2.1 billion ▲ (2017: $2.028 billion)

MARKETS SERVED

Decorative paints; Marine coatings; Protective coatings; Powder coatings

KEY EXECUTIVES:

Morton Fon, president and CEO; Vidar Nysaether, CFO; Baard Kristian Tonning, GEVP Decorative.

Jotun Group is divided into seven regions – Scandinavia, Western Europe, Eastern Europe and Central Asia, Middle East, India and Africa, North-East Asia, South East Asia and Pacific and the Americas – responsible for the sale of Decorative Paints and Performance Coatings (Marine, Protective and Powder Coatings). The company has 40 production facilities in 24 countries, 64 companies in 45 countries and is represented by more than 100 countries around the world. The company has 9,872 employees. Decorative coatings comprised 40 percent of sales, marine coatings 25 percent, general/industrial coatings 25 percent and powder coatings 10 percent.

New Product Launches

Jotun unveiled the next generation of its SeaForce biocidal antifouling range, with three new products featuring Hydractive technology. The new solution provides predictable, long-term performance for diverse vessel needs. Jotun originally launched its SeaForce range in 2004. Since that point, there has been some 27,000 vessel applications worldwide.

The range features three core products: SeaForce Shield, offering effective protection; SeaForce Active, actively working to safeguard hulls even when vessels are not in use; and SeaForce Active Plus, delivering premium protection at an affordable price.

SeaForce Active and SeaForce Active Plus also feature a triple biocide package, one of which is the same biocide combination used in the top of the range SeaQuantum product portfolio.

Jotun recently launched Ultra One, Ultra Lite and Primax Excel, which allow engineered wood to be protectively coated in powder – and for the first time, these products can be applied to natural wood too.

This process has not been possible before on natural wood due to the fact that the temperatures required to use powder coatings would damage the material.

This breakthrough gives designers a new way of considering wood as a viable building material and brings a durable, more environmentally friendly product to the forefront of forward-looking design. Copenhagen-based designer Troels Flensted has used Ultra One on one of his latest designs.

Flensted wanted to elevate his chosen material of MDF and have the design monochromatic, textured and with differing dimensions of reflection and shading – all of which the powder coating helped make possible.

Jotun Signs Agreement with World's Largest Shipbuilder

Jotun said it signed a memorandum of understanding with the world's largest shipyards for a new type of marine paint that reduces solvent emissions by up to 90 percent. A memorandum of understanding has been signed with Korean Hyundai Heavy Industries (HHI). This is the starting point of closer cooperation and the use of a new, innovative solvent-free primer.

The signing took place between Jotun's chairman Odd Gleditch, Jr. and HHI's Chief Executive Ka Sam-Hyun during the South Korean President's state visit to Norway in June.

South Korea's Minister of Industry Yunmo Song attended the signing ceremony.

"The partnership with Jotun will allow HHI, the world's largest shipbuilder, to be better equipped to meet the new environmental requirements that are aimed at reducing solvent emissions, " said Sam-Hyun.

"We are, of course, very pleased with the agreement with the world's largest shipyard, but even more satisfied that our innovation is contributing to a better environment," added Morten Fon, CEO Jotun.

The product will reduce solvent VOC emissions into the air from approximately 250 grams per liter to just nine grams per liter. Shipyards will save hundreds of millions of dollars by avoiding investments in plants related to the combustion of VOCs. VOC combustion also leads to CO2 emissions, so this innovation provides a double benefit.

Jotun Chairman Odd Gleditch d.y. and Hyundai Heavy Industries CEO Ka Sam-Hyun/Courtesy Emanuele Lombardo

"We have conducted research in Korea and in Norway while developing this paint, and after 13 years can conclude that we have succeeded in developing a product that reduces solvent emissions by over 90 percent," said Erik Risberg, one of the scientists behind the new paint.

Primers make up 60-70 percent of the total amount of paint applied to a ship. The new product is currently available for Korean shipyards and selected shipbuilders in Europe.

11. Masco Corp.

Taylor, Michigan/USA
www.masco.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1929

REVENUE: $1.8 billion ▼ (2017: $2.2 billion)

MARKETS SERVED

Architectural coatings

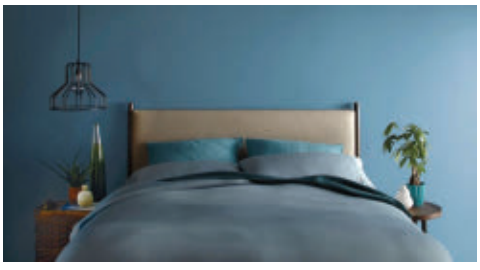
KEY EXECUTIVES:

Keith Allman, president and CEO; Amit Bhargava, VP, strategy and corporate development.

Masco Corp. reported net sales of $1.8 billion for paint and coatings, representing 32 percent of total net sales for Masco. The company produces architectural coatings including paints, primers, specialty paint products, stains and waterproofing products. The products are sold in the U.S. and Canada through do-it-yourself channels under brands including Behr and Kilz. The firm's high profile Behr products are sold through The Behr Process Corporation to The Home Depot, the segment's and the company's largest company.

"We are pleased with our 2018 results," Masco's President and CEO Keith Allman said in the company's Annual Report. "The macroeconomic fundamentals remain supportive of Masco's long-term growth. The age of housing stock, demographics, GDP, unemployment rates and consumer confidence point to a favorable repair and remodel market. We believe these fundamentals, combined with our focus on continuous improvement through deployment of our Masco Operating System and talent development initiatives, position Masco for profitable growth and continued value creation for our stakeholders."

Behr Paint Company's Premium Quick-Dry Oil-Based Wood Finish, which provides rain-resistant coverage in a unique formula that dries just one hour after application, was a finalist for The Home Depot's 2018 Innovation Awards.



Behr Paint reveals its 2019 Color of the Year: Blueprint S470-5, a mid-tone blue that charts a course for people to reimagine the colors and design of their home. Warmer than denim and softer than navy, this refined blue signifies authenticity, confidence and timelessness.

12. Hempel A/S

Kgs. Lyngby, Denmark
www.hempel.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1915

REVENUE: $1.49 billion ▼ (2017: $1.553 billion)

MARKETS SERVED

Architectural; Marine and Protective coatings; Container coatings; Yacht coatings; Decorative coatings

KEY EXECUTIVES:

Henrik Andersen, group president & CEO; Lars Jønstrup Dollerup, group VP and CFO; Lars Petersson, group VP and COO; : Peter Kirkegaard, group VP and CPCO; Michael Hanse, group VP and CCO; Charlotte Kempel, global head of marketing; Klaus Møller, group VP, head of services.

Protective coatings supplier Hempel recorded sales of $1.49 billion in 2018. Hempel employs approximately 6,500 people, is present in more than 80 countries and has 28 factories, R&D centers and more than150 stock points around the globe.

New CEO Appointed

EVP and COO Lars Petersson on July 1, 2019, will succeed Henrik Andersen as the CEO of Hempel A/S. Petersson joined Hempel in March 2015 as group COO.

"With Lars Petersson's insight in Hempel, his market insight, his leadership qualities, and the results he has created, Lars has shown that he is just the right person to take over as CEO and continue the journey for Hempel's future global transformation and growth," Chairman of the Board of Directors of Hempel A/S Richard Sand said. "The fact that the natural choice of a group president and CEO is an existing top leader from Hempel, shows that we have succeeded in establishing the right leadership team for the future. The Board has high expectations of Lars and his executive management team, and we are looking much forward to continuing the great collaborative work."

"I have experienced how unique this company is," Petersson said. "With more than 6,600 dedicated colleagues in 80 countries, a strong value-based culture, a very special customer focus and social engagement, as well as a commitment to always challenging ourselves, I am both enthusiastic and proud to be part of the Hempel family. Hempel is a company where we all work together to execute our strategy and to reach the goals we set for ourselves.

"We will continue our strategic journey, Journey to Excellence, with the purpose of improving in all parameters. The goal is to grow globally being the leader in the coatings industry. We have to be the front-runners in the global consolidation, and we have to be perceived as leading in the segments and markets we choose to compete in."

Sand commented on Andersen's departure. "It was with sadness that the Board received Henrik's resignation. At the same time, we are happy on Henrik's behalf that he has accepted a new and exciting challenge," Sand said.

13. DAW (Deutsch AmphibolinWerke)

Ober-Ramstadt, Germany
www.caparol.de

PRIVATE COMPANY; YEAR ESTABLISHED: 1895

REVENUE: $1.447 billion ▼ (2017: $1.52 billion)

MARKETS SERVED: Architectural coatings

KEY EXECUTIVE:

Ralf Murjahn, CEO, Christoph Hahner, executive board member R&D.

The parent company of the Caparol Group is the Deutsche Amphibolin-Werke von Robert Murjahn Stiftung & Co. KG (DAW).

Since 1895, DAW has developed, produced and sold innovative coating systems. As an independent family company in its fifth generation, DAW has continued to grow to become the third largest manufacturer of building paints in Europe and is the market leader in Germany, Austria and Turkey. DAW has approximately 5,600 employees.

The Caparol brand is the leading brand within the DAW Group. The marketing activities are subdivided into six strategic business units. In the professional business unit high-quality paints, enamels, glazes, chemical building products and materials for facades and insulation technology are marketed under the brands Caparol, Alligator and Alsecco for professional users. The building protection sector is covered by the brand DISBON and with LITHODECOR DAW SE serves the business field of curtain-wall, back-ventilated facades in glass or natural stone. Under the brand KRAUTOL a practically orientated range of products in paints and enamels is sold, mainly through building materials suppliers. The brand INTHERMO is the company's specialist for sustainable insulating materials based on wood fiber.

Datacolor partnered with DAW, to implement Datacolor's newest, hand-held color matching solution, ColorReaderPRO, for use in its retail stores and by pro painters.

"We needed a device with high accuracy and a user-friendly design to replace our aging in-store devices. Throughout the trials with the ColorReaderPRO, our users were very enthusiastic about this new device and its capabilities," said Enno Weber, head of coloristic and development department at DAW. "The ease-of-use of this reliable instrument, as well as the outstanding support of Datacolor, make this a successful partnership."

DAW will implement the ColorReaderPRO for its Caparol brand. The units will be DAW branded and will also be sold through their web shop.

14. Berger Paints India Ltd.

Kolkata, India
www.bergerpaints.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1923

REVENUE: $1.08 billion ▲ (2017 $1.02 million)

MARKETS SERVED

Decorative coatings; Automotive coatings; Industrial coatings; Powder coatings

KEY EXECUTIVES:

Abhijit Roy, managing director and CEO; Srijit Dasgupta, director – finance and CFO; Aniruddha Sen, senior VP and company secretary; Tapan Dhar, VP, technical director.

Berger Paints India Limited was founded in 1923 and is a leader in the Indian paint market. The company manufactures and markets a range of decorative and industrial paint products and has operations throughout India with seven manufacturing facilities, more than 135 depots, approximately 3,000 employees and more than 15,000 dealers. Architectural/decorative coatings comprise 81.7 percent of sales, general industrial and automotive comprise 10.8 percent, protective coatings comprises six percent and powder is 1.5 percent of sales. Berger's paint division related to automotive coatings and related ancillaries was transferred to BNB Coatings India Private Limited (now renamed Berger Nippon Paint Automotive Coatings Private Limited), an existing joint venture between Bergen Paints and Nippon Paints Automotive Coatings,

Product Launches in 2018

- Weathercoat Long Life, a new line of highly durable exterior coatings that can last up to ten years in the harsh India climate.
- Weathercoat Anti Dust, a new dust repellant for exteriors. It has been developed for dry, dusty regions of India where rainfall is sparse.
- Express Painting – The latest innovation from Berger Paints cuts down on the hassles of home painting, promising a faster, cleaner and better way to paint homes using automated tools to complete the painting process in 40 percent less time.
- Easy Clean, a high quality paint with stain resistance and washability.
- Easy Clean Fresh, a new entrant for interior paint. This product has been created using odor eliminating technology and pleasant fragrance to add freshness to the home, while keeping the wall stain free.

15. Benjamin Moore

Montvale, New Jersey/USA
benjaminmoore.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1883

REVENUE: $921 million ▲ (2017: $862 million)

MARKETS SERVED

Architectural coatings; Wood coatings

KEY EXECUTIVES:

Dan Calkins, chairman and CEO; Steve O'Neill, SVP marketing.

Benjamin Moore is a leading formulator, manufacturer and retailer of a broad range of architectural coatings. The company currently employs approximately 1,700 people. Benjamin Moore has facilities in Clifton, NJ; Johnstown, NY; Milford, MA; Pell City, AL; and Mesquite, TX. The company offers ready-mixed colors, sold under such brands as Benjamin Moore Paints, Moorcraft and Coronado Paint, and can match almost any shade with more than 3,400 colors.

Benjamin Moore announced its Color of the Year 2019 – Metropolitan AF-690, a stylish gray with cool undertones.

"Comforting, composed and effortlessly sophisticated, Metropolitan AF-690 exudes beauty and balance," said Ellen O'Neill, Benjamin Moore director of strategic design intelligence. "It's a color in the neutral spectrum that references a contemplative state of mind and design. Not arresting nor aggressive, this understated yet glamorous gray creates a soothing, impactful common ground."

The color leader also unveiled its Color Trends 2019, a corresponding palette of 15 harmonious hues that further amplify the cultured grace of Metropolitan AF-690.

Emphasizing the calming role gray plays in society, the Color Trends 2019 color card illustrates how to capture the coveted feeling of restorative quietude in any setting. Elements include the blending of heathered grays and soft linens to create an enveloping haze in a living room; utilizing reflective metallic accents and easygoing neutrals to add a comforting factor to a sleek kitchen; and creating a dose of modest allure to an elegant entryway by coating the walls, doors and trim in a bold navy blue.

16. Ace Paint

Oakbrook, IL, USA
www.acehardware.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1926

REVENUE: $900 million

MARKETS SERVED

Architectural coatings

KEY EXECUTIVES:

John S. Venhuizen, CEO and president; William M. Guzik, CFO, chief risk officer and executive VP; J. Thomas Glenn, president of East Tennessee and Northwest Georgia; Kerilyn M. Johnson, VP, general counsel and secretary; Lori L. Bossmann, executive VP of supply chain and retail support.

For its first 50 years in business, Ace was privately held. In 1976, Ace became a retailer-owned cooperative. Each store is independently owned and operated by local entrepreneurs. Today, Ace is the largest retailer-owned cooperative in the hardware industry in terms of wholesale and retail sales and strength of the brand. Ace's 4,600 stores in all 50 states and more than 60 countries generate annual retail sales of approximately $12 billion. Headquartered in Oak Brook, Illinois, Ace currently operates 14 distribution centers in the U.S. and one in Shanghai, China. Ace employs approximately 4,500 corporate team members worldwide and has four regional offices, located in Raleigh, NC; Atlanta, GA; Denver, CO and Woodridge, IL.

Ace Hardware ranked "Highest in Customer Satisfaction among Home Improvement Retail Stores" in a tie in the J.D. Power 2019 U.S. Home Improvement Retailer Satisfaction Study. Since J.D. Power began surveying the home improvement industry in 2007 Ace Hardware has achieved this ranking 12 out of the last 13 years.

The 2019 J.D. Power study is based on responses from nearly 2,433 consumers who have purchased home improvement products or services over the past 12 months. Ace ranked highest among major retailers with an overall satisfaction index score of 840 on a 1000-point scale. According to surveyed consumers, Ace performs particularly well in the category of Staff and Service.This year's score is based on overall performance in five areas: Merchandise, Price, Sales and Promotions, Staff and Service, and Store Facility.

"Receiving this recognition from J.D. Power and our customers once again is a tremendous honor. We are humbled to receive this award which reflects our Ace owners' passion for their neighbors and the outstanding service they and their red-vested heroes seek to provide every customer, every time," said John Venhuizen, president and CEO, Ace Hardware Corporation.

17. DuluxGroup Ltd.

Clayton, Victoria, Australia
duluxgroup.com.au

PUBLIC COMPANY; YEAR ESTABLISHED: 1918

REVENUE: $899 million ▲ (2017: $740 million)

MARKETS SERVED

Decorative coatings; Automotive coatings; Industrial coatings; Powder coatings

KEY EXECUTIVES:

Graeme Liebelt, chairman; Patrick Houlihan, managing director and CEO; Stuart Boxer, executive director.

DuluxGroup consists of Paints Australia, Australia's leading manufacturer of premium branded decorative paints, texture, protective and wood care coatings products; Paints New Zealand, New Zealand's leading manufacturer of premium branded decorative paints, texture, protective and wood care coatings products; Selleys Yates, which is Australia and New Zealand's leading manufacturer of home improvement and garden care products; and Offshore and Other segments which comprises Australia and New Zealand's leading manufacturer of powder and industrial coatings. DuluxGroup employs approximately 4,000 people in Australia, New Zealand, Papua New Guinea, South East Asia and China and has a comprehensive, world-class, scalable manufacturing base and supply chain across 21 main manufacturing sites, 21 distribution centers and more than 120 company owned trade outlets. Nippon Paint Holdings Co. agreed to buy DuluxGroup Ltd. 2.7 billion in cash, giving it access to the country's No. 1 sales channel for paints and coatings, as well as sealants, adhesives, garage doors, cabinets and architectural hardware.

The company was recently acquired by Nippon Paints.

Highlights for 2018

- Dulux's new $165M paint factory was successfully commissioned and is fully operational and meeting production targets
- DuluxGroup named in the top 50 of Australia and New Zealand's 'Most Innovative Companies' for second year in a row
- Dulux voted Australia's most trusted paint brand for 6th year in a row
- The Craig & Rose paints business in the UK opened its first two stand-alone stores and relaunched its website to drive online sales.

18. Kelly-Moore

San Carlos, California USA
www.kellymoore.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1946

REVENUE: $860 million

MARKETS SERVED

Architectural coatings; Industrial coatings; Decorative coatings

KEY EXECUTIVES:

Steve DeVoe, president and CEO; Roy George, executive VP and CFO; Dan Claybaugh vice president of marketing and business development; Jim Alberts, VP sales.

Kelly-Moore Paints is a leading premium paint manufacturer and retailer located in the western U.S. The employee-owned company produces approximately 20 million gallons of paint per year and owns and operates more than 145 stores in California, Washington, Oregon, Arkansas, Texas, Oklahoma and Nevada. Kelly-Moore sells approximately 400 types of paints, finishes and sundries to professional contractors and painters and to the do-it-yourself market.

Kelly-Moore continues its retail expansion with the opening of a new store in Windsor, California.

"We're delighted and are looking forward to offering our products and services in Windsor," said new store manager Greg Fitch. "This is our seventh store in Sonoma County and our 21st in the Bay Area. We're centrally located which makes us easily accessible to our loyal customers who now have a neighborhood paint store and won't have to travel across town for their painting needs."

Kelly-Moore Paints announced the results of its Color of the Year 2019 designer survey, sent to a nationwide group of 15,000 ASID-certified interior designers and members of the American Society of Interior Designers. As members of forecasting organizations Color Marketing Group and Color Association of the United States, the company selected the most influential colors that reflect home décor trends for 2019, and then presented those colors to this esteemed group of designers.

Peacock Blue KMA29 was chosen as the 2019 Color of the Year. This classic blue with green undertones is a hands down winner in the survey, capturing 35 percent of the votes. No surprise as saturated blues remain a mainstay in home fashion for 2019, the company reported. It is becoming a favorite color for modern kitchen cabinetry, replacing white as the go-to on-trend color. Peacock Blue and saturated blues are a must for textiles and home goods, but also can be an interesting option for walls, adding depth and a dramatic touch.

19. SK Kaken

Ibaraki-City, Japan
www.sk-kaken.co.jp

PUBLIC COMPANY; YEAR ESTABLISHED: 1955

REVENUE: $830 million ▼ (2017: $860 million)

MARKETS SERVED

SSpecialty coatings; Textured coatings; Architectural paints; Industrial coatings; Floor and roof coatings; Fire retardant and heat insulating coatings

KEY EXECUTIVES:

Minoru Fujii, chairman; Mitsuhiro Fujii, president; Masahide Sakamoto, senior managing director; Masahide Sakamoto, senior managing director; Kunfiro Fuji, director; Toru Fukuoka, director; Yoshiyuki Ito, director; Keizo Nagasawa, director.

SK Kaken Co., Ltd. is a Japan-based company mainly engaged in the manufacture and sale of architectural coatings and insulating refractory materials. The company operates in three business segments. The architectural coatings segment is engaged in the manufacture and sale of organic and inorganic aqueous coatings, synthetic resin coatings, inorganic coatings and inorganic building materials. The insulating refractory materials segment is engaged in the manufacture and sale of heat insulation materials, fire-retardant and insulating coatings, as well as fireproof paints. According to the Japan Building Coating Materials Association (2015), SKK provides 53 percent of building coating materials in Japan. The company has approximately 2,193 employees. SK Kaken was founded in 1955 and is headquartered in Ibaraki-City, Japan.

The company manufactures and sells organic and inorganic water-based painting materials in Japan and internationally. It offers inorganic painting and construction materials, special finishers, and architectural paints; and synthetic resin, fire retardant and heat insulating, floor, roof waterproofing, special and industrial, and textured coatings. The company also manufactures and sells fireproof paints. In addition, it is involved in contracting fireproof and insulated construction activities. The company was formerly known as Shikoku Kaken Industry Co., Ltd. and changed its name to SK Kaken Co., Ltd. in April 1991.

20. Chugoku Marine Paints

Tokyo, Japan
www.cmp.co.jp

PUBLIC COMPANY; YEAR ESTABLISHED: 1917

REVENUE: $802 million ▲ (2017: $735 million)

MARKETS SERVED

Marine coatings; Industrial coatings; Container coatings

KEY EXECUTIVES:

Masataka Uetake, president and CEO; Junji Tomochika, managing director and chief of administration HQ; Yasuyuki Kiseki, director and chief of production HQ; Hideyuki Tanaka, directory and chief of technical HQ.

Chugoku Marine Paints manufactures paint for ships, industrial and containers uses, as well as adhesives. The company offers paints for large vessels, pleasure boats and yachts, marine containers, fishing boats, and fishnets; protective paints for anti-corrosive protection; paints for building materials and woodworking; functional paints; heavy duty paints; paints for plastics; and caulking material for railways. It is also involved in the sale of painting related equipment; management and contract work for coating; inspection of surface treatment and coating; and other activities. The company has a headcount of 2,272 and 14 facilities. Marine and yacht comprises 70 percent of sales, general industrial 15 percent and container 15 percent.

SEAFLO NEO CF PREMIUM is one of the key products for Chugoku. This ultra low friction antifouling provides excellent performance against slime and barnacles. SEAFLO NEO CF PREMIUM has made the record of more than 100 applications for less than a year since its product launch. SEAFLO NEO CF PREMIUM utilizes CMP's zinc acrylate polymer technology and new biocide Selektope. The company is monitoring performance of SEAFLO NEO CF PREMIUM together with its clients.

Recently, an evidence of the effectiveness has been introduced in "The Naval Architect." The company is still on the way to fully prove it to the level of our expectation, but believes that it will be welcomed by the industry with big surprise and will contribute to protect environment. SEAFLO NEO CF PREMIUM is not only for hull coating in drydock; the company is ready to supply for newbuilding project from now onwards.

21. Shawcor

Toronto, Ontario, Canada
www.shawcor.com

PUBLIC COMPANY

REVENUE: $700 million ▼ (2017: $828 million)

MARKETS SERVED

Pipe coatings

KEY EXECUTIVES:

P.G. Robinson, chair of the board; Steve Orr, president and CEO; G.A. Tano, senior vice president, finance and CFO.

Shawcor Ltd. is a global energy services company specializing in products and services for the pipeline and pipe services segment of the oil and gas industry and related products for the petrochemical and industrial market. The company operates through a global network of fixed and mobile manufacturing and service facilities.

Shawcor Ltd. recently announced that its pipe coating division has been awarded a conditional contract from Sumitomo Corporation Europe Limited valued at approximately C$30 million to provide anticorrosion and concrete weight coating services for the Greater BP Tortue Ahmeyim Phase 1A Project development, located offshore Senegal and Mauritania, West Africa. The contract is scheduled to be executed from the Kabil, Indonesia facility during 2020.

22. KC Corporation

Seoul, South Korea
www.kccworld.co.kr

PRIVATE COMPANY; YEAR ESTABLISHED: 1958

REVENUE: $700 million

MARKETS SERVED:

Marine and container; Automotive coatings; Automotive refinish; General industrial coatings; Decorative coatings; Powder coatings

KEY EXECUTIVES:

Chung Mong-Jin, chairman Chung Mong Ik, CEO; Yoo Sungki, executive director.

Korea Chemical Co., Ltd. is the largest paint producer in South Korea. The company is involved in the production of paints for automobiles, ships, containers, construction and industrial use. It also manufactures PVC material for flooring and paint sealant.

Paint for the marine market is the largest segment and accounted for 25 percent of sales. Automotive OEM sales amounted to 17 percent of sales; decorative coatings accounted for 15 percent; general industrial six percent; powder coatings six percent; auto refinish four percent; and the remainder of sales is not detailed.

Two products including anti-corrosion coatings for ships have been selected as World Class Products of Korea by the Korea Trade-Investment Promotion Agency (KOTRA) for 10 consecutive years. The products continuously selected since 2009 include anti-corrosion coatings for ships (Korepox EH2350) and ceramic material for vacuum circuit breakers (Vacuum Interrupter), as

well as antifouling coatings for ships (Seacare A/F795) that has been selected for eight consecutive years dating back to 2011.

In particular, the anti-corrosion coatings for ships "Korepox EH2350" selected as World Class Products of Korea for 10 consecutive years. Moreover, 'Vacuum Interrupter' is a ceramic material for vacuum circuit breakers separating circuitry in case of normal load break of currents or accidents.

The antifouling coatings for ships "Seacare A/F795" selected as World Class Products of Korea for 8 consecutive years is a product that protects ships from marine life inhabiting the body of ships that sail for a long time and increases sailing efficiency, thereby conserving fuel usage.

KCC plans to improve product quality and actively meet customer demands through research and development of leading global products in various fields.

23. Beckers Group

Berlin, Germany
beckers-group.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1865

REVENUE: $670 million

MARKETS SERVED

Industrial coatings; Coil coatings; Consumer design finishes

KEY EXECUTIVES:

Boris Gorella, CEO; Karsten Eller, COO; Olivier Laune, CFO; Bernd Vogel, CTO; Christophe Sabas, president CC EA&A; Paul Menezes, president CC A&ME; Christian Vogel, president industrial coatings.

Beckers is a privately-owned, global industrial coatings company with Swedish roots, providing products and services across many manufacturing sectors. The company employs 1,800 people and its operations currently span five continents in 19 countries and 24 sites.

Beckers Group was awarded a Gold rating by EcoVadis for the second consecutive year.

This certification, awarded by an independent third-party organization, recognizes companies for their outstanding Corporate Social Responsibility performance. The Gold Standard, the highest rating offered by EcoVadis, places Beckers Group in the top five percent of companies EcoVadis assessed globally in the category "Manufacture of paints, varnishes and similar coatings".

In October 2018, an internal cross-functional team conducted a global assessment of Beckers' CSR performance, looking closely at four core fields: Environment, Ethics, Labour Practices & Human Rights, and Sustainable Procurement.

"Not only have we retained the gold rating at Group level, but we have also increased our overall score from 63 in 2017 to 65 in 2018," said Nicklas Augustsson, global sustainability director at Beckers. "This result is a reflection of our focus and efforts in implementing robust ethical practices, while continuously improving on the three other themes."

24. Dai Nippon Toryo

Osaka, Japan
www.dnt.co.jp

PUBLIC COMPANY; YEAR ESTABLISHED: 1929

REVENUE: $661 million

MARKETS SERVED

Protective coatings; Architectural coatings; Metal baking coatings; Plastic coatings; Automotive coatings; Rolling stock coatings

KEY EXECUTIVES:

Toshijiro Iwasa, president; Norihiro Mashima, director of finance, executive officer.

Dai Nippon Toryo Co., Ltd. operates in the paint industry primarily in Japan. The company offers various coating products, which include heavy duty, industrial, automobile, refinishing, marine, home use paints, plastics and powder. The company also provides machines and equipment for paints manufacturing and coating applications. In addition, it offers its products in various fields, including electrical home appliances, housing, automobiles and information-related equipment, as well as for infrastructures, including high-rise buildings and largescale bridge construction. Dai Nippon Toryo Co., Ltd. formed a joint venture with Kuboko Paint Co., Ltd., which is a consolidated subsidiary of Kansai Paint Co., Ltd., under the name Japan Powder Coating Manufacturing Co., Ltd.

25. Tikkurila Oyi

Vantaa, Finland
www.tikkurila.com

PUBLIC COMPANY; YEAR ESTABLISHED: 1892

REVENUE: $650 million

MARKETS SERVED: Decorative coatings

KEY EXECUTIVES:

Elisa Markula, CEO; Melisa Bärholm, Senior VP, Human Resources; Jukka Havia, CFO; Fredrik Linde, Senior VP, Operations; Petri Miettinen, Senior VP, Sourcing; Meri Vainikka, Senior VP, Offering.

Tikkurila Oyj is a Finnish manufacturer of paints and lacquers. Tikkurila is the market leader in decorative paints in Russia, Sweden, Finland and the Baltic countries. Russia, Sweden, Finland and Poland account for 80 percent of the group's revenue.

Tikkurila has joined the Indoor Air Quality Ecosystem (IAQe) initiative.

The purpose of the IAQe initiative, launched in 2018 and funded by Business Finland, is to develop new solutions that improve indoor air quality, bring together Finnish expertise and export them to the international markets. The objective is to work together to improve indoor air quality and to find new solutions in the form of joint and pilot projects.

The project brings together research institutions, Finnish companies and other organizations; the ecosystem consists of more than 20 partners in addition to Tikkurila. This cooperation is based on the activities of the organizations themselves, supported by external experts.

"The IAQe combines the skills and needs of many organizations to enable cooperation to achieve and maintain healthy indoor air. Joint projects and solutions enable a new kind of service development, opening up business areas that would be inaccessible to individual actors," said Jari Erkkilä, who is in charge of the project.

One of Tikkurila's sustainability customer promises is that Tikkurila will improve and protect air quality with its products and professional services.

For Tikkurila as paint manufacturer, eco-friendliness means, among other things, that the company develops and promotes the use of products that have as low an environmental impact as possible.

"Thanks to our high-quality, low-emission and eco-labelled products, indoor air quality will be better and health risks lower. We have a firm belief that, through the IAQe project and partners, we will promote the use of high-quality surface treatment products and the development of comprehensive services, thereby leading to cleaner indoor air," said Joonas Auvinen, Tikkurila's director for Business & Portfolio Development, Professionals.

26. Shanghai Huayi Fine Chemical

Shanghai/China
www.shhuayuan.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1915

REVENUE: $585 million

MARKETS SERVED

Coil coatings; Industrial coatings; Marine coatingss

KEY EXECUTIVE: Hongmei Yang, GM.

Shanghai Huayi Fine Chemical Co. Ltd. (formerly Shanghai Coating Co. Ltd.) is a subordinate enterprise of Shanghai Huayi Croup. The company has 13 wholly owned enterprises and six joint ventures. Shanghai Huayi Fine Chemical produces coil, industrial and marine coatings. The company launched China's first coatings brand – Winged Tiger. Other brands include KwangMing, Yipin and Lionhead.

27. Brillux GmbH & Co. KG

Muenster, Germany
www.brillux.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1889

REVENUE: $558 million

MARKETS SERVED

Architectural coatings; Wood coatings; Floor coatings ; Industrial coatings

KEY EXECUTIVE: Peter König, CEO.

Brillux is now in its fourth generation of independent ownership by the König family. The company's headquarters is in Muenster, Germany and currently employs 2,500 employees and has four production facilities. The company has more than 180 branches in Germany, Italy, the Netherlands, Austria, Poland and Switzerland. Brillux is a manufacturer and direct supplier of-

fering a complete range of paints and varnishes. As a full-range supplier and direct supplier, Brillux offers comprehensive services in the field of enamels and paints. It's complete product range with over 12,000 items offers coordinated products and systems for painting, varnishing and plastering.

28. Xiangjiang Paint Group

Changsha, Hunan, China
www.xitlgroup.cn

PRIVATE COMPANY; YEAR ESTABLISHED: 1950

REVENUE: $538 million

MARKETS SERVED

General industrial coatings, Architectural coatings, Powder coatings

KEY EXECUTIVES:

Xu Yin, chairman of the board; board members: Ming Xiancheng, Huang Lifeng, Xie Wei; Shoubing Liu, technical director.

Xiangjiang Paint Group is headquartered in Changsha, Hunan and has more than 2,200 employees. The company has four facilities throughout China. Ninety-eight percent of the company's sales are general industrial coatings; the rest is comprised of architectural and powder coatings. The company generated revenue of $538.8 million in 2018. As the Chinese government continues to increase environmental regulations Xiangjiang Paint has increased its R&D focus on waterborne and high solids coatings products, bringing a number of new products to market. These include waterborne automotive and construction machinery coatings and high solids anti-corrosion coatings.

29. Nihon Toksuhu Toryo Co. Ltd.

Tokyo, Japan
www.nttoryo.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1929

REVENUE: $536 million

MARKETS SERVED

Decorative coatings; Performance coatings

KEY EXECUTIVES:

Masahiro Nojima, chairman and CEO; Makio Sakai, president and COO; Jun Taya, managing director and CFO; deputy chief officers of paints and coatings: Hisami Nishioka and Yoshihiko Doi.

Nihon Tokushu Toryo Co., Ltd. is a Japan-based manufacturing company that operates in two business segments. The paint-related segment manufactures and sells paints and soundproof materials. This segment is also involved in the paint-related and soundproof material-related construction work. The automobile product-related segment manufactures and sells automotive soundproof materials, such as damping materials, acoustic absorbents and sound insulators, as well as antirust materials. The company has nine subsidiaries and 10 associated

companies in Japan, as well as overseas markets, including the U.S., Thailand, China and Singapore. The company was founded in 1929, is headquartered in Tokyo and has approximately 580 employees.

30. Fujikura Kasei Co. Ltd.

Tokyo, Japan
www.fkkasei.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1938
REVENUE: $502 million
MARKETS SERVED
Plastic coatings; Architectural coatings; Automotive coatings
KEY EXECUTIVES:
Daisuke Kato, president; Hikoji Ueda, senior VP Yoshizo Shimoda, senior VP; Hisashi Kajiwara, executive director: Hiroaki Watanabe, Masahiro Takano and Satoshi Watanabe.

Fujikura Kasei Co. Ltd. was founded in 1938. The company is headquartered in Tokyo, Japan and has a presence in Singapore, Thailand, China, Maylasia and Vietnam.

Fujikura Kasei offers coatings for plastics, which include automotive interior and exterior, automotive lightings, cosmetic containers and enclosures, electronic appliances, plastic hobby items and plastic sheets; architectural coatings, such as exterior and interior building materials, decorative items and housing equipment; and electronic materials.

The company also provides architectural coatings for use in exterior and interior building materials, public buildings and facilities, decorative items, and housing equipment; and electronic materials, including conductive paste.

"We are committed to providing further valued products and services even in today's dramatically changing environment with our proven technology and impetus making use of our company scale," President Daisuke Kato said.

31. TOA Group

Bangkok, Thailand
www.toagroup.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1957
REVENUE: $484 million
MARKETS SERVED
Architectural coatings; Marine and protective coatings; Wood coatings
KEY EXECUTIVES:
Arsa Sarasin, honorary chairman; Prachak Tangkaravakoon, president; Motoo Horiguchi, senior executive VP; Rams Das Ahuja, executive VP.

TOA is the leading supplier of decorative coatings in Thailand with an estimated market share of 50 percent. The company manufactures products that cater to the mid-tier and premium-tier markets. It derives 90 percent of its revenue from its home market.

The TOA Group of companies includes TOA Paint Thailand, which is TOA's 100 percent Thai-owned main base of operation; TOA-Chugoku Paint, a JV between TOA Paint Thailand and Chugoku Marine Paint; TOA Union Paint Thailand, a JV company with Japanese-based wood coatings producer Union Paint; TOA Vietnam; Shanghai-TOA Paint; and TOA Paint Malaysia.

TOA has emerged one of the largest paints & coating producers in the ASEAN region. The company operates three production plants in Thailand and five in other countries of ASEAN region. With a sales revenue of THB 12,059.6 million in the first nine months of the year 2018, the company registered a growth of 5.3 percent as compared to the figures of previous year nine months. In the previous full financial year (2017), the company had registered sales revenue of THB 15,717.7 million.

32. Noroo Paint Co. Ltd.

Anyang-Si, South Korea
www.noroo.co.kr

PRIVATE COMPANY; YEAR ESTABLISHED: 2006
REVENUE: $482 million
MARKETS SERVED
Architectural coatings; Industrial coatings; Automotive refinishes
KEY EXECUTIVE:
Soo-Kyoung Kim, CEO.

Noroo Paint Co., Ltd. engages in the manufacture and sale of paints and coatings worldwide. Its products include architectural coatings, which comprise natural paint, general coatings, functional coatings and Decopia; waterproof and floor coatings; decorative coatings, such as lacquers, polyurethane paints, cracking paints and wood stain; primer and topcoat heavy duty coatings; and industrial coatings, including metal coatings and pattern finishes. The company also offers coating equipment; and coatings for auto refinishes and plastic finishes, as well as coil coatings. The company was founded in 2006 and employs 787 people. Architectural coatings account for 43.7 percent of sales while industrial coatings make up 17.9 percent, automotive refinishes 10.5 percent and others comprising 27.9 percent.

33. Teknos Group Oy

Helsinki, Finland
www.teknos.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1948
REVENUE: $457 million
MARKETS SERVED
Architectural coatings; Industrial coatings
KEY EXECUTIVES:
Paula Salastie, CEO; Pasi Taipalus, CFO; Tuukka Ryynänen, chief technology officer; Fredrik Calenius, chief procurement officer; Jacek Karnicki Schweizer, chief HR officer; Kalle Härkönen, operations director; Arto Mannonen, group SVP, Architectural Coatings; Lassi Tirkkonen, group SVP, Metal Paints & Coatings; Marcel Dissel, interim segment director, Industrial Wood.

Teknos Group Oy is the leading supplier of industrial coatings in Scandinavia with a strong position in retail and architectural coatings too. Teknos is one of Finland's largest family-owned businesses. Group companies operate in Scandinavia, Germany, the UK, Poland, Slovenia and Russia, and through a well-established network of agents and representatives in approximately 20 other European countries. The company has approximately 1,700 employees and 16 facilities

Teknos made an agreement and closed the deal to acquire Czech paint distributor Finnproduct s.r.o. Finnproduct has been Teknos dealer since 1992.

34. Cromology

Clichy, France
www.cromology.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1986

REVENUE: $452 million

MARKETS SERVED

Architectural coatings

KEY EXECUTIVES:

Loïc Derrien, CEO; Rui Caldas, international operations director; Bernard Chapuis, R&D and supply chain director; Christian Chareire, business and digital transformation director.

Formerly known as Materis Paints, the company changed its name to Cromology in 2015. The group ranks second in France for decorative paints and is the market leader in Southern Europe (Italy, Spain and Portugal). With eight research laboratories, 10 production facilities and nine logistics platforms, Cromology designs and produces cutting-edge, professional decorative paints, sells and distributes its innovative products in more than 50 countries around the world, with a direct presence in nine: Belgium, France, Luxembourg, Italy, Morocco, Portugal, Spain, Switzerland and Turkey.

Cromology operates its own distribution network of almost 410 integrated stores, Couleurs de Tollens, Zolpan, Robbialac and Colori di Tollens Bravo, which serve more than 50,000 professional clients and hundreds of thousands of private customers. Cromology also relies on over 6,500 partner points of sale operated by independent distributors and more than 2,000 DIY stores.

With approximately 3,650 employees, Cromology recorded revenue of $452 million in 2018. Cromology manufactures interior and exterior paints, technical and decorative plasters and fillers, External Thermal Insulation Composite Systems (ETICS), waterproofing solutions and floor paints.

Cromology's Tollens & Zolpan named Capital Magazine's "Best Brands 2019" for third year.

35. National Paint Factories

Dubai, United Arab Emirates
national-paints.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1969

REVENUE: $427 million

MARKETS SERVED

Decorative coatings; Powder coatings; Protective/Marine coatings; Automotive coatings; Wood finishes

KEY EXECUTIVES:

Michael Faeq Sayegh, chairman, NP Group; Ibrahim Faeq Sayegh, vice chairman NP Group and technical director; Samer Saleem Sayegh, managing director NP Group.

National Paints, the mother company of Sayegh Group, ranks number one in the Middle East and the Arab world in both sales and production, and is considered one of the pioneer paints companies of high quality standards in paints and respective raw materials. The company owns 14 paint and three resin plants worldwide and had originally started in Jordan, then the United Arab Emirates. The factory in Sharjah is considered the biggest in the Arab World and Middle East and specializes in paints production of all kinds. The company has an annual production capacity of 264 million liters.

Other similar factories were established in Palestine, Kyrgyzstan, Kazakhstan, Oman, Romania, India, KSA and Egypt, which is considered to be the second largest industrial complex of National Paints. In addition to several showrooms in Lebanon and Russia, National Paints also exports to over 80 countries worldwide.

36. Mankiewicz

Hamburg, Germany
www.mankiewicz.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1895

REVENUE: $395 million

MARKETS SERVED

Industrial coatings; Aviation coatings; Automotive coatings

KEY EXECUTIVE:

Michael O. Grau, CEO.

Mankiewicz is a globally operating paint manufacturer, founded 1895 in Hamburg. The Mankiewicz group supplies high-quality coating systems for industrial series production to various sectors, including demanding markets such as machinery, automotive, aviation, railway, utility vehicles, medical engineering, yacht and wind power industries. The in-house development department permits the creation of all paint systems in all color shades, gloss grades and textures, tailor-made for each customer. More than 1,500 employees worldwide are involved in the realization of "Coating Concepts of the Future" to ensure long-term preservation of utility and capital goods. Mankiewicz is certified according to ISO 9001, ISO/TS 16949, EN9100, ISO 14001 and has been successfully audited according to VDA 6.3. In

November 2017, the company opened a new, 90,000 square foot U.S. Headquarters in Charleston, South Carolina.

37. Musashi Paint Co. Ltd.

Tokyo, Japan
www.musashipaint.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1958
REVENUE: $375 million
MARKETS SERVED
Plastic coatings
KEY EXECUTIVES:
Yumiko Fukui, president and CEO; Junya Yamada, director and Kazunori Kasahara, director.

Musashi Paint Company Co., Ltd. manufactures and distributes coatings for household appliances, electronic devices, information technology devices and industrial products. It specializes in synthetic resin paints. The company provides touch feel, PRTR law adherent, water-based, UV, acrylic silicon, functional and special primer coatings, as well as coatings for molded plastics, laser etching and metal materials. In addition, it offers coatings for information/telecommunication devices, including mobile phones, laptop computers and digital cameras; coatings for household appliances, such as plasma/LCD televisions, DVD players, vacuum cleaners, refrigerators, dehumidifiers and air cleaners; and coatings for automobile devices, including navigation systems. Musashi Paint Company offers its products through dealers in Japan, Korea, Malaysia, Hong Kong, Taiwan, the UK and U.S.

The company has plants in Japan, China, Southeast Asia, India, the U.S. and Europe.

38. Carpoly

Jiangmen, China
www.carpoly.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1999
REVENUE: $373 million
MARKETS SERVED
Architectural and industrial coatings
KEY EXECUTIVES:
Donghang Qiu, chairman of the board; Shuchao Cao, VP; Xiaobo Lu, group GM and marketing director; Ronghua Chen, technical director.

Carpoly offers products and services to the furniture and decorative paints market. The company has 3,500 employees, eight production facilities located in Guangdong, Shanghai, Sichuan and Hebei; approximately 2,100 direct distributors and more than 15,000 points of sales throughout China. In 2018 the group restructured its project businesses by grouping façade coatings, floor coatings and EIFS. The newly formed business division was named The Grand Architectural Paint Division and it enjoyed a high speed growth in the first year. The success was marked by synergies in entering into cooperation with top real estate developers.

39. Betek Boya San. ve Tic. AS

Istanbul, Turkey
www.betek.com.tr

PRIVATE COMPANY; YEAR ESTABLISHED: 1988
REVENUE: $360 million
MARKETS SERVED
Architectural coatings; Adhesives; Industrial coatings; Thermal insulation; Wood coatings
KEY EXECUTIVES:
Gozde Akpinar, chairman of the board; Tayfun Kucukoglu, board member and GM; Mert Erdog, VP supply chain; an Gökhan Güner, VP of Finance

Betek entered the decorative paints industry in 1993 through its technological cooperation with DAW, which owns 26 percent of the company. Betek was the first Turkish paint company that commenced production with a European partner. Betek has been the market leader in the industry with its multi-brand strategy which is being delivered to more than 5,000 retail outlets. The company currently has approximately 1,200 employees. Betek has five manufacturing facilities.. Betek has been at the forefront of adopting environmental protection and health standards of European Community since 1993 for all its products manufactured. The company was recently acquired by Nippon Paint.

40. Origin Electric

Tokyo, Japan
www.origin.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1938
REVENUE: $344 million
MARKETS SERVED
Synthetic resin paints; Coatings for digital devices
KEY EXECUTIVES:
Kazuhiro Seo, president & representative director; Shinichi Shinohara, director, managing executive officer, GM of R&D; Katsuyuki Takagi, director & GM of administration; Yasuhiro Genjima, director & senior executive officer; Masaru Kadowaki, director, executive officer & manager, mechatronics; Shoichi Tozuka, director, executive officer & manager, electronics.

Origin Electric operates in three segments: Electronics, Mechatronics and Chemitronics. The Chemitronics division is supported by metal surface treatment and surface plating technologies as well as by its history of R&D in the fields of electronics and coating materials. Energy-saving measures jointly

developed with other engineering groups have resulted in developments being achieved in the field of synthetic resin paints. The company operates in Japan, as well as in Taipei, Hong Kong, the U.S. and China. Origin began developing paints in 1947 as a part of its surface processing research efforts creating highly functional paints, including paints used for plastic substrates, water-based paint/TX-free paint and paints used for plated nonferrous metals. Applications include auto interior and exterior parts, cell phones and computers.

41. Ennis-Flint

Thomasville, NC/USA
www.ennistraffic.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1996
REVENUE: $340 million
MARKETS SERVED
Traffic marking paint
KEY EXECUTIVES:
Bryce Anderson, chairman; Matt Soule, president and CEO; and Michael Murren, CFO; Dan Carpenter, chief operating officer.

Ennis-Flint is the world leader in pavement markings and traffic safety solutions for a diverse customer base of private contractors, government agencies and independent distributors. Ennis-Flint supplies a wide range of products including: traffic paint, hot-applied and preformed thermoplastic, plural components, raised pavement markers and intelligent transportation systems from a network of 26 manufacturing facilities on five continents. Ennis-Flint is headquartered in Thomasville, North Carolina, with manufacturing facilities located in the U.S., Canada, Australia, Malaysia and Europe.

Ennis-Flint announced progress is underway for a new manufacturing facility in the Triad. The new plant will focus on increased converting capacity of preformed thermoplastic pavement markings for our Specialized Market products including, but not limited to, decorative crosswalks, custom logos and surface signage for public roadways and private properties as well as airfield markings at airports and military bases.

"Market interest and demand for complex, multi-colored pavement marking designs continue to grow. The substantial production capacity added at this second facility allows us to better serve our network of certified applicators to meet the timeline needs of customers' streetscape and airfield projects." said Matt Soule, Ennis-Flint president and CEO.

According to Dan Carpenter, COO, "We're excited to see our continuous improvement initiatives for preformed thermoplastic spring into action in multiple ways. We're also adding capacity at our Thomasville, NC plant." The Thomasville plant will focus on pavement markings for our Regulatory Market products such as, but not limited to, lines, legends, arrows, symbols, contrast, bike/bus lanes, and more.

42. Tiger Coatings

Wels, Austria
www.tiger-coatings.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1930
REVENUE: $330 million
MARKETS SERVED
Powder coatings
KEY EXECUTIVES:
Clemens Steiner, CEO; Reinhold Freiseisen, CFO; Thomas Loibl, COO; Christian Ebenberger, marketing director; Gerhard Buchinger, technical director.

Tiger Coatings produces powder coatings for industrial applications and the DIY market. Its powder coatings are used in a wide variety of markets such as architecture, automotive, construction and furniture. Tiger Coatings offers products such as Tiger Drylac Powder Coatings and TigerTogital Inks. The company markets its products in Austria, Egypt, Brazil, China, Canada, Mexico, the U.S., Vietnam, Belarus, Bosnia and Herzegovina, Bulgaria, Denmark, Germany, India, Croatia, Latvia/Lithuania, the Netherlands, Poland, the Russian Federation, Switzerland, Serbia and Montenegro, Slovenia, Spain, South Africa, Taiwan, Thailand and Ukraine. Tiger Coatings was founded in 1930 and is based in Wels, Austria with eight manufacturing facilities in Austria, Egypt, China, Canada, Mexico, the U.S. and Vietnam. The company has 1,254 employees.

42. Bardese Chemical

Zhongshan, China
www.bardese.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1996
REVENUE: $330 million
MARKETS SERVED
Architectural/decorative coatings, General industrial coatings, Powder coatings.
KEY EXECUTIVES:
Xueping Fang, president; Yunfeng Qiu, GM; Bin Kang, vice GM.

Bardese Group has seven large-scale production factories across China, which are located in the most industrialized regions, in order to provide just-in-time product delivery and technical services to clients. In addition, Bardese Group has expanded its distribution channels and sales network throughout China, covering all the provinces and major cities. The company employs 1,800 people. Under increasing environmental protection and awareness in the Chinese market, Bardese Group invested heavily in the research and development of new eco-friendly coating products and solutions, including: waterborne wood paints, powder coatings on wood, UV paints, high performance interior wall paints, textured exterior wall paints, waterproof coatings, and others. In June 2018, Bardese Group officially launched its "Wood Powder Coatings" conference in its headquarters, showcasing its leading innovations and development in powder coatings

on wooden substrates. In September 2018, Bardese Group held the opening ceremony of its newest Boshi Furniture factory in Jiangxi Province, which demonstrated one of the most advanced water-borne wood paint application centers in China.

44. Pacific Paint (Boysen)

Quezon City, Philippines
www.boysen.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1953
REVENUE: $290 million
MARKETS SERVED
Decorative coatings; Industrial coatings; Marine coatings
KEY EXECUTIVES:
Willy Ong, CEO; Jahja Suriawinata, president; Johnson Ongking, VP; Ruben Cueto, VP of marketing; Catherine Ramirez, R&D manager.

Walter Neal Boysen founded Boysen Paints in Oakland, California in 1926. After expanding the brand across the U.S., Boysen Paints was introduced to Asia in the 1960s. It has given Pacific Paints the license to manufacture its premium paint products. The growing market share in Asia and the Pacific, especially in the Philippine market, necessitated the creation of a fully integrated state-of-the-art manufacturing facility in Cavite, Philippines, said to be the most modern paint factory in Southeast Asia. Pacific Paint (Boysen) Philippines, Inc. was awarded Sustainable Company of the Year at the Global Responsible Business Leadership Awards 2018 ceremonies at the Sunway Convention Center in Petaling Jaya.

45. Cloverdale Paint Group

Surrey, British Columbia, Canada
www.cloverdalepaint.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1933
REVENUE: $284 million
MARKETS SERVED
Decorative coatings; Industrial coatings; Wood finishes; Marine coatings
KEY EXECUTIVES:
Tim Vogel, chairman and CEO; Larry Lozinski, president and COO (Cloverdale Paint); David Wolf, president and COO (Rodda Paint); Paul Schmidt, Group VP, finance.

Cloverdale Paint maintains more than 100 retail stores and a network of dealer outlets across Western Canada and the Pacific Northwest. The firm manufactures architectural and industrial maintenance products directly and through subsidiary companies in Calgary, Alberta (Far-go Paint Inc.) and Portland, Oregon (Rodda Paint Company). Cloverdale operates manufacturing plants in Surrey, Portland, Winnipeg, Edmonton and Calgary, and employs approximately 1,400 people.

Cloverdale recently acquired Allcolour Paint. Founded in 1963 by George Chapman and operated by Charles and Bob Chapman since 1977, Allcolour produces high quality light industrial and heavy-duty industrial coatings for the Canadian market from their 64,375 square foot facility located in Oakville, Ontario.

46. Karlworwag Lack-Und Farbenfabrik

Stuttgart, Germany
www.worwag.de

PRIVATE COMPANY; YEAR ESTABLISHED: 1918
REVENUE: $277 million
MARKETS SERVED
Industrial coatings
KEY EXECUTIVES:
Peter Moritz, managing director; Hannes Worwag, managing director.

Karl Wörwag Lack-und Farbenfabrik GmbH & Co.KG develops, manufactures, and markets coatings and paints for various industrial applications. Its products include liquid coatings, powder coatings, UV coatings, and painted films. The company's products serve vehicle exteriors and interiors, car bodies and commercial vehicles, vehicle components, construction and agricultural machinery, household appliances, plant engineering, furniture, and building equipment industries in Germany and internationally. The company was founded in 1918 and is headquartered in Stuttgart, Germany. It has subsidiary locations in Langfang, China; Cape Town, South Africa; Baden-Dättwil, Switzerland; Swiebodzin, Poland; Lafayette, Illinois; and Polinya, Spain. The company has 1,000 employees and six manufacturing facilities.

47. CIN – Corporação Industrial do Norte, SA

Maia, Portugal
www.cincoatings.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1926
REVENUE: $277 million
MARKETS SERVED
Architectural, Industrial and Protective coatings
KEY EXECUTIVES:
João Serrenho, chairman and CEO; Ângelo Machado, board member; Fernando Jorge Ferreira, CFO.

CIN has been at the forefront of the sector in the Iberian Peninsula for two decades. With approximately 1,400 employees and a presence in more than 20 countries, its business is focused on the three main market segments – Architectural, Industrial and Protective Coatings. With three research and development centers, in Portugal, Spain and France, CIN is unwaveringly committed to innovation – anticipating market needs, improving processes – thus ensuring the success of its products, which can now be found in 40 countries in Europe, the Americas, Asia and Africa.

After a three-year European approval procedure, Artilin 3A

Mate, CIN's anti-mosquito paint, became the first anti-mosquito paint that met the most stringent requirements and thus was approved for sale on EU in 2016.

48. Flugger Group

Rødovre, Denmark
www.flugger.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1785
REVENUE: $272 million
MARKETS SERVED
Architectural coatings
KEY EXECUTIVES:
Jimmi Mortensen, CEO; Michael Larsen, chief operations officer; Keld Sørensen, CFO; Thomas Thorsøe, chief people officer; Ulf Schnack, chief DNA officer; Thomas Bendixen, chief commercial officer (effective Aug. 1).

Flügger Group is one of Scandinavia's largest suppliers of decorative paint, wood stain, wallcoverings, paint tools and cleaning articles. Flügger Group is represented by Flügger shops in Denmark, Norway, Sweden, Iceland, Poland and China. Its subsidiary DAY-system contributes with sales from 214 shops in Denmark, Norway and Sweden. Another company, PP Mester Maling, has 41 shops in Denmark. The company has six factories; the two main ones are in Kolding, Denmark and Bollebygd, Sweden. There, Flugger produces paint, wood stain, fillers and chemical products. In Kolding, it produces 20 million liters of water-based paints per year. In Bollebygd, Flugger produces 24 million liters of both water-based and turpentine-based paint per year. The company employs 1,486 people.

49. Lanco Paints

Orlando, FL/USA
www.lancopaints.com

PRIVATE COMPANY; YEAR ESTABLISHED: 2003
REVENUE: $270 million
MARKETS SERVED
Decorative coatings; Industrial coatings; Roof coatings; Waterproof coatings, Wood coatings.
KEY EXECUTIVES:
Juan Pablo Gaztambide, president; Sergio Blanco, owner; Josue Vidal, CFO; Lisandra Quinones, CTO.

Lanco & Harris Corp. (dba Lanco Paints and Coatings) is part of the Blanco Group. In business since 1978, Lanco & Harris Corp. manufactures architectural and industrial coatings, roof sealers, wood finishes, industrial adhesives and high-performance sealants. The company has nine manufacturing facilities in the U.S., the Caribbean and Central and South America and employs approximately 2,000 people. The latest products launched include Lanco Aqua-proof. Lanco Coolguard and Lanco Insulaflex.

50. Taiho Paint

Dongguan, China
www.taihopaint.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1992
REVENUE: $263 million
MARKETS SERVED
Wood paints; Industrial paints; Decorative paints
KEY EXECUTIVES:
Chen Ho Sheng, chairman; Chang Cheng Hsien, GM.

Taiho Paint is a coating company focused on scientific research, production, sales and service. It covers the wood coatings, metal coatings, plastic coatings, architectural coatings and related markets, supporting a variety of chemical products, such as colorants, diluents series and resin. The company heavily invested to set up its global automatic production lines, experimental unit, testing equipment, and a high standard of technology research and development center. The company has five manufacturing facilities in China, Japan and Tawain. More than 15 new products are expected to be launched in 2019.

51. Meffert AG Farbwerke

Bad Kreuznach, Germany
www.meffert.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1947
REVENUE: $254 million
MARKETS SERVED
Architectural coatings; Wood coatings; Industrial coatings
KEY EXECUTIVES:
Klaus Meffert , president and member of the executive board, Dieter Meffert, member of the executive board.

Meffert is one of Europe's leading manufacturers of high-quality paints and varnishes, wood stains, plasters, sealing compounds, and renovation and building-protection products. Located in Bad Kreuznach, Germany and founded in 1947, Meffert's product range is sold in 60 countries and encompasses more than 30,000 products.

The company employs approximately 1,400 employees at more than 20 domestic and international production and distribution locations. The Meffert group of companies pursues the aim of aligning its services and support to the needs of its customers. The brands Dinova, ProfiTec and Albrecht, supply wholesalers for craft trades and industry. The brands düfa, Super Nova, Correx, farbfit and Pronova are for DIY users.

The company been committed to the guidelines of the worldwide initiative Responsible Care since 1999. The German Paint and Printing Ink Association (VdL) joined the United Nations Global Compact (UNGC). Being the UN's largest and most important initiative worldwide for responsible business management, the UNGC provides a unique framework to create the basis for a sustainable

global economy across borders and industry lines. As a member of the VdL Meffert champions the goals and the principles of the UN Global Compact.

52. ICP Group

Andover, MA, USA
www.icpgroup.com

PRIVATE COMPANY; YEAR ESTABLISHED: 2015
REVENUE: $250 million
MARKETS SERVED
Industrial coatings, Sports coatings, Architectural coatings, Rroof coatings, Environment coatings, Cementitious floor and deck coating
KEY EXECUTIVES:
Doug Mattscheck, CEO;
Sven Doerge, CFO;
Dave Baker, VP operations;
Eric Sifferlin,
VP Business Development;
Scott DeLeo and Doug Caffoe- VP marketing; Mojee Cline and Doug Rahrig- VP Technology.

ICP Group is a portfolio company of Audax Private Equity. In the first quarter of 2019, ICP Group completed three acquisitions.

The first acquisition included the brands of Fireshell, Heat Shedder, FireSafe and Structure Saver Intumescent Coatings – proprietary fire and thermal products that have been servicing the various construction markets for over 20 years. The second acquisition included ASTEC, a leading brand of fluid-applied membrane systems for the sustainable restoration of roofs, walls, tanks, piping, ductwork and other industrial surfaces. The third acquisition included Benefect, a world-recognized leader in next-generation botanical antimicrobials that produces disinfectant and cleaning supplies for the environmental remediation industry.

53. Samhwa Paints Industrial

Gyeonggi-do, Korea
www.spi.co.kr

PRIVATE COMPANY; YEAR ESTABLISHED: 1946
REVENUE: $247 million
MARKETS SERVED
Aerospace Coatings; Architectural Coatings; Floor and Protective Coatings; Industrial Coatings; Powder Coatings; Car Refinishes
KEY EXECUTIVES:
J.Y. Kim, CEO; S. Huh, COO; J.S. Oh, VP.

At Samhwa Paints, approximately 30 percent of employees are engaged in R&D activities. Samhwa invests four percent of revenue in R&D, and the amount increases year after year. Through the continuous investments in R&D, the majority of products being developed and sold are as premium paints such as The Classy and Aisaengkag. Samhwa makes a wide range of products from decorative paints to paints for architectural application and performance coatings such as plastic coatings, metal coatings, automotive refinishes, electronic materials coatings, protective coatings and powder coatings. The company also produces high-tech functional paints and aims to supply develop innovative products from its state-of-the-arts facilities. The company has plans to make inroads into the global paint market, including China.

53. Daoqum Chemical Group

Zhongshan City, Guangdong Province, China
www.daoqum.com.cn

PRIVATE COMPANY; YEAR ESTABLISHED: 1985
REVENUE: $247 million
MARKETS SERVED
Automotive coatings, Industrial coatings, Powder coatings.
KEY EXECUTIVES:
Xin Liu, group GM; zwenfeng Fu, vice GM.

Daoqum Chemical Group is a coatings company located in Zhongshan City, Guangdong Province in China and employs 733 people. The company has four facilities: Hefei, China, Auto OEM Coatings; Chongqing,China, Auto OEM Coatings/Industrial Coatings; Shanghai, China, Industrial Coatings and Zhongshan, China, Industrial Coatings/Powder Coatings. Automotive OEM coatings comprises 43 percent of revenue, general industrial and industrial maintenance comprises 36 percent, OEM comprises nine percent, powder coatings seven percent and specialty coatings five percent. The company recently launched waterborne coatings system for high-speed railway. Key brands include Daoqum /GoldenTree: Automotive OEM, Industrial Coating, Powder Coating.

55. SKSHU

Putian, Fujian/China
www.3treespaint.com

PRIVATE COMPANY; YEAR ESTABLISHED: 2003
REVENUE: $243 million
MARKETS SERVED
Decorative coatings; Architectural coatings; Wood coatings
KEY EXECUTIVE:
Hong Jie, chairman and president.

SKSHU Paint Co., Ltd. develops, produces and sells paints under the 3trees brand in China. It offers decorative paints, such as interior paints, architectural coatings, including floor paints, granite paints, stone covers, texture paints, and rock chip paints; wood paints comprising ultraviolet paints, PU paints, and NC paints; and auxiliary materials consisting of adhesives, waterproof paints and putties. The company has 3,000 employees.

56. Yasar

Izmir, Turkey
www.dyo.com.tr

PRIVATE COMPANY; YEAR ESTABLISHED: 1927
REVENUE: $238 million
MARKETS SERVED
Decorative paints; Construction paints; Industrial paints; Furniture paints; Automotive paints; Marine paints
KEY EXECUTIVES:
Selcuk Yasar, honorary president of Yasar Holding; Mehmet Kahya, chairperson of audit committee; Ahmet Metin Onaner, chair of early detection of risk committee.

Yasar Coatings Group is one of the leading paint producers in Turkey. Consisting of five companies led by Dyo Boya, it serves the market with 1,000 different products. Under the brand names Dyo and Dewilux, Yasar Coatings Group employs approximately 1,000 people and exports its products to 40 countries. The group's export markets are located primarily in Central Asia, the Middle East, Europe and Russia. Yasar has invested in Dyo Powder Coatings Facility and Dyo Africa LLC. The powder coatings facility is located in Turgutlu Organized Industrial Zone and will have an initial capacity of six tons. Dyo Africa was founded in Cairo, Egypt to handle the production marketing and sales in the construction, automotive and furniture segments in the Africa and Middle East Markets.

Yasar offers 1,200 products, in a range of 60,000 color options.

57. Grebe Group

Weilburg, Germany
www.grebe.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1936
REVENUE: $237 million
MARKETS SERVED
Industrial coatings; OEM coatings (non-automotive)
KEY EXECUTIVE:
Frank Gläser, CEO

Established in 1936, Grebe Group offers coatings for several markets. For household articles, the firm offers Greblon non-stick coatings and decorative, temperature-resistant coatings. For the stove industry, it offers high-temperature resistant coatings. For general industry applications, Grebe offers coating systems for metals, plastics and glass in applications such as sewage pipes, household appliances, rail vehicles, mobile phones and defense technology. The group operates facilities in Germany, U.K., Italy, Poland, China, Hong Kong Indonesia, India and Japan.

58. Pintuco

Medellín, Colombia
www.pintuco.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1945
REVENUE: $233 million
MARKETS SERVED
Decorative paints; Industrial coatings; Specialty coatings; Auto refinish coatings; Powder coatings
KEY EXECUTIVES:
Juan Carlos Moreno, president; David Villegas, director of international relations.

Pintuco is a member of the Orbis Group, a multinational holding with paints, chemicals, pipes and trade business. The company recorded revenue of $233 million, up four percent from the previous year. 73.3 percent of its sales are from decorative coatings, general industrial is 8.6 percent, 10.7 percent for specialty coatings, 3.7 percent for auto refinish and 3.7 percent for powder coatings.

Pintuco has approximately 2,500 employees. Grupo Orbis has begun the development of a domestic chain of Do-it-Yourself stores named Master Pro that will feature subsidiary Pintuco's full line of paints and coatings. The independent Pintucasa paint store network will continue to be expanded, as well, with a Pintucasa section planned inside each Master Pro store. Among Pintuco paint brands, Viniltex and Koraza are well known architectural segment brands. Similarly, the Terinsa and ICO brands are well known in the construction industry.

The group is active in over a dozen countries in Latin America. Last year Pintuco began distributing AkzoNobel's protective coatings under the International Paints brand in Peru. In Venezuela, Orbis owns Venezolana de Pinturas. Pintuco is broadly distributed in Central America in Costa Rica, El Salvador, Guatemala, Honduras, Panama and Nicaragua, as well as in the Caribbean islands of Aruba under the brand Arvefa, and Curacao, under the brand AVF.

59. Bauhinia Coatings Group

Shanghai, China
www.baucoatings.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1971
REVENUE: $232 million
MARKETS SERVED
Decorative coatings; Furniture coatings; Architectural coatings
KEY EXECUTIVES:
Fung Ping Kwong, co-president; Chan Chuen Sang, co-president; Kang Ning, chief technology officer.

Established in 1971, Bauhinia Coatings Group manufacturers decorative coatings, furniture coatings and architectural coatings. Approximately 45 percent of the company's sales were focused in architectural and decorative markets; 55 percent was for the general industrial and industrial maintenance sectors.

Parent company, Yip's acquired coatings brands Camel, Aquapro and VIVA in 2018 and their respective architectural and industrial coatings businesses in Mainland China, Hong Kong and Macau. The Group believes that the acquisition will help gain a significant foothold in Hong Kong's coating market and will create a synergy effect with the current businesses of the coatings group in areas such as manufacturing, technology, distribution and marketing, building a solid foundation for the development of Guandong-Hong Kong Macau Greater Bay Area.

60. Remmers Baustofftechnik GmbH

Löningen, Germany
www.remmers.de

PRIVATE COMPANY; YEAR ESTABLISHED: 1949
REVENUE: $226 million
MARKETS SERVED
Industrial coatings, Wood coatings
KEY EXECUTIVES:
Dirk Sieverding, chairman; Supervisory board: Klaus Boog, Heiko Dirks, Alexander Böhler.

The Remmers Group AG is an internationally operating company in the construction material technology with headquarters in Löningen, Lower Saxony. The family-owned company offers various products for the construction supplies, wood paints and coatings industry. With 1,500 employees, the Löning-based company develops and produces building chemical products for cellar sealing and facade repair, for concrete repair, industrial floor coating as well as wood paints and varnishes for the furniture, wood window and wooden door industry and industrial coatings for other industries and applications. In Central and Eastern Europe, Remmers has 15 independent subsidiaries and sales agencies in more than 30 countries.

61. Rock Paint

Osaka, Japan
www.rockpaint.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1952
REVENUE: $222.9 million
MARKETS SERVED
Automotive refinish coatings; Industrial coatings
KEY EXECUTIVES:
Utsumiya Tohgo, president and representative director; Yuji Ikeya, representative senior managing director; Akira Ichikawa, executive officer and director; Hideaki Shimizu, executive officer and director; Takanohashi Yoshinori, executive officer and director.

Rock Paint is among the leading manufacturers of automotive refinish paints in Japan. These include brands such as its Panarock Mars 2K series, Rockace and Hirock. Rock Paint has in recent years introduced a one-package type basecoat called Pro Touch. Responding to movements aiming to reduce levels of VOCs in paint products, Rock Paint set out early to develop waterborne automotive refinish paints.

62. Kikusui Chemical

Nagoya, Japan
www.kikusui-chem.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1959
REVENUE: $205 million
MARKETS SERVED
Architectural coatings
KEY EXECUTIVES:
Hitoshi Yamaguchi, president, president of subsidiary, representative director; Takeshi Nagai, director of industrial paint business, director of overseas business, chairman of subsidiary, director; Hiroyuki Imaida, managing director, chief director of housing business; Akiyoshi Nakagami, managing director; Shuichi Anan, deputy chief director of general-purpose paint business, director; Makoto Furukawa, deputy chief director of housing business, director; Nobuhiko Inaba, chief director of administration, director; Izumi Takada, director; Masao Toyama, director; Kenji Yamamoto, independent director.

Kikusui Chemical Industries Co. Ltd. engages in the production and sale of architectural coatings, specialty functional materials, construction materials, and civil engineering materials. The company offers ceramics, building materials, paints and crushed natural decorative material sheets. In addition, it involves in the manufacture and sale of machinery and equipment. The company was founded in 1959 and is headquartered in Nagoya, Japan. Under the slogan, "Work in Harmony with Nature, Work for the Benefit of People," Kikusui manufactures water-based and organic-solvent-free architectural paints and uses its own methods to minimize drainage and waste generated during the production process. In addition, the company deals with natural paints from Germany and allergy-free paints from Sweden.

63. Tambour Paint

Nethanya, Israel
www.tambourpaints.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1936
REVENUE: $200 million
MARKETS SERVED
Architectural coatings; Industrial coatings; Powder coatings
KEY EXECUTIVES:
Max Sartayev, chairman; Michael Dayan,CEO; Micha Scharir, financial director and VP; Ronen Cohen, CEO of Tzah-Serafon; Kobi Greenblum, sales director and VP; Ronen Kayzerman, international export director and international marketing director.

Founded in 1936, Tambour is the largest Israeli paint manufacturer. The firm operates six production facilities in Israel for architectural paints, industrial paints and powder coatings. Production capacity is approximately 90 million liters per year. Tambour will invest NIS 100 million in a new manufacturing facility in the southern city of Ashkelon. The company has begun construction on a new factory in Ashkelon.

64. MIPA

Essenbach, Germany
www.mipa-paints.com/en/welcome/

PRIVATE COMPANY; YEAR ESTABLISHED: 1948

REVENUE: $199 million

MARKETS SERVED

Automotive refinish coatings, Decorative coatings, Industrial coatings and Wood coatings

KEY EXECUTIVES:

Directors: Markus Fritzsche, Klaus Fritzsche, Uwe Rohr and Robert Jungwirth.

MIPA focuses on paints and varnishes. It offers car-refinishing solutions. The company also provides decorative products, including wood sealer, sealing agents/impregnation solutions, building enamels/primers, special exterior paints, white enamels, color concentrates, interior paints, additions, exterior paints, textured plasters, fillers/sealing agents, primers, wood preservations/primers, full-shade and tinting paints, colored enamels, special enamels, floor coatings, wood preservation/stain/weather protective paints, and thinners for building enamels. In addition, it offers industry products, such as waterbased single-coat-enamels, basecoats/clearcoats, pigment pastes, epoxy-primers/fillers, acrylic top coats, waterbased top coats, epoxy top coats, synthetic enamels, single-coat-enamels, acrylic enamels, nitrobased-top coats, and hardeners and additives. Further, the company provides aerosols, such as fillers and primers, acrylic-sprays, special coatings, corrosion protection solutions, clearcoats, plastic coatings, spot and linemarking solutions, aerosol filling machines, and prefilled aerosols. MIPA AG was formerly known as Paul Mittermayer GmbH and changed its name to MIPA AG in 2001.

65. RAR Holdings

Dubai, UAE
www.rarholding.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1970

REVENUE: $198 million

MARKETS SERVED

Wood coatings; Industrial and protective coatings; Decorative coatings; Powder coatings

KEY EXECUTIVES:

Rabih Reiady, chairman and CEO; Rudy Kairuz, chief marketing officer; Claudio Magagnoli, CTO; Wissman El Kassis; COO.

RAR Holdings is one of the largest coatings manufacturers in the Middle East, with a company headcount of 600. The company has factories throughout the Middle East, Africa and Europe. The focus of the company is in the in the Middle East where most of the manufacturing and sales are made. Recent product launches include:

- Anti Mosquito Emulsion Paints: Water Based Top Coat paints that repel mosquitos and other insects. Ecofriendly, safe and available in 12 color shades
- Board Paints: Solvent Based 2K paints that transforms any wall into a white board that can easily wiped
- An updated Stain Mix System: An updated version of its stain mix

system including 100 new stain colors and a more updated software and solution

- Intumescent Paints: Fire retardant paints that can resist heat for up to two hours

- DTM: Direct to metal one component paints that require no primer nor topcoats, it possesses anti rust properties and flawless adhesion.

66. Kapci Coatings

Port Said,Egypt
www.kapci.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1985
REVENUE: $180 million
MARKETS SERVED
Automotive refinish; Decorative paints; Wood finishes
KEY EXECUTIVES:
Mohamed Mohamed Ahmed El-Sayed, CEO; Amr Mohamed El-Sayed, commercial director; Lotfy Hassan El-Badrawy, R&D director.

The company was founded in 1985 under the name Kantara Paints and Chemical Industries specializing in car refinish paints. In 2002 the company opened its current headquarters located in Port Said and changed its name to Kapci Coatings. The company has a headcount of 1,500. In 2018, Kapci generated revenue of $180 million. Car refinishes accounted for 63 percent of sales; architectural and decorative coatings 20 percent; wood finishes accounted for 14 percent, and inks accounted for three percent. Kapci Coatings' production facility is located on 210,000 square meters of space where the company has an annual production capacity of roughly 80,000 tons. It has recently expanded its warehouse space. The new location, specifically for emulsion paints, will be nearly 62,000 square meters.

67. Frei Lacke

Döggingen, Germany
www.freilacke.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1926
REVENUE: $171 million
MARKETS SERVED
Powder coatings, Industrial coatings, Corrosion protection
KEY EXECUTIVES:
Rainer Frei, managing director; Hans-Peter Frei, technical director.

Frei Lacke is a family-owned company in its third generation and develops customized solutions for clients from the wheel and vehicle manufacturing industries, as well as those in the fields of mechanical and apparatus engineering, job coating, functional furniture, storage technology, construction and sanitation, directly through its 568 employees at its Döggingen base.

The product range of Europe's leading system coating provider covers the entire spectrum of industrial coatings, powder coatings and electrodeposition coatings all the way through to Durelastic surface solutions for composites. Its international sales are carried out though a global network of foreign subsidiaries and partners.

68. Natoco

Miyoshi, Japan
www.natoco.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1948
REVENUE: $162 million
MARKETS SERVED
Architectural coatings; Industrial coatings
KEY EXECUTIVE:
Kenji Kasuya, president and representative director.

Natoco Co., Ltd. manufactures fine chemicals and paints. It offers synthetic resin paints and inks. The company primarily provides coatings for metal, building and other functional materials, as well as related equipment. The company was founded in 1948 and is headquartered in Miyoshi, Japan and operates in three business segments. The paint segment is involved in the manufacture and sale of synthetic resin paints, thinners and paint-related products. The fine chemical segment manufactures and sells chemical products such as film-use coating materials, as well as fine particles for liquid crystal displays (LCDs), among others. The company employs approximately 205 people.

69. Dold Gruppe

St. Gallen, Switzerland
www.igp-powder.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1968
REVENUE: $155 million
MARKETS SERVED
Powder coatings
KEY EXECUTIVE:
Curt Christian Dold, president.

IGP Powder Coatings, part of the Dold Gruppe, has 470 employees worldwide. The develops high quality powder coating solutions for its customers. Thanks to the close co-operation between its subsidiaries and the headquarters in Wil, St. Gallen, Switzerland, a concentrated transfer of know-how takes place. Market needs are thus quickly detected and met with progressive, tailor-made system solutions. Over the years, the company has made a name for itself as a reliable partner by clearly committing to quality and reliable supply.

70. Sniezka Woj.

Lubzina, Poland
www.sniezka.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1984
REVENUE: $153 million

MARKETS SERVED

Interior coatings; Exterior coatings; Wood and metal preservation

Sniezka Paints and Varnishes Plant S.A. is an industry leader in Poland, both in terms of quantity and value. Sniezka is a modern plant employing approximately 600 people and producing approximately 90 million liters yearly of a variety of chemical products used in the construction industry in the domestic market and foreign markets. The company concentrates its activity in the area of emulsion paints (thinned with water), oil and phthalic paints (solvent paints), and putty substances. The company offers a wide range of high quality paints and varnishes, at the same time providing its customers with assistance in the implementation and application of its products.

71. Diamond Vogel

Orange City, IA, USA
www.diamonvogel.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1926

REVENUE: $150 million

MARKETS SERVED

Architectural coatings; Industrial coatings; Heavy duty coatings; Traffic coatings; Wood finishes

KEY EXECUTIVES:

Drew Vogel, chairman and CEO; Jeff Powell, president; Meika Vogel, VP and general counsel; Doug Vogel, VP marketing and strategic relationships; Mark Vogel, VP corporate business development and strategic relationships.

Diamond Vogel Paints is a family-owned, Midwestern-based paint manufacturer and retailer established in 1926 and headquartered in Orange City, Iowa. The company operates seven manufacturing facilities and more than 80 service center outlets. Diamond Vogel is a provider of liquid and powder coatings for industrial OEM applications, architectural paints for commercial and homeowner applications, and heavy-duty protective coatings for industrial maintenance applications.

Diamond Vogel announced the launch of a new online store for its Peridium Powder Coatings. The new online marketplace makes it easy for customers to find and purchase Peridium Powder Coatings from the Power 80 On-Demand collection. The Power 80 On-Demand collection is eighty of their most popular powder coating colors that are in-stock and ready to ship.

72. ICA Group

Civitanova Marche, Italy
www.icaspa.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1971

REVENUE: $132 million

MARKETS SERVED

Industrial wood coatings

ICA SpA is an Italian company founded in Civitanova Marche in 1971 and specializing in coatings for wood. The iCO division retains intact the personnel, facilities and expertise of Salchi Wood Coatings, based in Romano D'Ezzelino. In 2018, ICA Group's revenue was $132 million, of which 54 percent was generated outside Italy. The manufacture of coatings is carried out at two production plants in Italy. ICA group sealed an important joint-venture agreement with Pidilite for the distribution of its products on the Indian market as well as for other adjacent countries such as Sri Lanka, Bangladesh, Bhutan and Nepal. The group currently has 560 employees and more than 10,000 clients.

73. Shinto Paint

Amagasaki, Japan
www.shintopaint.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1933

REVENUE: $130 million

MARKETS SERVED

Automotive coatings; Industrial coatings

KEY EXECUTIVES:

Satoshi Takazawa, president; Masayoshi Kashida, executive senior managing director and director; Yukifumi Tokunaga, executive senior managing director, general manager of sales department and representative director; Toshio Mitsuhara, managing director, general manager of production division and director.

Shinto Paint Co., Ltd. engages in the manufacture, processing and sale of paints, adhesives, pigments, synthetic fats/oils, fats/oils, and chemicals in Japan. In addition, the company designs, implements, and supervises painting work and other various construction work, as well as related technical supervision. Further, it engages in contracting of installation work for painting facilities; and related machinery equipment, tools, and devices, as well as design and supervision of such installation work. The company provides maintenance coatings for protection against rust and corrosion to nuclear power stations, chemical plants, petroleum refinery plants, water and sewage treatment plants, and paper mills, as well as large-sized steel structures, such as ships, drilling rigs, offshore platforms, and other ocean development plants.

73. Industrias Titan

Barcelona, Spain
www.titanlux.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1917

REVENUE: $130 million

MARKETS SERVED

Decorative coatings; Industrial coatings; Marine coatings; Powder coatings; Fine arts materials

Since it was founded in 1917 in Barcelona, Industrias Titan has produced paints, enamels, varnishes, powder coatings, colors for fine arts and handicrafts, as well as ancillary products. Titan has of the most modern manufacturing plants in

Europe with a capacity to produce over 50,000 tons of products every year. The warehouses, laboratories and offices combined have a surface of over 130,000 m2 in El Prat de Llobregat. The factory is strategically located in an area close to the airport, the AVE train station, the port of Barcelona and the largest Spanish water treatment plant. Expansion has led to more manufacturing plants in Seville, Canary Islands (Gran Canaria), Porto (Portugal) and Tangier (Morocco).

75. Kangnam Jevisco

Pusan, South Korea
www.jevisco.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1945

REVENUE: $129 million

MARKETS SERVED

Decorative coatings; Industrial coatings; Marine and protective coatings; Automotive

KEY EXECUTIVES:

Ki-suk Woo, chairman and CEO; Gyeong Tai Shin, president; managing directors: Sang Kun Lee; Jae Hui Kim; Dong Hyeon Cho; Seung Hwan Shin.

Kangnam Jevisco offers a range of products, including architectural coatings for concrete, plaster, slate and cement mortar surfaces, as well as for vehicles, machinery, buildings, glass and furniture; general industrial coatings for various applications, such as wood, steel furniture, electric home appliance, machinery, engineering plastics, steel products and decorative home appliance; wood coatings for furniture, general wooden materials, and musical instruments; and powder coatings for decoration and protection, interior use, home appliances, and architectural use. launched the best color collection, made by selecting colors with high usage in interior designs as well as exterior designs. Each of the 240 colors listed in the best color collection applies a unique color naming system in Korea and the color story delivers the meanings and utilization methods of each color to help non-professionals to easily and quickly coat and to enable broader application in interior and exterior design for professionals.

75. ADLER-Werk Lackfabrik

Schwaz, Austria
www.adler-lacke.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1934

REVENUE: $129 million

MARKETS SERVED

Architectural/decorative coatings, Wood coatings

KEY EXECUTIVES:

Andrea Berghofer, managing director; Bernd Pichler, marketing director; Alfred Rössler, technical director.

ADLER-Werk Lackfabrik is Austria's leading manufacturer of varnishes, paints and wood preservatives. The company has 620 employees. ADLER-Werk Lackfabrik is an independent company owned by the Berghofer family in its third generation. Some of the newest products include: quawood InterCare SH (window coating), Aquawood DSL Carat (window coating), Aquawood Nativa (window coating), Aduro Vitea (furniture coating), Bluefin Smart (furniture coating), Bluefin Pigmosoft (furniture coating), Lignovit Terra (wood preservative for in- and outdoor use), Lignovit Interior UV 100 (wood preservative for indoor use). Key brands include: Aquawood (window and front door coatings, water- based), Bluefin (industrial furniture coatings, water-based), Innolux (industrial furniture coatings, solvent-based), Aduro (non-industrial furniture coatings, sovlent-based), Arova (wood stains, water-based), Pullex (wood preservative coatings, solvent-based), Lignovit (wood preservative coatings, water-based), Legno (wood-oils and wood-waxes), Aviva (wall colors).

77. Asahipen

Osaka, Japan
www.asahipen.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1940

REVENUE: $125 million

MARKETS SERVED

Onshore coatings; Marine coatings; Automotive coatings; Decorative coatings

KEY EXECUTIVES:

Takeshi Tanaka, president; Tatsuo Nishi, managing director; Nobuyuki Goto, managing director; Kazuharu Yamamoto, director; Kogo Sawada, director.

Asahipen Corporation engages in the manufacture and sale of various paints and coatings, painting tools and wallpaper products in Japan. The company offers water-based, oil-based, anti-rust, spray, gloss varnish, wood, hobby craft and business paints. Asahipen Corporation markets its products through dealers, government agencies, and other outlets in China, Hong Kong, Taiwan, and southwestern Asia. The company was formerly known as Asahi Paint Company and changed its name to Asahipen Corporation in 1965. Asahipen Corporation was founded in 1940 and is headquartered in Osaka, Japan. Asahipen Groups are organized into many paint-manufacturing subsidiaries including Asahipen Corporation, Daiho Tokyo Inc., Asahipen America Inc. and in the field of UV finishing it operates Trust Inc.

78. Tnemec

Kansas City, MO/USA
www.tnemec.com

PRIVATE COMPANY; YEAR ESTABLISHED: 1921

REVENUE: $124 million

MARKETS SERVED

Water tank coatings; Water and wastewater coatings; Industrial coatings; Architectural coatings; Processing and manufacturing coatings

KEY EXECUTIVES:

Chase Bean, CEO and president; Steve Eiserer, CFO.

Since 1921, Tnemec Company Inc. has been a leading manufacturer of high-performance architectural and industrial coatings that protect a wide range of substrates and enhance aesthetics. From water tanks and treatment plants, to manufacturing plants, industrial facilities and specialty architectural buildings, Tnemec coatings can be found protecting virtually all types of structures and buildings. Tnemec operates two manufacturing facilities in the U.S. in North Kansas City, Missouri and Baltimore, Maryland. The company currently has 260 employees.

79. Kayalar Kimya

Istanbul, Turkey
www.kayalarkimya.com.tr

PRIVATE COMPANY; YEAR ESTABLISHED: 1976

REVENUE: $123 million

MARKETS SERVED

Architectural coatings; General industrial coatings; Wood coatings

KEY EXECUTIVES:

Ersin Kenan Kayalar, CEO; Ender Bahadir Baykara, CFO; Zafer Kayalar, assistant GM of purchases and finance; Tolga Kayalar, assistant GM of sales, marketing and IT.

Founded in 1976, Kayalar Kimya provides a stable and reliable production environment of total 59.000 m2 area in Turkey and in Spain, equipped with state-of-the-art technology and cutting edge automation system. With its 60,000 tons of capacity, Kayalar Kimya is one of the Europe's largest paint and varnish manufacturers. Turkish Exporters' Union rewarded the company with "Star of Export" award in recognition of export performance in 60 countries.

80. Russian Coatings JSC

Yaroslavl, Russia
www.ruskraski.ru

PRIVATE COMPANY; YEAR ESTABLISHED: 1838

REVENUE: $110 million

MARKETS SERVED

Decorative and building materials; Automotive OEM; Car refinishes; Industrial materials; Powder materials

KEY EXECUTIVES:

Abramov Valeriy, CEO; Savelyev Phillip, director of economic; Kolomichev Mikhail, coatings technical director.

Russian Coatings celebrated its 180 year anniversary this year. Production volume in 2018 amounted to 35.9 thousand tons (+two percent) compared to the previous year), the sales volume in monetary terms has grown by five percent in ruble equivalent. Not all business lines have developed equally; the industrial business was the most successful. The sales growth amounted to +15. The sales driver has become new anti-corrosion materials for the protection of metal structures. The volume of these materials in the product portfolio reached 40 percent.

81. Tohpe

Sakai City, Japan
www.tohpe.co.jp

PRIVATE COMPANY; YEAR ESTABLISHED: 1915

REVENUE: $107 million

MARKETS SERVED

Onshore coatings; Marine coatings; Automotive coatings; Decorative coatings; Adhesives

KEY EXECUTIVES:

Hiroyuki Shiaku, president and representative director; Nobuo Matsuki, GM of technology & director; Kunihiko Morishita, GM of administration and director; Kazutami Kato, VP and director; Seiji Ishii, GM of production and director.

Tohpe Corporation is a Japan-based manufacturer that supplies paints and other chemical products. Its paints include synthetic resin paints, lacquers, water-based paints, oil-based paints and thinners. The company employs 316 people. The company has 44 subsidiaries, 56 branches and five associated companies. Its offers architectural coatings, exterior paints, steel coatings, concrete protective coatings, marine paints, industrial paints and road paints. In addition, it involves in exterior painting contract and building construction works, as well as in the sale of paint-related equipment. The company was founded in 1915 and is headquartered in Sakai City, Japan.

82. WEG

Guaramirim, SC - Brazil
www.weg.net

PRIVATE COMPANY; YEAR ESTABLISHED: 1983

REVENUE: $100 million

MARKETS SERVED

Powder coatings; Marine coatings; Industrial coatings; Protective coatings; Automotive refinish coatings; Varnishes

KEY EXECUTIVE:

Reinaldo Richter, director and superintendent.

WEG Group's Coatings Unit provides solutions in liquid industrial and anticorrosive coatings, automotive refinish coatings, powder coatings and electro insulating varnishes and resins. WEG Coatings is a leader in the Brazilian market in powder coatings and electro insulating varnishes and resins and is a leader in industrial and anticorrosive coatings in Latin America. The company was founded in 1983 and is based in Guaramirim, Brazil. WEG Tintas Ltda. operates as a subsidiary of Weg SA. ***CW***

A Fraught Path through the Summer for Epoxy Resins

Jennifer Hawkins, *Contributing Writer*

It was a tumultuous first half of the year for the global epoxy resins industry. Global economic headwinds and the U.S./China trade war weighed down on consumer sentiment and this created a pervasive negative outlook for the epoxy resins and its downstream markets. Then on March 21, a tragic explosion at a pesticide/fertilizer plant in Jiangsu, China saw a huge swathe of plants in the surrounding areas being shut for safety inspections. Up to 50 percent of China's epoxy resins capacity is based in this region. There was a collective intake of breath as market participants across the world feared that supply in China and then Asia would suddenly tighten and send prices rocketing. But then, news emerged that the downstream plants had also been shut, meaning that both epoxy resins supply and demand in China had ground to a halt. As a result, the accident hardly registered a blip in the Asian, European and the U.S. markets for most of April and May but this was because both demand and supply were being artificially suppressed by the safety inspections.

This also meant that the epoxy resins' feedstock markets, epichlorohydrin (ECH) and bisphenol A (BPA), also suffered. Bisphenol A has had a particularly bad run since the middle of last year as its major end-use consumption from polycarbonate has been hit by the weak performance of the automobile industry and escalating tensions in the current trade war. The epichlorohydrin market also stagnated during this time even though Hali, the largest global ECH producer, based in China, had all of its lines shut. This was because one plant in Shandong was shut at the end of October 2018 following an environmental inspection and then its remaining line in Jiangsu was also shut for safety inspections after the accident in March. Also, another large ECH producer, Yihai Kerry was reported to have been shut down in May due to certification problems and all of its inventory stock had been sold out.

Then, towards the end of May, some of the Chinese epoxy resins producers and their downstream customers were given permission to restart. By early June, it was becoming clear that epichlorohydrin supply in China was tightening at an alarming rate and within one week prices had jumped by more than Rmb2500-3000/ton ($320-385/ton before VAT). Bisphenol A values in Asia also started to increase during this time but any rise was expected to be capped by a poor performing polycarbonate market. (Normally, the polycarbonate market has an average 65 percent share in total bisphenol A consumption.)

There was a very similar scenario back in mid-2017 when environmental policies in China saw a number of ECH plans being shut to make necessary modifications to their wastewater management. As a result, epichlorohydrin supply in China became very tight – Asian suppliers in the region quickly diverted their export volumes from the U.S. and Europe to a more favorable Chinese market ECH prices rocketed and it wasn't long before epoxy resins prices were following the same sharp trajectory. It took almost four months before the global epichlorohydrin and epoxy resins markets finally settled down. Sources believe that it is going to be the same story for summer 2019 and the first signs have already started to emerge.

It is possible that it is going to be a tough summer for epichlorohydrin and epoxy resins buyers but there is light at the end of the tunnel. The ECH tightness is expected to be short-lived. The reality is that the world has more epichlorohydrin than it can cope with and it will take very little for the market to descend back into its usual oversupply situation. A new epichlorohydrin producer had started trial production at its new plant in May and a further two new manufacturers are expected to bring production online in Q3 2019. Also, a propylene oxide producer in China has the ability to switch its production to ECH. In other words, almost 200 ktpa of extra ECH capacity is due to start before the end of this year. However, much will depend on Chinese demand; if this falls back to the same depressed state as it was before the Jiangsu fire, it is likely that the global epoxy resins markets will settle down again very quickly. **CW**

Jennifer Hawkins reports and provides in-depth analysis on the European, North American and Asian phenol, acetone, bisphenol A, epichlorohydrin and polycarbonate markets for a monthly report published by Tecnon OrbiChem. If you would like to contact Jennifer you can do so at jennifer.hawkins@orbichem.com

Tecnon OrbiChem has been a leader in providing data and analysis to the petrochemical industry since 1976. The company is now one of the world's foremost marketing consultancies to the bulk chemicals, petrochemicals and plastics industries, specializing in chemical intermediates, synthetic Fibers and resins. For further information go to www.orbichem.com.

Coatings Industry Joins Forces to Secure Mica Supply Chain and Eradicate Child Labor

Fanny Fremont, *Executive Director, Responsible Mica Initiative*

Coatings manufacturers and pigments suppliers have combined resources with other members of the mica supply chain and NGOs focused on child labor to create the Responsible Mica Initiative (RMI), a global initiative with a singular purpose: to establish a responsible and sustainable mica supply chain and eliminate the use of child labor in India's mica industry. Extreme poverty and political instability in the northeast states of Bihar and Jharkhand have created poor working conditions and made it a financial necessity for parents to bring their children to work in mines. A permanent solution was needed that would not only take children out of mines but tackle the underlying causes and create a safe and secure mica supply chain.

Mica has many applications. Its visual properties provide effects in cosmetics and in coatings for automotive OEMs. The electronics industry relies on mica's natural insulating properties for cables, capacitors and a myriad of other products. Mica is a functional filler in plastics and construction materials and a lubricant in oil and gas drilling.

In 2017, 20 companies and NGOs established the RMI. To achieve an ambitious goal of establishing a responsible and sustainable supply chain and eliminating child labor in the sector by 2022, RMI adopted a strategy that would simultaneously implement three program pillars. Together, the programs would lead to outcomes that would benefit both members of the global supply chain and sustain the village communities that provide the local mica workforce.

First, to secure the supply chain every RMI member participates in a mica mapping protocol that links the mica in their products to individual mines and processors. Concurrently, RMI partnered with an Indian workplace practices expert to develop environment, health and safety standards – including labor practices that prohibit child labor – that would be adopted by the mines and processors. The mapping protocol and workplace standards operate in tandem so that all RMI members can support – with resources provided by RMI – the implementation of these standards within their supply chains.

However, taking children out of mines – without addressing the underlying causes – would not provide a permanent solution. Therefore, RMI's second program pillar focuses on empowering and supporting the communities that supply the mica workforce. A staff of more than 90 professionals drawn from eight Indian NGOs and trained local village leaders works to improve the quality of village schools, deliver better health care to women and children, and identify additional means of livelihood to reduce village dependence on mica. Launched in the first half of 2018, the community empowerment program has already reached 80 villages and benefited more than 5,300 households.

To further promote a long-term solution, RMI's third program pillar advocates for laws and regulations that will provide an inclusive and sustainable legal framework for the sector. RMI supported the establishment of a Business Committee, comprised of local mica industry leaders, and a Civil Society Committee to develop and validate the legal framework in collaboration with state government representatives and to support the other program pillars.

RMI's multi-stakeholder approach turns policy into practice. Our program pillars implement the mandates and fulfill the goals established by intergovernmental bodies such as the UN Guiding Principles on Business and Human Rights, the UN Sustainable Development Goals and the OECD's Practical actions for companies to identify and address the worst forms of child labor in mineral supply chains. In recognition of RMI strategy and accomplishments, in 2018 RMI was recognized in a case study by the U.S. Department of Labor International Labor Affairs Bureau in its annual report on child labor and by the UN Forum on Business and Human Rights as best practice at its annual November conference in Geneva.

Today, RMI has more than 50 members who are the sole source of funding. We invite members of the coatings industry, their suppliers and their customers such as automotive OEMs to join RMI and become part of the solution. For more information about RMI please visit us at www.responsible-mica-initiative.com and read our RMI 2018 Annual Report. ***CW***

Higher Performance, Higher Solids – A New Platform for High-Solids Alkyds

Jeffrey Arendt and Jun Kim, *Arkema Coating Resins, USA*

Abstract

In many market segments alkyd technology offers a value proposition unmatched by other coating technologies. As a result alkyds maintain significant share in these segments. Increasing market trends toward sustainability are creating a need to adapt the technology without sacrificing coating performance. High solids, exempt solvents and waterborne approaches are often evaluated when aiming to reduce the VOC of alkyd coatings. Exempt solvents face limitations in odor, solubility, cost, flash point and geographic compliance. Waterborne performance is improving, however gaps in performance and aesthetics still exist. For the end-user, high solids approaches require the least investment and are often the simplest approach to meeting VOC targets. Historically moving to high solids has come with a compromise in dry time and hardness. With this in mind, the authors of this paper have continued to advance high-solids alkyds and have developed a new alkyd platform. The new platform expands performance in the high-solids space and is useful for creating alkyds and modified alkyd polymers that offer low VOC, low viscosity and fast dry benefits. Differing from some other high solids approaches, this new platform is derived from readily available feedstock materials and is commercially viable. This paper reviews the versatility of this new technology platform and demonstrates coating applications that can improve their performance/VOC balance using this development. Applications span across both Architectural and Industrial markets, including: ACE, maintenance, wood, and decorative coatings.

Introduction

With a history of proven performance in architectural and industrial coatings and the ability to adhere to less-than-ideally prepared substrates, alkyd resins have remained at the forefront of coating technology for well over 50 years. With such an established history, alkyds are often thought of as old technology and often synonymously associated with environmental compliance issues. Such historical associations are not the contemporary story. New technology has been developed to take alkyd technology into the future. This paper discusses applications for an innovative alkyd platform designed to solve performance challenges observed when reformulating solvent-based alkyds to meet increasing consumer demands and tighter environmental regulations. This novel alkyd platform allows for faster surface dry and earlier hardness development at reduced VOC.

Alkyd technology originated in the mid-1920s. At that time drying oils were often used, however drying oils lacked the durability needed to advance coating performance. Scientists combined polyester technology with air drying oils to create oxidatively-curable alkyd resins. This invention improved upon the properties of drying oils and polyesters. Unmodified polyester resins do not air dry. Alkyds are modified polyesters that can air dry. The alkyd resins developed offered improved coating durability over drying oils. As the industry advanced, numerous alkyd and modified alkyd resins were created demonstrating the versatility of alkyd technology for coating applications.

To manufacture a solvent-based alkyd paint a coating producer will use an alkyd polymer supplied as a concentrated resin solution. Coating manufacturers disperse pigment into the resin solution and add solvent to the system to reduce the viscosity to the desired application viscosity. In the industry today the use of solvents is regulated as most common solvents qualify as volatile organic compounds (VOCs). With increasing consumer pressure and increasing environmental regulations there exists a need to reduce the VOCs in solvent-based coatings. It is this need that inspired the work of this research team to develop a novel alkyd platform to aid the coating manufacturer in VOC reduction while maintaining the performance levels higher-VOC coatings are known for.

Marketing data shows water-based coatings are on the rise and this paper's authors have demonstrated novel water-based alkyd technology for VOC reduction.[1] At the same time, there are situations where water-based coatings have not been able to meet the application parameters required. An example of this is the metal coatings industry. Solvent-based alkyds continue to hold a significant position in the metal coating industry as a result of their cost/performance balance. The ISO 12944 standard is intended to assist engineers and corrosion experts in adopting best practice in corrosion protection of structural steel at new construction. A cursory review of major coatings manufacturer's recommendations for ISO 12994 rarely turns up a latex paint recommendation. The minimum performance recommendation for this standard generally consists of solvent-based alkyds. Water-based coatings have certain inherent challenges and limitations that researchers still need to overcome to replace alkyds in all markets. An unavoidable limitation of water-based technology is caused by the high surface tension of water. To overcome this, high levels of surfactant are needed. Also, because water-based resins generally do not thicken the water phase, high levels of water soluble rheology modifier are needed. Solvent-based alkyd coatings require fewer additives than water-based coatings. With minimal additive requirements solvent-based coatings are easier to formulate for water resistance, corrosion resistance, and adhesion.

Alkyd coatings develop properties and molecular weight via an oxidative curing mechanism. This curing mechanism remains a significant technology for creating easy to use, cost effective, one-component coatings. Alkyd coatings begin the filming process with a low molecular weight. Starting the filming process with a low molecular weight allows for better substrate wetting and flow into the substrate (i.e., the cellular structure of wood) if the substrate is porous. This type of polymer flow is not possible with a high-molecular-weight polymer. This high degree of polymer flow also enables alkyds to achieve superior gloss. After wetting the substrate, the solvent begins to evaporate and the alkyd begins crosslinking with atmospheric oxygen. Crosslinking increases the molecular weight of the coating system developing the needed mechanical properties. A primer on this technology can be found in other publications.[2] Over the years the performance, cost and versatility of alkyd technology has resulted in this polymer technology holding significant share in almost all coatings markets. In markets where alkyd coatings are still used today it is often difficult to replace this technology without trading off a performance property, paying a higher cost, or investing in new coating applications procedures and equipment.

Alkyd Coatings Market

Almost all major coating segments in the United States use alkyd resins. Table 1 indicates the share of each coating market segment that uses alkyd resins.[3]

In these segments alkyd technology maintains a share of the segment because of the value and performance offered. If VOC levels are tightened these segments may need to replace their current technology with a lower-VOC capable technology.

High-solids alkyds are an option for compliance. High-solids systems can be applied using conventional spray equipment with minor modifications. Also, high-solids alkyds can be blended with conventional alkyds to lower the total VOC emitted. The challenge with moving to high solids is to maintain performance.

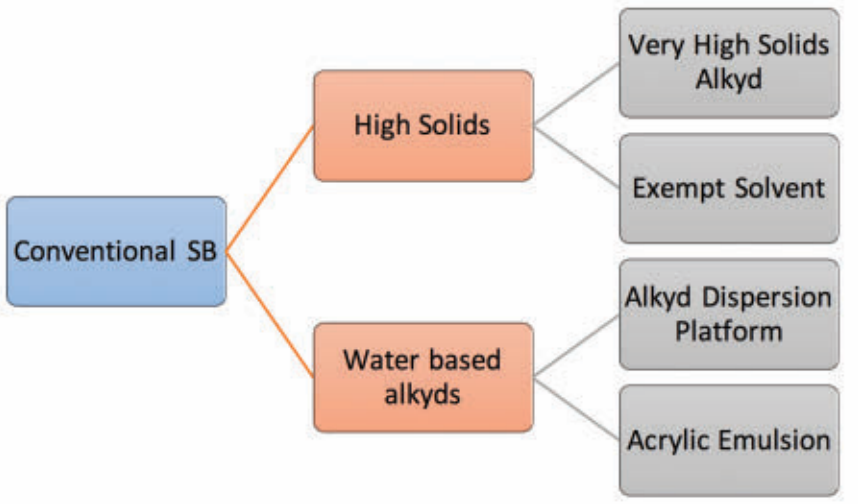
TABLE 1: Market share of alkyd technology in various coating market segments.

Coating Segment	Alkyd's Share of Segment
Heavy Equipment	38%
Transportation	22%
Protective and Marine	10%
Industrial Wood	8%
Aerosol Paint	50%
Traffic Paint	6%
Industrial Maintenance	10%
Architectural	17%

The Problem - Alkyd VOC Challenges and Current Approaches

As noted in Table 1, alkyds have a prominent share position in most major coating markets. With evolving consumer preferences and increasing environmental regulations acting upon coating manufactures there is a need to develop lower-VOC coatings with minimal change in performance. Figure 1 outlines the evolution alkyd technology has undergone as markets and technology have responded to comply with tightening VOC regulations.

FIGURE 1: Alkyd technology evolution for meeting VOC requirements.



As we move from left to right (in Figure 1) each of these technologies has advantages and disadvantages. Waterborne approaches were discussed earlier in this paper and are covered in detail in other papers. Advances have been made, however performance challenges still exist making the high-solids paths the easier approach to take to achieve compliance and performance.

Exempt solvents are solvents that do not need to be counted as a VOC. Some examples include para-chlorobenzotrifluoride (Oxsol 100), acetone, t-butyl acetate, VMS fluids, methyl acetate and di-methyl carbonate. These solvents are exempt from the VOC calculations in most United States areas. In principle the use of exempt solvents is a terrific solution for VOC reduction. Simply exchange the solvent and maintain performance. In practice the exchange of these solvents is not simple. Each of these solvents has its own challenges in solvency, cost, evaporation rate, stability and performance. Furthermore, not all exempt solvents are recognized as exempt in all air districts and there are increasingly more local air districts to comply with.[4] Exempt solvent can be an approach to compliance, however we will not take this approach in this paper as we believe a polymer approach is a more broadly applicable solution to compliance and performance.

To understand how VOC reduction occurs when moving to high solids, Table 2 shows the relationship between the volume solids and the VOC of a coating thinned with butyl acetate solvent. To achieve a VOC of 250 g/L, the coating will require 72% of its volume to be comprised of non-volatiles. To achieve such high solids and allow for good atomization with normal sprayers, the resin must have a low viscosity while also having all the other required technical performance properties needed for each end-use application.

To achieve higher solids the formulator must load more non-volatiles into the coating. A significant portion of the added non-volatiles is resin. To load in more resin and achieve a low application viscosity requires that the resin have a low viscosity. Typically what is seen is a large fall off

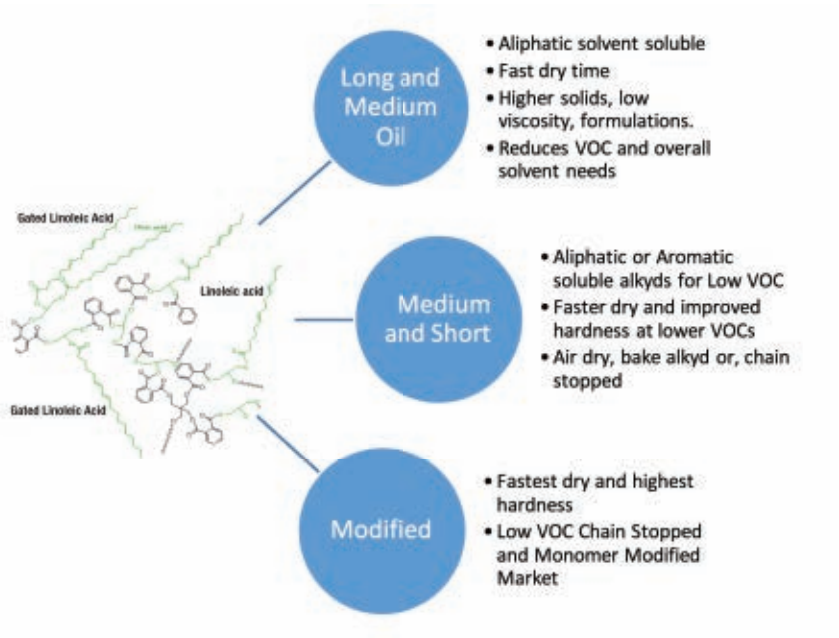
TABLE 2: Relationship between solvent volume solids and VOC.

		00VOC	
Paint Volume Solids	**Solvent Volume Solids**	**g/L**	**lbs/gal**
0%	100%	882	7.35
10%	90%	794	6.62
20%	80%	706	5.88
30%	70%	617	5.15
40%	60%	529	4.41
50%	50%	441	3.68
60%	**40%**	**353**	**2.94**
65%	35%	309	2.57
70%	30%	265	2.21
72%	**28%**	**250**	**2.08**
75%	25%	221	1.84
77%	**23%**	**203**	**1.69**
80%	20%	176	1.47
83%	**17%**	**150**	**1.25**
85%	15%	132	1.10
89%	**11%**	**100**	**0.83**
90%	10%	88	0.74
95%	**5%**	**44**	**0.37**
100%	0%	0	0.00

in dry time and hardness development as the resin's molecular weight is lowered to achieve a low viscosity. A low-molecular-weight resin requires more time and more crosslinks to build to properties than a high-molecular-weight resin.

There are several approaches that can be taken to lower the viscosity of alkyd polymers thereby allowing for higher-solids formulations. These approaches include: lowering the molecular weight, increasing the fatty acid amount, building a highly branched polymer structure, and focusing on a narrow molecular weight distribution. Decreasing the molecular weight and increasing levels of a fatty acid does lower viscosity, however this comes at the expense of other coating properties. On the other hand, building a highly branched polymer structure and achieving narrow molecular weight distribution requires high-cost raw materials and a tedious long batch process.

FIGURE 2: Potential modifications paths and applications of the novel alkyd platform.



*As the composition is proprietary a traditional alkyd appears in graphic

A Potential Solution – A New Technology Platform for Alkyds

To solve these challenges we have developed a new alkyd technology platform. This platform builds upon the experience gained through the commercial manufacturing of previous generations of high-solids alkyds. The new platform delivers faster dry times and higher hardness than the standard approaches used to make high-solids alkyds. This technology has been designed to utilize feedstock raw materials that are readily available today and viable long term in the marketplace.

Using this platform's technology in conjunction with known structure property rules of alkyd polymer design it is possible to create novel alkyd products spanning the entire alkyd performance spectrum. Figure 2 outlines some of the modification paths that are possible using this novel alkyd platform technology. The novel alkyd may be modified to make long-, medium-, and short-oil alkyds. It is also possible to monomer-modify this alkyd for further

FIGURE 3: Conventional and novel alkyd dry time vs VOC level at constant paint viscosity.

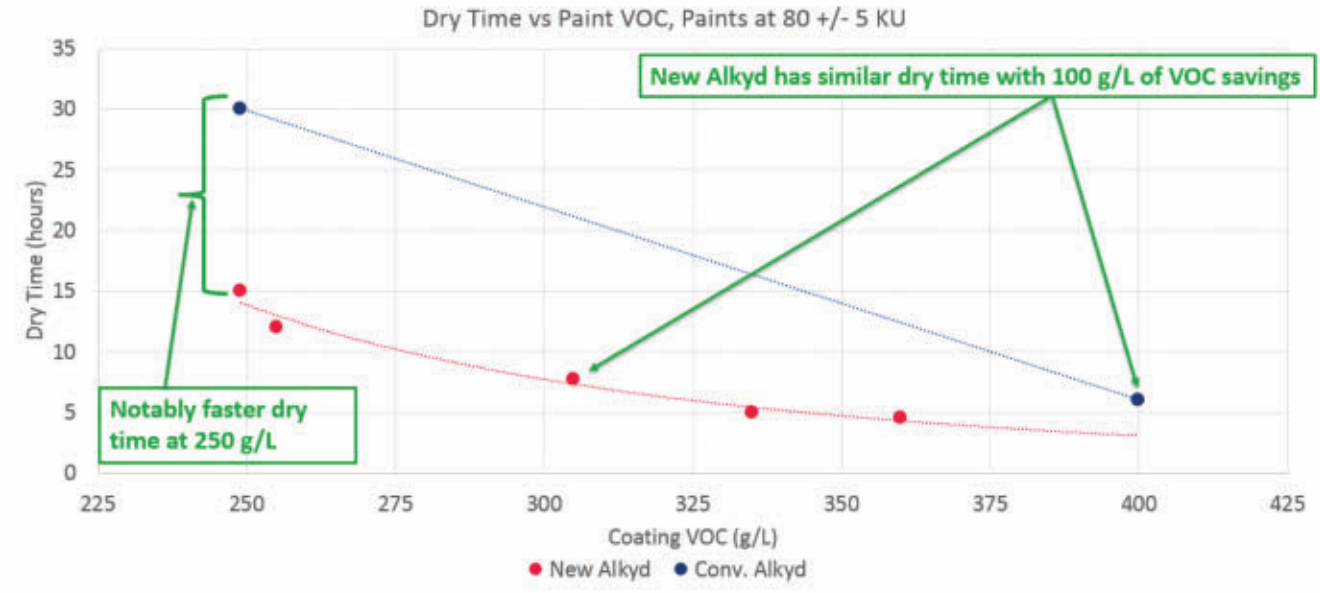
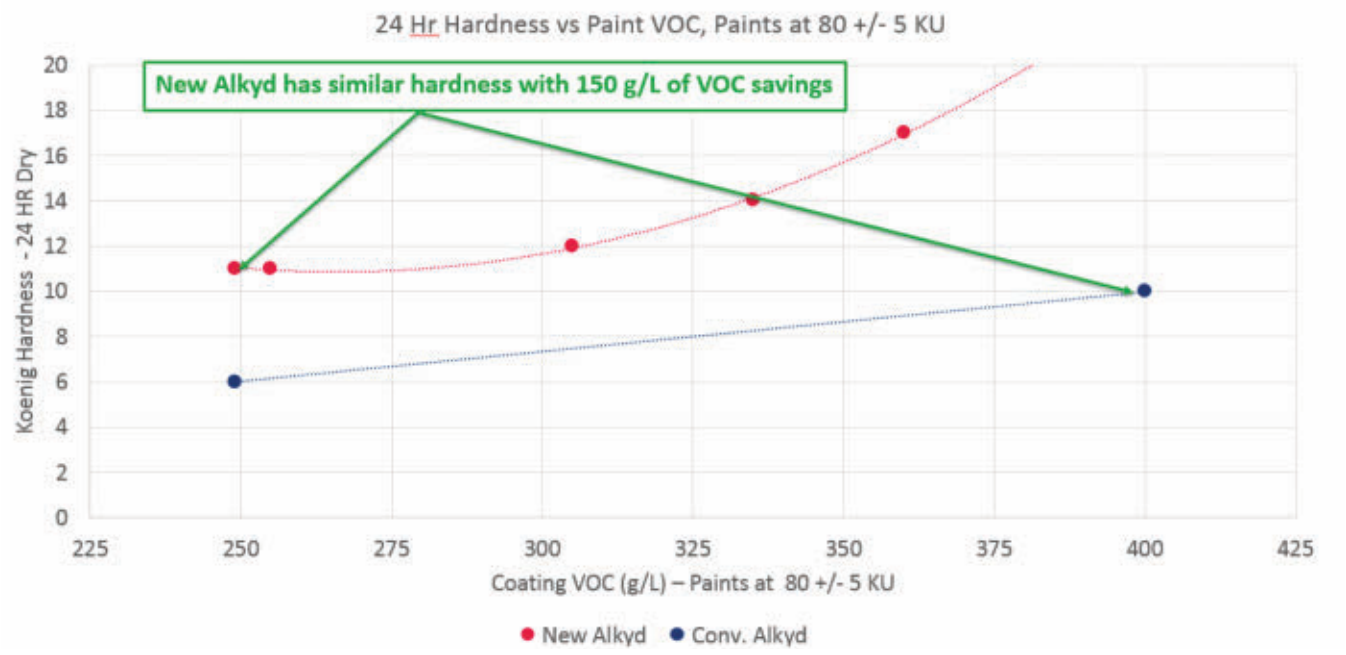


FIGURE 4: Conventional and novel alkyd hardness vs VOC level at constant paint viscosity.



performance tailoring. As this is a baseline review of the technology, none of the novel alkyd prototypes presented in this paper are monomer modified.

To understand the capabilities of the novel alkyd platform this paper presents performance data from different applications comparing the novel alkyd against a similar oil length conventional alkyd.

Long Oil

The data in Figures 3 and 4 was obtained using alkyd resin samples cooked to the molecular weight required for achieving a constant paint viscosity (80 KU) over a distribution of paint VOCs. This shows how molecular weight affects coating performance for conventional alkyds and for the novel alkyd approach. In general high-VOC coatings have high-molecular-weight resins. All paints were formulated with TiO2 as the sole pigment and mineral spirits as the only solvent.

Figure 3 demonstrates the dry time capability of the novel alkyd platform vs a conventional alkyd across the VOC spectrum. A lower value indicates a faster dry. The new alkyd polymer offers faster dry. Note the dry time achieved with the new alkyd at 300 g/L is similar to the conventional alkyd's dry time at 400 g/l. The novel alkyd offers 100 g/L of VOC savings at a similar dry time. Alternatively on the low VOC side of the data plot, the dry time for the novel alkyd is twice as fast as the conventional approach to achieving low VOC.

The hardness development is plotted in Figure 4. In Figure 3 we saw that the novel alkyd platform dries faster than conventional approaches for making high-solids resin. In Figure 4 we see that the novel alkyd also delivers higher hardness than conventional alkyd manufacturing approaches regardless of the VOC/molecular weight. In the 250 g/L paint the novel alkyd platform delivered similar hardness after one day of dry as the conventional alkyd at 400 g/L.

The data in Figures 3 and 4 shows that the novel alkyd/new alkyd platform dries faster and harder than conventional synthesis approaches for making high-solids alkyds.

In this study the novel long oil alkyd resin developed for the 250 g/L paint is a 100% solids long oil with a dry time of 12-15 hours. Ongoing optimization has shown this can be improved upon, however this will not be reviewed in this paper as the goal for this paper is to demonstrate the platform and not an individual product.

PHOTO 1: Comparison of novel alkyd long oil EX-LO and novel alkyd medium oil EX-MO against commercial stains on southern yellow pine. Photo taken at 15 months.

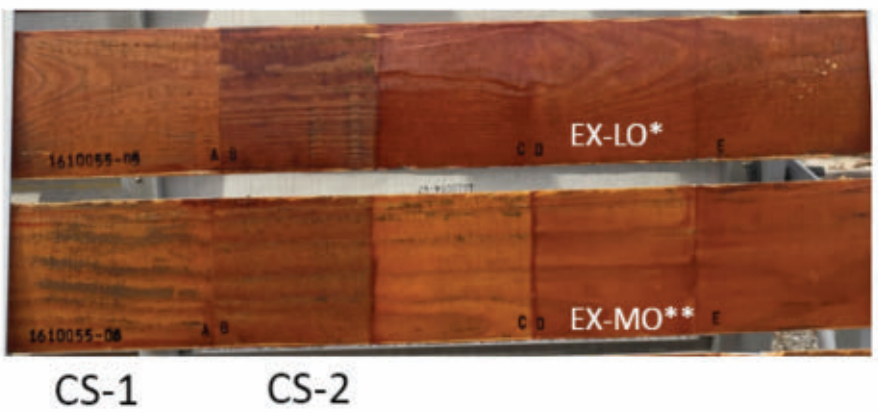


TABLE 3: Paint property comparisons between the novel alkyd short oil and an acrylic monomer-modified short oil.

Description	Novel Alkyd	High Solids Acrylic Modified
VOC (lbs/gal)	2.92	2.85
VOC (g/L)	349	342
% NV, Volume	58.8	58%
Dry-to-Touch	10	15
Foil-Free	25	35
Gloss, on Leneta		
20°	96	89
60°	100.4	96
Gloss, on B1000		
20°	96.6	93.5
60°	98.3	100.7
Konig Hardness		
1 day	16	20
7 days	39	41
Adhesion (B1000)		
7 days	5B	4B
MEK Double Rubs	9	4

Novel Long Oil and Novel Medium Oil in a Wood Stain Application

Using a 100% solids long oil derived from the platform described above and a 90% solids medium oil (also made using this platform's technology) transparent oxide wood stains were formulated and compared against commercially purchased transparent oxide wood stains from leading consumer brands. The comparisons appear in Photo 1. Using the novel long oil (EX-LO) to create a 250 g/L wood stain resulted in a stain with a viscosity of 56 KU's. Using the novel alkyd medium oil (EX-MO) to make the same 250 g/L wood stain resulted in a viscosity of 92 KU's. No UV absorbers were added to the stains.

The exposure data in Photo 1 shows the novel alkyd prototypes without UV absorbers performing as good as, or better than, the commercial stains after 15 months of exposure. Commercial stains are labelled as CS1 and CS2. The commercial stains appear on each board in the spot directly above their label. CS1 appears on both boards in position A and CS2 appears on both boards in position B. Gloss, color, crack resistance and overall appearance for the novel long oil and the novel medium oil vs the commercial controls was very good. The advantage of using the long oil is that this resin gives a lower viscosity than the medium oil.

Novel Short Oil in a Metal Coating Application

The novel alkyd utilizes drying oils/fatty acids to air dry just like conventional alkyds. In the higher oil length formulas the novel alkyd platform is more constrained by these higher oil/fatty acid levels. In the next example we will review a short oil created using the new platform. Dry time for the novel alkyd short oil was noted to be very fast. Therefore we will compare it to a monomer-modified alkyd. The novel alkyd short oil is not monomer modified. Monomer modification is often done to enhance the dry time of an alkyd. Both the novel alkyd short oil paint and the monomer modified paint were formulated to ~350 g/L and a similar viscosity was obtained. The results appear in Table 3.

The novel alkyd short oil dries faster than the acrylic-modified alkyd and offers similar hardness. The novel alkyd was observed as having better adhesion.

Summary

As coating VOCs have reduced the standard approaches for creating high-solids, alkyds have not been able to maintain performance at low VOC. To maintain performance in higher-solids alkyd systems Arkema has developed a new technology platform that can be leveraged across the alkyd polymer design space creating high-solids alkyds with notable dry time and hardness improvements.

Technology from this platform offers the coating formulator a high level of flexibility and an easier path to VOC reduction. Alkyds from this novel platform formulate like a traditional alkyd. Traditional oil length monikers (long, medium, short) are used to designate modifications of this technology. The new platform does not require exempt solvent. It can be formulated with or without exempt solvent.

The new platform is commercially viable and allows coatings formulators to mitigate performance losses in dry time and hardness development when formulating lower-VOC alkyd coatings. ***CW***

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Carbon Capture Coatings: Proof Of Concept Results And Call To Action

Brittney M. McInnis, Jonathan D. Hurt, Steve McDaniel, Reactive Surfaces, Austin, TX; Lisa K. Kemp, Reactive Surfaces, Austin, TX and The University Of Southern Mississippi, Hattiesburg, MS; Tyler W. Hodges, Reactive Surfaces, Austin, TX and The University Of Alabama, Tuscaloosa, AL; David R. Nobles Jr., The University Of Texas, Austin, TX

Summary

Coatings capable of adhering to surfaces routinely exposed to light can exploit a biomimetic system similar to surfaces covered with photosynthetic lichen in order to capture, fix, and sequester carbon dioxide. When applied over sufficiently large amounts of surface area, such coatings are capable of rivaling natural carbon sinks in their ability to remove excess atmospheric carbon. The coatings industry stands in a unique position to cooperatively and profitably address climate change caused by excess carbon dioxide and to do so in a timely manner geared to preventing the most damaging of predicted environmental harm. By capturing large quantities of such greenhouse gases and sequestering the captured carbon into carbohydrates such as cellulose, these paints are capable of manufacturing useful byproducts, including some of the raw materials from which they themselves are formulated. This is the first technical description of these types of coatings.

Introduction

It is well known that carbon dioxide is a by-product of both naturally occurring and man-made activities. Examples of such naturally occurring activities include: animal respiration, decomposition of formerly living organisms, weathering of carbonate rocks, volcanic eruptions, and plant (e.g., forest) fire; examples of man-made activities (anthropogenic) include: fossil fuel use, intentional burning of biomass (e.g., wood stoves, intentional forest fires), and cement production. However, the current, drastic increase in carbon dioxide in the Earth's atmosphere is being driven by release of additional carbon dioxide by mostly terrestrial, man-made activities, particularly in cities and industrialized regions. [1,2]

Photosynthesis from land-based plants (including lichen and other cryptogamic species) and from ocean-bound algae (including cyanobacteria which are photosynthetic prokaryotes) is the primary, naturally occurring process for removing carbon dioxide from the Earth's atmosphere. This naturally occurring photosynthetic conversion of carbon dioxide (CO_2) requires water (which can be in the form of environmental moisture) and sunlight to convert available carbon dioxide in the atmosphere to oxygen (O_2) and carbohydrates (e.g., saccharides). The ocean-bound algae are in the form of a thin layer floating at/near the surface of ocean water, known as the photic zone, and the vast size of the earth's oceans provides a substantial surface area by which these ocean-bound algae can perform the majority (70 to 80%) of photosynthetic capture of atmospheric carbon dioxide and release of oxygen into the atmosphere. [3,4]

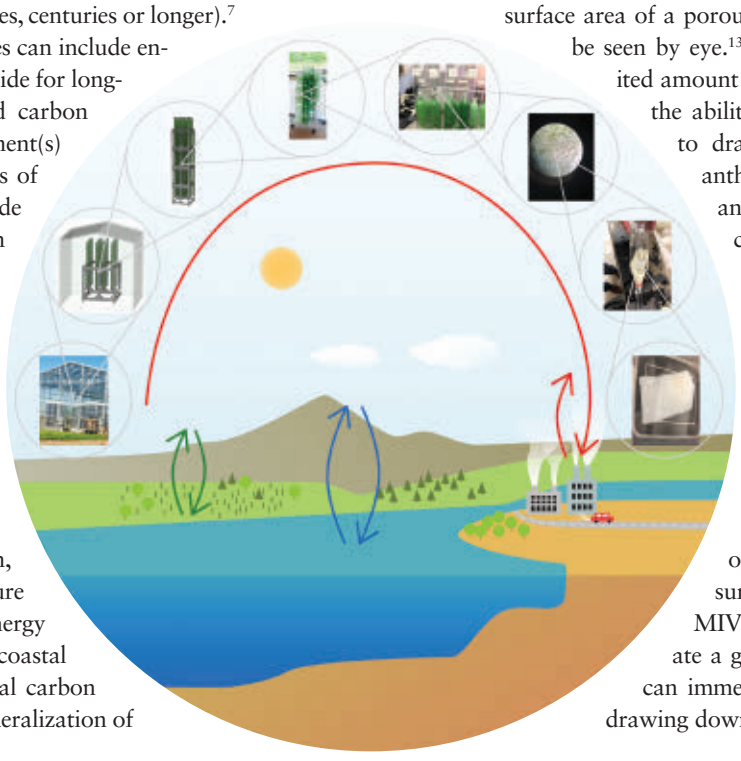
However, because of the sheer magnitude of carbon-dioxide resulting from man-made activities, naturally occurring photosynthetic conversion of carbon dioxide has **for many decades been unable to mitigate the amount of carbon-dioxide produced by man-made activities.** As a result, excess amounts of carbon dioxide have built up in the atmosphere. It is estimated that the amount of carbon dioxide in the Earth's atmosphere has increased from 280 parts per million (ppm) in the 1700s to 411 ppm as of March 2019.[5] To make matters worse, approximately 50 gigatons of additional carbon dioxide equivalents (e.g., greenhouse gases such as carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride) are released into the Earth's atmosphere yearly, primarily from fossil fuel usage.[6] It is well known that carbon dioxide represents about 80% of "greenhouse gas," with methane, nitrous oxide, and fluorinated gases representing the balance. It is also well known that these greenhouse gases are the primary contributing factor to global warming and the associated climate change around the globe (i.e., severe storms, warming of the oceans, melting of glaciers, rising sea

levels). The current level of greenhouse gases and their projected rate of increase have led experts in the field of climatology to the conclusion that, if left unchecked, further increases in greenhouse gases will result in irreversible climatic changes and catastrophic effects of climate change on people, property, and the ecosystem.[1,2]

To combat the current level of greenhouse gases and their projected rate of increase, various forms of negative emission technologies are being developed. A negative emission technology removes (i.e., captures) carbon dioxide equivalents from the atmosphere where they may be sequestered or stored for long periods of time (i.e., years, decades, centuries or longer).[7] Negative emission technologies can include enhanced carbon sinks that provide for long-term storage of the removed carbon dioxide (and/or other component(s) of greenhouse gas). Examples of enhanced carbon sinks include storage of captured carbon dioxide underneath the surface of the earth, conversion of captured carbon to useful solid or liquid materials such as plastics, carbon fibers, biofuel, or carbon-based chemicals.[8,9] Some other negative emission technologies include: geological carbon sequestration, direct carbon dioxide capture from the atmosphere, bioenergy carbon capture and storage, coastal blue carbon capture, terrestrial carbon sequestration, and carbon mineralization of carbon dioxide.[10]

In much the same way that the magnitude of photosynthetic conversion of atmospheric carbon dioxide by ocean-bound algae is limited by the surface area of the ocean, known negative emissions technologies are limited in their efficiency and effectiveness for mitigating carbon dioxide by their available footprint (terrestrial or otherwise). Surface areas occupied by facilities housing these negative emissions technologies must do so in a manner that is practically feasible from societal and financial perspectives.[11,12] Therefore, a negative emissions technological solution that simulates the unequalled efficiency and effectiveness of ocean-bound algae, but in a manner that provides for markedly greater surface area-to-volume practicalities, would be advantageous, desirable, and useful.

The coatings industry is a world-wide industry servicing paintable-surface-area measured in the billions of square meters, much if not most of which coated area is vertically oriented or otherwise incorporated into vertical structures such as buildings, glass windows, plastic components, etc. When coupled with myriad other types of articles of man-made manufacturing, the actual surface area coated yearly is staggering. Even more enormous is the true surface area of a porous coating itself, which cannot be seen by eye.[13] To mimic this almost unlimited amount of vertical surface area to test the ability of carbon capture coatings to drawdown sizeable portions of anthropogenic carbon dioxide, an economical model system comprising translucent plastic sleeves containing translucent PET containers with easily measurable interior paintable surface area was constructed. While this model does not entirely mimic all surfaces amenable to carbon capture coating (CCC) coverage, it allows the construction of massively iterated vertical surface (MIVS) devices (CCC-MIVS) that may be useful to initiate a global-scale coating effort that can immediately be placed into service drawing down large amounts of CO_2.



Natural carbon cycles include those that are chiefly terrestrial (green arrows) and oceanic (blue arrows). These natural cycles are generally balanced, both slightly favoring carbon withdrawal. Man-made (anthropogenic) carbon emissions (red arrows) are chiefly unbalanced. The proposed carbon capture coatings applied over massively iterated vertical surfaces (CCC-MIVS) system is designed to act as an artificial offset in total or in significant part in order to bring the man-made carbon emissions into balance, essentially creating an anthropogenic carbon cycle intended to mitigate the present unchecked excess CO_2 in the atmosphere. Since this anthropogenic carbon cycle is limited only by the amount of painted surface area, it additionally has the potential to be used to drawdown historical excess greenhouse gas residing in the atmosphere, thereby potentially acting as a "thermostat" tune-able by coordinated climatology/geo-engineering to address global warming."

Experiments and Results

From the Ocean to a Flask

Culturing algae has long been performed with great success, and our collaboration with the Culture Collection of Algae at the University of Texas at Austin (UTEX; one of the most extensive collections of algae in the world) has provided us with access to thousands of potential algae candidates. Here we report our work with a particular algal (cyanobacterial) strain, *Synechococcus leopoliensis* (UTEX strain 2434, "wild type"). These algae have also been genetically engineered to produce additional cellulose

Figure 1. Liquid algae cultures were grown in our lab under LED grow lights by bubbling filtered air through the mixture.

(NS::abΔc7S, "overproducer")[14], and we examined both the wild type and the engineered cellulose overproducer in this work. Figure 1 shows both cultures being grown in glass jars under LED grow lights in our laboratory.

Out of the Flask and Almost a "Coating"

Bernal et al.[15] reported the use of algae mixed 1:1 with a latex resin and coated onto paper in an effort to make a "synthetic cellular biocomposite leaf." They reported CO_2 uptake rates of up to 5.67 mmol CO_2 hr^{-1} m^{-2} for cells kept hydrated by wicking an algae culture medium onto the coated filter paper in an artificially increased CO_2 environment (20% CO_2). These researchers stated their belief that similar systems should be capable of exceeding the rates of carbon capture seen in green plants such as *Arabidopsis* (18 mmol CO_2 hr^{-1} m^{-2}), and we agree. We chose to replicate their system using several test algae without the artificial CO_2 environment to see if our rates of CO_2 uptake would be similar. Figure 2 shows a typical filter paper sample containing either algae cells alone or a 1:1 wet mixture of algae cells and latex resin being measured for its CO_2 uptake rate. The filters were kept moist by placing them on fresh agar pucks. Our CO_2 uptake rates were very similar to those of Bernal et al. when tested for an hour of 250 PAR LED light exposure. These samples were followed with time, and the CO_2 uptake rates are shown in Figure 3.

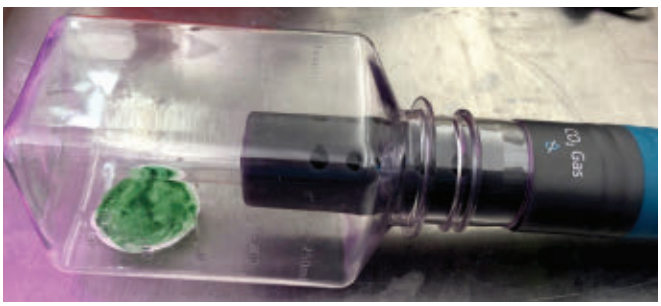


Figure 2. Test setup to measure the rate of CO_2 uptake for 50% algae cells or 50% algae cells plus latex on filter paper kept moist on top of an agar puck.

Once we had evidence of CO_2 uptake for both the cells alone and the cells mixed with latex resin, we tested the viability of the algae cells mixed with BG-11 media, agar, or an acrylic latex resin as either dried films or in the wet state. We also tested the samples under different lighting conditions: under LED illumination or under ambient laboratory light. Each sample was run in triplicate, and controls for the BG-11, agar, and latex resin were included. Figure 4 shows the test plate after the MTS viability testing where a darker red/brown color indicates increased cell metabolism, which correlates with positive cell health and/or growth. Alcohol killed samples and heat killed samples were used as negative controls and showed no reaction in the test. Figure 5 shows the numerical comparison for the testing of the cells alone and with the polymer systems. In all cases, the wet films had higher performance (in some cases much higher performance) than the dry films. This led us to develop a highly-hydrated coating that did not require constant wicking of water or medium and that would better support the viability and CO_2 uptake of the algae over long periods of time.

Super-Hydrated Algae Gel-Coatings

Based on the results in the MTS viability studies and our review of literature on lichens (that perform this function in nature),[16] it was determined that high levels of hydration in the coating (80-100%) could lead to improved viability of the cells and increased photosynthesis. It was our goal to develop a coating based on natural materials from renewable resources, and we screened many water absorbing polymers. The system that best met our requirements was a blended system of sodium alginate (we chose a commercial, pre-formulated alginate) and xanthan gum. This system has many advantages: it can absorb many times its weight in water, is tolerant to moderate levels of ions and minerals (supplied in the media as nutrients for the algae), and gels into a pliable, semi-solid that can retain its shape on a vertically positioned surface – essentially a polymeric, hydrogel coating. The algae cells are dispersed in the media or water used to hydrate the coating, and upon the addition of the liquid, the alginate begins the crosslinking process with about 5-8 minutes of total working time before the material sets into a semi-solid state. Figure 6 shows the process of making the coating mixture and applying it to the PET containers.

Once the PET containers are coated with the algae-containing carbon capture coating, they can either be measured as single devices or placed into plastic sleeves and measured as a group of samples (Figure 7). The CO_2

uptake rates are compared in Figure 8 showing the change in CO_2 with time for a flat plastic dish containing the coating without algae and for one with algae. The rate over the one-hour measurement period for the control was slightly negative (CO_2 released, no uptake), but the rate was 1.75 mmol CO_2 per m^2 of coating surface area (rate reported as mmol CO_2 h^{-1} m^{-2}) for the sample containing 2.5% algae.

Evidence of Algae Growth and Longevity in Gel-Coatings

Several formulations were tested on the PET substrates to understand CO_2 capture rates of the coatings. As an example, we studied the algae level initially added to the coating to understand what level might provide optimal CO_2 uptake and were pleased to see that the algae have an extended lifetime in this coating system. Pictured in Figure 9 is an array of sleeves of the coated PET containers, which show the samples on the day they were made (day 0), as well as on days 10 and 45 after the samples were made. From left to right in the photo, the samples contain increasing amounts of algae cells: 0.5%, 1.0%, 2.5%, and 5.0%.

As expected, the green color in the PET containers darkens as the amount of algae in the PET container increases. The CO_2 uptake rates on day 0 (normalized to the same starting concentration in Figure 10), which were measured for each sleeve of PET containers (5 PET containers total), also shows an increase with the increasing amount of algae until the rate equalizes between the samples at 2.5% and 5% algae concentration. As the coated PET containers age, the color changes and shows an increase in chlorophyll density (assumed due to algae cell growth) in the systems, and the rate of CO_2 uptake shows an increase for the darker, aged coatings (Figure 11 shows the data for the 1% algae sample).

Figure 12 shows the color change for identical, freshly made samples compared to the 45-day old samples. MTS analysis was conducted on the 45-day old samples and confirmed that they still contained viable algae cells (Figure 13).

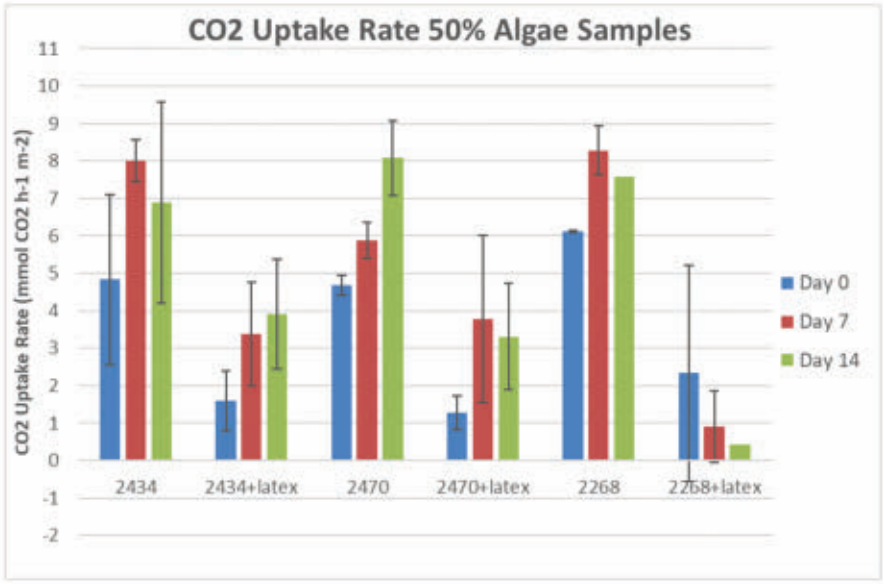


Figure 3. CO_2 uptake rates tested over a 2 week period for algae cells alone and 50/50 algae cells:latex resin wet coating.

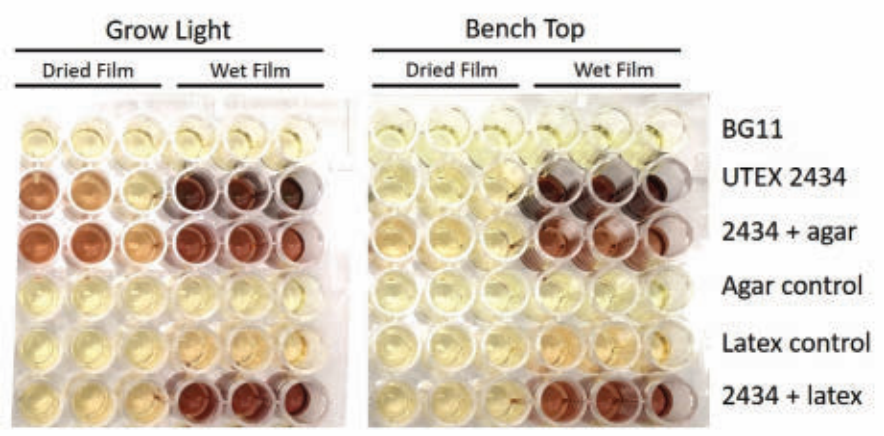


Figure 4. MTS viability plate after incubation. Darker spots indicate more cells are alive in the sample.

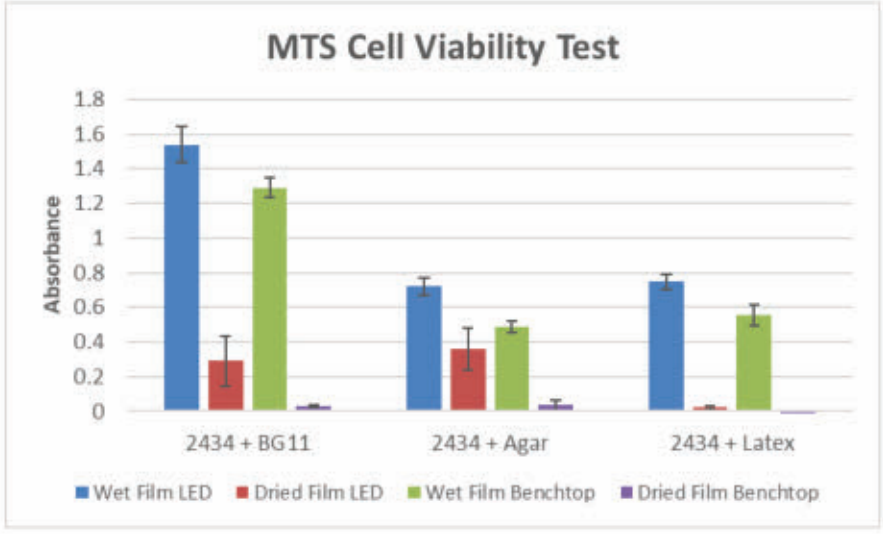


Figure 5. MTS viability data for 2434 algae cells under different incubation conditions.

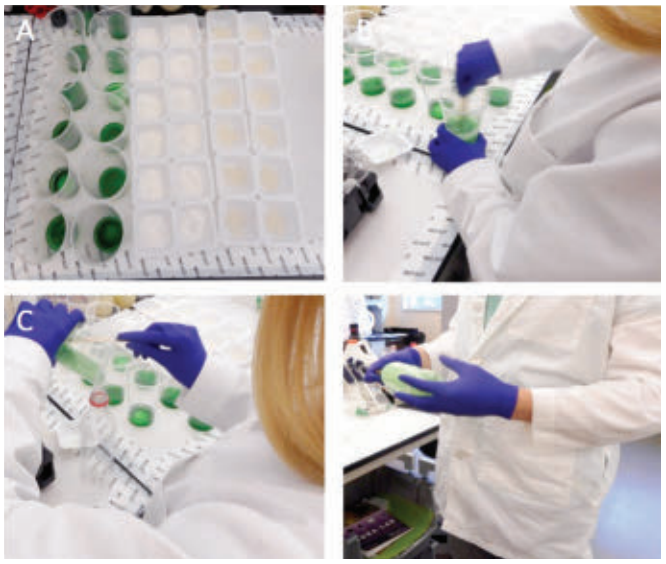


Figure 6. Coating a prototype PET container with the carbon capture coating. A) coating components measured: algae in media, alginate, and pre-hydrated xanthan gum; B) mixing the components by hand which starts the timing for pot life; C) adding the liquid mixture to a PET container; D) rotating the PET container to coat the interior and keep the coating distributed until it crosslinks into a semi-rigid film.

Figure 7. (Top) Coated PET containers measured for CO_2 uptake as a single device outdoors, and (Bottom) a clear sleeve holding PET containers set up for measurement as a group under LED lighting.

Isolation of Algae-Grown Cellulose from Gel-Coatings and Gravimetric Analysis

The genetically modified alga we used in this work was modified to express cellulose synthesis genes from *Gluconacetobacter hansenii* (ATCC 53582, formerly *Gluconacetobacter xylinus*), which naturally exudes a cellulose product. Figure 14 shows the *Gluconacetobacter* in a liquid culture with the cellulose pellicle (the lighter colored material floating on top of the liquid media) it produced over 14 days. While the genetically modified algae (overproducer) does not exude the cellulose to form a pellicle per se, the excess cellulose is secreted from the cell into an extracellular matrix. We have been able to (1) harvest the coatings from the bottles and then (2) extract the cellulose-enriched cells by simply reversing the ionic alginate crosslinks of the gel coating using common calcium chelators (Figure 15).

Vertically Scaled, Algae Gel-Coating Arrays

To tackle a problem of such an enormous scale as the anthropogenic CO_2 released each year (approximately 50 gigatons), the solution must also be able to scale to significant proportions. This is where coatings truly shine – the ability to apply the carbon capture coating in multiple iterations of vertical structures (in our proof-of-concept model using stacked PET containers) allows significant capture of CO_2 while using a smaller horizontal footprint. Considering our initial proof-of-concept system, we can easily scale our coated PET container array from 3 feet tall sleeves to 10 feet tall (Figure 16). For this very small-scale system that change would create a 3x multiplier in CO_2 uptake without using any additional horizontal area footprint.* As surface area/volume is further maximized, additional efficiency in carbon capture can be realized. Additional benefits to this algae coating system include the fact that the thin coatings on the surfaces are much lower weight than equivalent liquid cultures

**The model used in the proof-of-concept testing was not maximized in any way for rates of capture or surface to volume ratios. However, it may be instructive to use it to understand the power of coatings applied across large amounts of surface area to achieve impressive results. If one uses a cubic meter device occupying a square meter of horizontal ground space as the unitary carbon capture coating device, then one such device using the bottle-and-sleeve construct described here offers about a 50:1 vertical surface area to horizontal surface area advantage (when maximized this ratio will easily improve by at least a factor of 10). Operating such a device at a rate of capture (5 mmol CO_2 hr^{-1} m^{-2}) on a 12-hour per day basis for a year (4380 hours of capture per year) produces about 50 kg of a captured carbon per year. Thus, even at this modest rate, simple greenhouse-type structures sited upon non-arable land (e.g., that measure only 10 meters in length by 10 meters in width by 10 meters in height) would capture, fix, and sequester about 50 metric tons of CO_2 per year.*

(allowing taller vertical structures), and the water content of the coatings, while significant, are also greatly reduced from the amount of water used to create liquid algae cultures. The end use of the captured CO_2 is dependent on the intended application and is where the flexibility of coatings is again a significant advantage. As discussed in the previous section, the current gel-coating system can have the crosslinks reversed allowing the collection of the carbon-containing product synthesized by the algae, or the entire coating system and could be used to make other materials (such as pressed boards, concrete, bricks, etc.) to sequester the carbon for a significant amount of time.

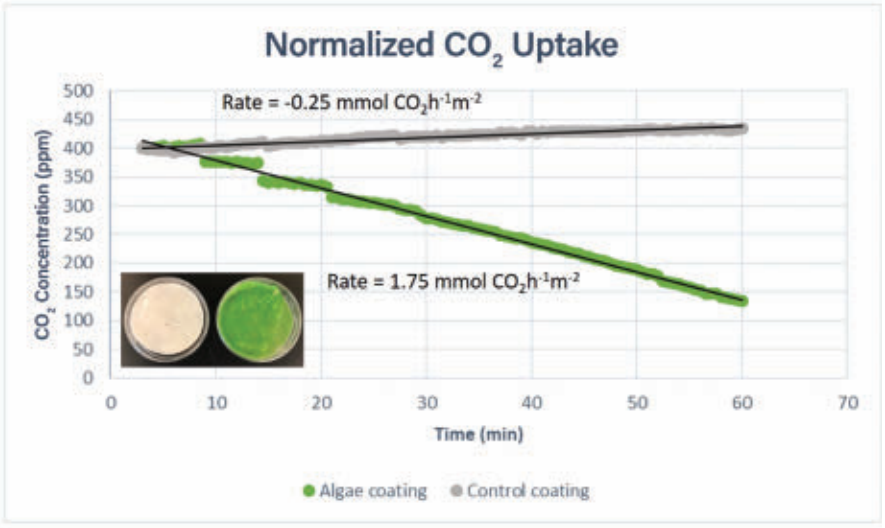


Figure 8. CO_2 uptake measured for (gray) a coating without algae cells, and (green) a coating containing the algae cells. Inset picture shows the plastic dishes coated without algae cells (white) and with 2.5% algae cells (green).

Conclusions and Call-to-Action

There is an enormous amount of paintable man-made surface area in the world. If the coatings adhered to such surfaces are dynamically functional, these surfaces can become enormous machines with which to accomplish otherwise difficult to imagine tasks. We have been conducting extensive research and development on how to use bio-based molecules (such as peptides, enzymes, and isolated cell parts) to program coated surfaces to repeatedly carry out useful dynamic functionality since we began in 2001. We now extend this work to include long-term inclusion of living cells into coatings. While this goal to create coatings that help reverse climate change might seem an impossible task, it is the first step in just such a plan we are researching and report here.

We decided to formulate compositions mimicking the carbon capturing rates of marine algae by entraining whole cell algae capable of capturing, fixing, and sequestering carbon dioxide into cellulose in a thin, super-hydrated coating. We've reported promising initial rates of CO_2 uptake by lab-scale versions of these coated surfaces, and these surfaces are easily iterated to create extremely large amounts of coated surface area to potentially offset the large amounts of excess carbon dioxide we currently generate. Our results indicate that this goal can be met, and that if the manufacturing and distribution capabilities of the coatings industry can be rapidly engaged, it is possible to offset very large portions, if not all, of the excess carbon presently emitted annually. The rates of capture will be increased with experimentation, and as we and others have stated, should rival that of green plants at close to a 20-fold increased rate over that we initially have observed. The squared surfaces area to cubic volume ratios will be dramatically increased with simple engineering. As critically, the types of resin systems and the particulars of formulations will undoubtedly yet again

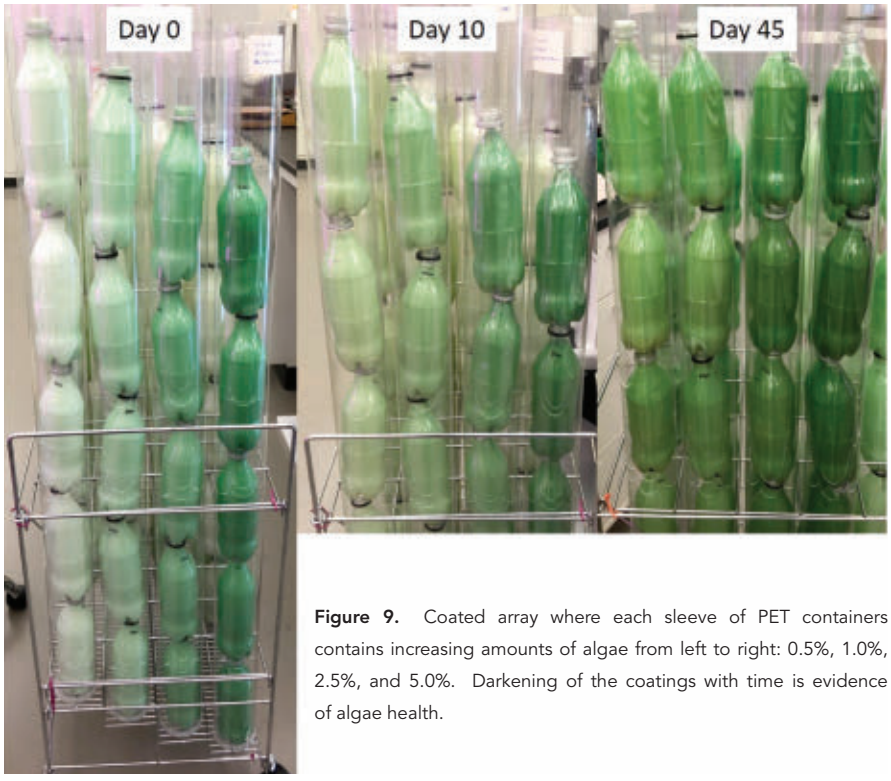


Figure 9. Coated array where each sleeve of PET containers contains increasing amounts of algae from left to right: 0.5%, 1.0%, 2.5%, and 5.0%. Darkening of the coatings with time is evidence of algae health.

increase the greenhouse gas capturing capabilities of these systems.

It is the lattermost issue where we hope to quickly gather a coating industry-wide consortium. Such a consortium can leverage our initial proof-of-concept findings into more efficient polymer systems. That consortium will be able to quickly determine the maximal means to drive economic value over-and-above the enormous benefits of mitigating global warming, including inputs from those along the paint supply chain to end users/consumers. Clearly, no one company can do what a consortium can rapidly achieve. A "landing site" for those interested in forming such a consortium can be found at www.reactivesurfaces.com/carbon_capture_coatings.

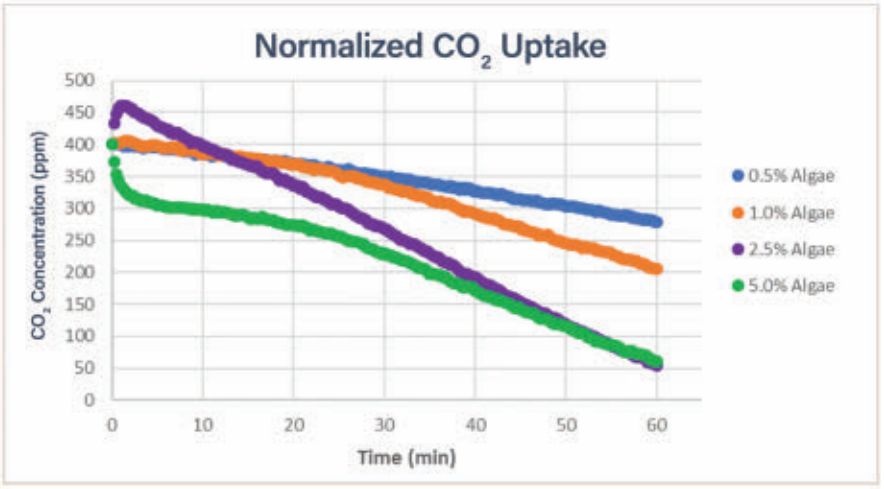


Figure 10. Carbon dioxide uptake (drop in CO_2 ppm with time) for the coated PET containers at various algae loading levels measured on the day the PET containers were made.

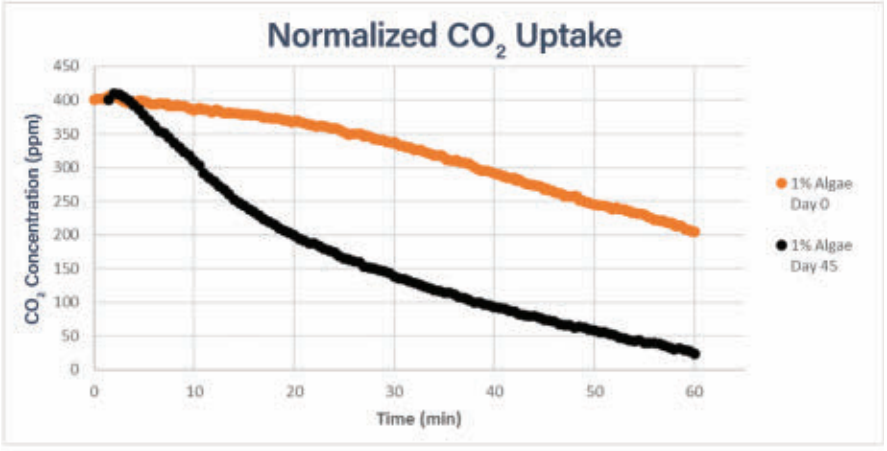


Figure 11. Carbon dioxide uptake for the coated PET containers at 1% algae loading level tested on 0 and 45 days after the coatings were made.

Figure 12. Freshly made samples at 0.5, 1, 2.5, and 5% algae loading levels (left to right) versus the same loading levels after 45 days of storage at room temperature under ambient lights.

Materials and Methods

Growth of Algal Strains

For algae growth media, Blue-Green Medium 11 ("BG-11") liquid and solid media were prepared as described in literature.[17] The primary photosynthetic organism evaluated was the algae *Synechococcus leopoliensis* ["wild type" strain UTEX 2434; source UTEX Culture Collection of Algae, The University of Texas at Austin, TX] or a genetically engineered variety of this strain modified to produce additional cellulose ["overproducer," *Synechococcus leopoliensis* strain UTCC 100 modified with the cellulose synthesis genes (acsABΔC) from *Gluconacetobacter hansenii* (formerly *Gluconacetobacter xylinus*), ATCC 53582][4]. Additional cyanobacteria tested in this study include *Synechocystis* sp. (UTEX 2470) and *Agmenellum quadruplicatum* (UTEX 2268). The algae were cultured either in flasks, in which the BG-11 medium volume was 1/5 the total flask capacity (e.g., 10 mL medium per 50 mL flask, which were incubated with gentle shaking at 100 revolutions per minute (rpm), or in 1 L bottles with 1 L BG-11 medium, which were incubated with filtered house air bubbling through them. In either culture technique, a culture was grown until it reached an optical density (OD) measured at 540 nm (OD_{540}) of about 1. All cultures were incubated at ambient temperature (about 20-23 °C) under grow lights [about 70 µmol photons m^{-2} s^{-1} photosynthetic active radiation ("PAR") for flasks and 15 PAR for the 1 L bottles during growth from one or more 9.6 Watt extendable 16 inch

emitting diode ("LED grow light strips (Litever, Shenzhen, Guangdong, China).

Preparation of Algae Wet Cell Pellet

To prepare wet cell pellets, the algal cultures that had reached OD_{540} of about 1 were centrifuged at 3000x gravity (g) for 15 minutes. The supernatant was poured off, and the remaining cell pellet was resuspended in the remaining liquid BG-11 medium for a total volume of approximately 1/100 of the original volume to make the wet cell pellet.

Preparation of Algae and Algae/Latex Coated Disks

Algal cells (*Synechococcus leopoliensis* UTEX 2434; *Synechocystis* sp. UTEX 2470; *Agmenellum quadruplicatum* UTEX 2268) were concentrated into wet cell pellets. One hundred microliters of the wet cell pellet was mixed with either 100 µL of BG-11 liquid medium or 100 µL of acrylic latex resin (Sherwin-Williams Company, Cleveland, Ohio) adjusted to pH 7. Algal medium or acrylic latex resin control samples were also prepared. The cell suspensions were pipetted onto 0.8 µm nylon filters (Millipore Sigma, Burlington, MA) about 10 cm^2 in area. The filters were allowed to dry about 5-10 minutes, then placed onto the surface of BG-11 agar. The agar was cut around the filter so that the filter was sitting on an agar "puck." The filter and agar puck were transferred to a 250 mL clear plastic chamber, and the CO_2 concentration was measured using a Vernier Go Direct CO_2 sensor (Vernier Software & Technology). The sensor recorded the CO_2 concentration in ppm every 5 minutes for about an hour, which was plotted as ppm vs. time in minutes to get the rate of CO_2 capture over time from the slope of the line. The CO_2 capture of the no alga control latex resin was later subtracted from the CO_2 capture of the alga/acrylic resin to determine the alga latex CO_2 capture. This CO_2 capture rate was used to calculate the CO_2 capture rate as mmol CO_2 hr^{-1} m^{-2}.

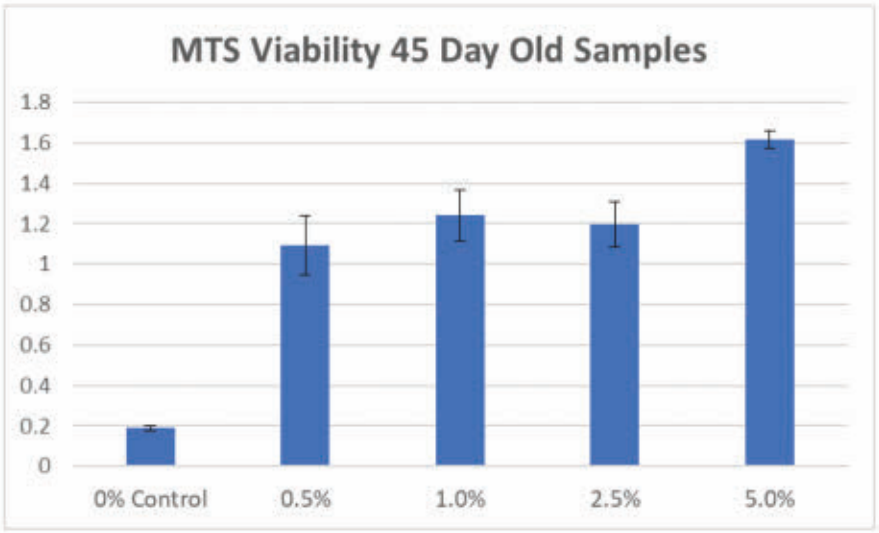


Figure 13. MTS viability results for samples at 0.5, 1, 2.5, and 5% algae loading levels after 45 days of use show significant increases in absorbance over the coating control with no algae cells indicating living cells are still present in the old coatings.

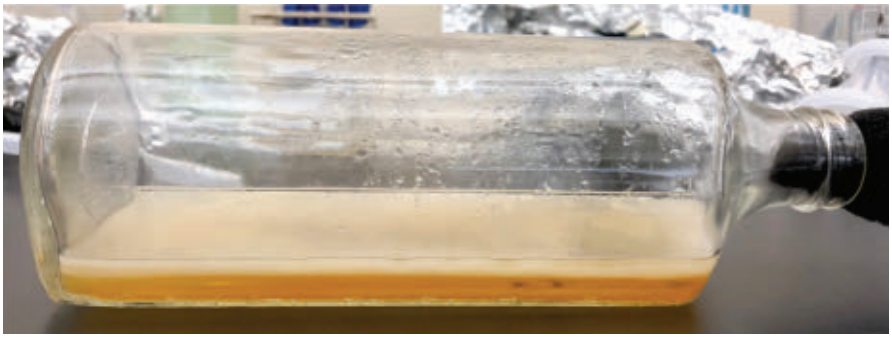


Figure 14. Floating cellulose pellicle produced by *Gluconacetobacter hansenii* after 14 days of growth in liquid media.

Coating PET containers

BG-11 media (42 mL) was poured into a plastic cup and the desired amount (generally between 300 µL and 3.0 mL) of wet cell pellet of *Synechococcus leopoliensis* (UTEX 2434, wild type) or the algae overproducer was added and mixed. Lifemold alginate powder (6 g) was added to the plastic cup and stirred by hand with a wooden tongue depressor until mostly smooth. Prehydrated xanthan gum (12 g of 2 wt% mixture in BG-11 media) was added to the container and mixed until a smooth texture was achieved. The pot-life of the gelation reaction is dependent on several factors (water temperature, ion content, water ratio, etc.), but generally the alginate converts from a liquid mixture to a gel within about 5 to 8 minutes after mixing with water. Then the mixture was poured into a PET container and the container was rotated continuously for several minutes until most or all the inside surface was coated by the mixture and the coating solidified.

CO_2 Uptake Measurements

Carbon dioxide captured by coatings was measured using a Vernier® Go Direct CO_2 sensor (Vernier Software & Technology, Beaverton, OR). For monitoring coated PET containers, they were placed in a plastic sleeve with end caps to seal the interior space of the plastic sleeve (sleeve and caps both available from Cleartec Packaging). One end cap was modified

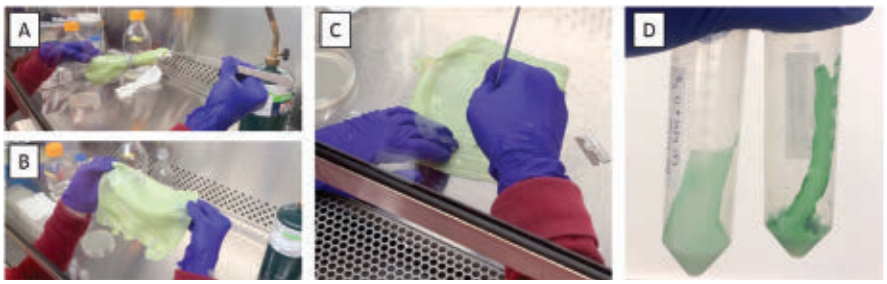


Figure 15. A/B) removal of the coating from the container, C) the algae-containing coating is sampled in triplicate for cellulose isolation, D) cellulose isolated from coatings containing the cellulose overproducer (left) and the wild type algae (right).

Figure 16. Uncoated PET container proof-of-concept array at 5 containers per sleeve and at 15 containers per sleeve. Because of the ability to vertically scale, within the same floor space "footprint," the 10-foot-tall array contains 3x the potential coated surface area of the smaller 3-foot-tall array.

to fit the CO_2 the sensor. The CO_2 capture monitoring was generally conducted while the carbon dioxide capture devices were illuminated at 250 PAR by LED grow lights. The CO_2 concentration in ppm was measured over a defined period of time using Vernier® Graphical Analysis software (Vernier Software & Technology). The ppm CO_2 concentration was plotted against the time data to obtain a linear relationship, and the slope was measured as the capture of CO_2 in ppm per unit time. This value was converted to a rate of mmol CO_2 hr^{-1} m^{-2}, with a positive rate occurring when carbon dioxide was captured. The rate in mmol CO_2 hr^{-1} m^{-2} was based on the total volume of the device (e.g., coated container, coated PET container) in which measurement occurred as well as the total area in m^2 that the carbon dioxide capture coating covered. The samples all showed slightly different beginning CO_2 concentrations when monitored; therefore, when comparing samples measured at different times, the data was normalized to a 400 ppm CO_2 starting concentration.

MTS Viability Assay of Algae Coatings

CellTiter 96® Aqueous One Solution (which contains the tetrazolium compound [3-(4,5-dimethylthiazol-2-yl)-5-(3-carboxymethoxyphenyl)-2-(4-sulfophenyl)-2H-tetrazolium; "MTS"] Promega Madison, WI) was used to assay the viability of the cells in the various formulations by coating the bottoms of the wells in a 96-well microplate with 0.05 g of coating for both control (no algae added) and polymer/algae coatings. To begin the assay, 100 µL of BG-11 liquid growth medium was added followed by 20 µL of the MTS solution to each well, and the plate incubated under normal indoor lighting at 25 °C with rocking in the MTS solution for 1 hour. After the incubation period, the contents were transferred to microcentrifuge tubes, centrifuged at 13,000 rpm for 10 minutes, and 60-80 µL of supernatant was transferred to new wells in a 96-well microplate. The absorbance at 492 nm was measured using a Multiskan Ascent microplate reader (Thermo LabSystems Inc. Beverly, MA). The change in absorbance is indicative of a change in cell proliferation with an increase in absorbance value resulting from increased cell metabolism.

Extraction of Cellulose from Algae Coatings

The genetically engineered overproducer was created to produce more significant amounts of cellulose than the wild-type algae (UTEX 2434).[14] The coating used for these experiments also contains cellulose, but the cellulose included in the coating was accounted for by using coating-only controls or controls with the wild type algae. Because the alginate-based coatings crosslink using a multivalent ion (calcium in our formulation), chelators can be used to remove that multivalent ion from the gel and essentially return the gel to a liquid. After inhibiting the calcium crosslinkers, all the components of the coating formulation are soluble in water except the cellulose. We used two common calcium chelators to isolate the cellulose for our samples: 0.3 M ethylenediaminetetraacetic acid (EDTA) in deionized water (DI water) and 0.5 M sodium citrate in DI water. For a typical extraction, 5 g of gelled coating was added to a stirring mixture of 30 mL EDTA solution and 15 mL sodium citrate solution. Once the gel appeared dissolved (10-15 minutes) and a white-colored solid remained in the stirring solution, the entire contents of the extraction mixture was transferred to a centrifuge tube and centrifuged at 5,000 rpm for 15 minutes. The supernatant was poured from the centrifuge tube and the white powder was either transferred to a tared dish to dry or was left in the centrifuge tube to dry.

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Nouryon Completes Expandable Microspheres Expansion in Sweden

Nouryon completed a €20 million project at Sundsvall, Sweden that significantly raises production capacity for its Expancel expandable microspheres. These are used to enhance the properties of products ranging from shoe soles and food packaging to wind turbines.

"Expancel demand is growing fast as we develop new applications to fulfil customer needs," said Sylvia Winkel Pettersson, director Expancel at Nouryon. "Examples include underbody coatings, weather strips and repair putty for the automotive market, and sealants, floorings and elastomeric cool roof coatings for the construction market."

Expancel microspheres are used as a lightweight filler and a blowing agent to make end products lighter, create attractive textures, protect against damage or shield against the elements. At the same time it also reduces costs as less raw material is needed.

Nouryon is the leading producer of expandable microspheres. The company recently announced that it would invest in a new world-scale Expancel plant in the US, subject to final board approval.

"These projects reflect our commitment to meet growing demand and grow successfully alongside our customers around the world," said Niek Stapel, managing director Pulp and Performance Chemicals at Nouryon. "Expanding our capacity will significantly strengthen our leadership position in expandable microspheres."

OCSiAl Agrees to Manufacture TUBALL Matrix

OCSiAl announced a licensing agreement with Brazilian company Skintech for production of OCSiAl's TUBALL Matrix product. Skintech will manufacture and supply TUBALL Matrix for customers in Brazil, with production beginning immediately.

The agreement is another step in OCSiAl's expansion into the North, Central and South American markets. The company's TUBALL Matrix product is an additive that transforms existing materials to reduce weight, improve strength, increase adhesion or add conductivity. Initial applications in the Americas are focused on electrostatic discharge (ESD) flooring.

Through its unique production process, OCSiAl can produce nano additives at a cost 75 times lower than competitive technologies and at a scale that has never before been possible. The resulting products are TUBALL, a universal graphene additive that augments material performance, and TUBALL Matrix, a pre-dispersed form of TUBALL.

TUBALL Matrix builds on the properties of TUBALL to enable faster mixing, easier handling and broad compatibility with base materials. In the ESD flooring space, when added to coating mixes, it eliminates hot spots and reduces material requirements and costs.

Petronas Chemicals Group Bhd Acquiring BRB

Petronas Chemicals Group Berhad (PCG) has entered into a Sale and Purchase Agreement to acquire 100 percent of Da Vinci Group BV, a holding company of BRB International BV.

The acquisition is PCG's first step into specialty chemicals via inorganic growth. PCG has recently announced its next chapter of growth focusing on future strategic positioning venturing into derivatives and specialty chemicals.

Upon completion of the Sales and Purchase Agreement, BRB International BV will become a wholly-owned subsidiary of PCG.

ALTANA's ACTEGA Division Inaugurates New Innovation Center at Grevenbroich Site

ACTEGA Rhenania on June 5 inaugurated its new laboratory building in Grevenbroich. The company, which belongs to the specialty chemicals group ALTANA, invested approximately €10 million in the new building.

The building has an area of 5,700 square meters, doubling ACTEGA Rhenania's space for research and development.

A special feature of the new building, which at full capacity will accommodate around 70 employees, is the customer technology center. It encompasses various manufacturing plants in miniature format and enables ACTEGA to understand production processes and specific customer requirements better in practice than is possible under pure laboratory conditions. Not only ACTEGA Rhenania but also other companies in the ACTEGA division will make use of it.

DIC Joins TCFD Consortium

DIC Corporation announced it has declared its support for the recommendations of the Task Force on Climate-related Financial Disclosures (TCFD) and has joined to the TCFD Consortium of Japan established on May 27, 2019.

The TCFD was established in 2015 by the Financial Stability Board (FSB), the members of which include representatives of the finance ministries, financial regulators and central banks of 25 major countries and regions, as well as other key global financial bodies. The task force developed its recommendations to assist corporate efforts to disclose information on climate-related risks and opportunities.

As signaled by the Paris Agreement, a multinational accord aimed at curbing climate change adopted in December 2015, rising average global temperatures and other aspects of climate change have the potential to significantly impact society, ecosystems and corporate activity, underscoring the need to take action to mitigate this urgent challenge. DIC's decision to declare its support for the TCFD reflects its recognition that companies will increasingly be expected to focus on growing sustainably with society by achieving a balance between social value, that is, value that contributes to the resolution of social imperatives, and economic value, which underpins corporate growth. *CW*

Ashland Launches Thickening, Anti-sagging Agent

Ashland has launched a new highly efficient thickening and anti-sagging agent for use in inorganic zinc-rich primers.

Klucel MS HPC is a non-ionic water-soluble cellulose ether with a versatile combination of properties. The product is suitable for permanent and temporary coatings sprayed onto ship panels prior to welding.

"This brand new HPC technology enables a major improvement in dissolution speed in polar organic solvents. The product provides the highest thickening efficiency against chemistries commonly used as thickeners and anti-sagging agents for solvent-based zinc-rich primers," said Dr. Robert Gibbison, marketing director performance additives. "Furthermore, the product is soluble in water and multiple polar organic solvents used to control viscosity.

"Our customers are looking to improve their efficiencies and to improve the speed they can turn around product to the end customers," Gibbison added. "This new Klucel MS HPC gives them an edge in a competitive market place by offering fast dissolution and also a cost saving due to the lower dosage needed in the formulation."

ROSS Offers Sanitary Tumble Blenders

The ROSS VCB-0.25 Tumble Blender is uniquely suited for specialty blends with extremely minor active components and additives.

Ideal for processing high value and delicate applications, the Tumble Blender is often provided in sanitary all-stainless steel construction and imparts gentle agitation.

Options for process optimization include vacuum design, heating jacket, intensifier bar for deagglomerating clumps, and custom PLC controls.

The vessel's characteristic V-shaped geometry facilitates 100 percent product discharge. ROSS Tumble Blenders are available across a full range of working capacities from ¼ cu. ft. to 100 cu. ft.

Michelman ProHere E 00017 Polymer Dispersion

Michelman introduced the newest addition to its line of ProHere waterborne polymer dispersions and emulsions for use in metal coatings.

Formulated for use in sealers for fasteners and window fittings, ProHere E 00017, provides lubricity and enhanced corrosion resistance on electroplated metal.

Used at a low dry film thickness (DFT 0.5 – 7 µ), ProHere E 00017, exhibits excellent adhesion to a variety of metals including cold-rolled, electroplated, and hot-dipped galvanized steel. Easily stripped from plating racks with a hot alkali solution, it contributes to metal preservation through its water, solvent, and acid resistance.

BYK Introduces RHEOBYK-440

Under the new brand name RHEOBYK, BYK has grouped together approximately 40 organic products from its wide-ranging rheology portfolio.

One product presented to trade professionals for the first time was RHEOBYK-440, which has been developed for water-based epoxides and is suitable for a variety of systems.

That is because, in the area of sea freight containers especially, the manufacturers of protective coatings have dealt extensively in the last two years with aqueous systems based on the latest epoxy resin dispersions.

These coatings are formulated with a high pigment content and are applied in higher film thicknesses so that a rheology control agent is needed to adjust coating properties like anti-sagging and anti-settling. However, since established rheology additives in the market are not efficient enough, are not stable, or even do not work at all in epoxy dispersions, new technology is required.

With RHEOBYK-440, a liquid polyamide-based rheology additive has been developed which offers a tailor-made solution for adjusting the rheological properties in these modern aqueous epoxy systems, while simultaneously complementing the BYK product family of liquid polyamides with a product for various other water-based systems.

Besides optimizing anti-sagging and anti-settling properties in waterborne epoxies, RHEOBYK-440 is suitable for various other aqueous coatings, e.g. for achieving good effect pigment orientation.

Phoseon Technology Introduces FireEdge FE410 LED Curing Systems

Phoseon Technology announced the new FireEdge FE410 LED curing product solution with advanced features that deliver up to 50 percent higher irradiance, power and dose than the original FireEdge FE400. This will help customers who need increased process speed for improved throughput.

With built-in intensity control options, the FireEdge FE410 can be used for both full cure and pinning applications such as inkjet pinning, 3D print and adhesives curing. With the segment control feature, FE410 can help users save energy and achieve more precise UV coverage when needed.

The new air-cooled product offers customers process stability with Phoseon's patented TargetCure technology that provides users with precise and predictable UV output. Phoseon's unique scaling feature allows units to be stacked "end-to-end" with contiguous, uniform UV output to fit any application size. The FireEdge FE410 also comes equipped with WhisperCure technology that provides a quieter solution with high UV output and small form factor. WhisperCure technology uses proprietary and patented Phoseon innovations to provide a unique, compelling solution. ***CW***

PPG Names Jaime Irick VP, Architectural Coatings, U.S. & Canada

Jaime Irick was appointed VP, architectural coatings, U.S. and Canada, PPG announced.

He will report to Tim Knavish, PPG SVP, architectural coatings and president, Europe, Middle East and Africa.

Irick will succeed Dave Cole, current PPG VP, architectural coatings, U.S. and Canada (AC USCA), who announced his intent to retire, effective July 31, 2019.

Jaime Irick

Irick joins PPG from the Life Fitness Division of Brunswick Corp., where he served as president.

Prior to joining Life Fitness, Irick worked for General Electric Company as chief commercial officer, Current, powered by GE. Before that, he served as VP, GE Lighting North America; president and CEO of GE Lighting Solutions; general manager, GE Power Sensing; director of sales, GE Security; and director, Corporate Initiatives Group, GE.

Dave Cole

"Jaime's wide-ranging leadership, innovation and experience will be invaluable in his new role at PPG," Knavish said.

Cole joined PPG's chemicals business in 1981 and held various sales positions in the chlor-alkali and specialty chemicals businesses through 1990, when he moved to Transitions Optical, PPG's former joint venture with Essilor International. Starting as sales and marketing manager, Americas, Cole advanced to become director of sales and business development, Americas, and then GM, Americas, Australia and New Zealand, before being named president of Transitions Optical in 2011. In 2014, Cole rejoined PPG as VP, packaging coatings, and he was named VP, AC USCA, in December 2015.

"During his 38-year career with PPG, Dave has delivered tremendous value to employees, customers, shareholders and communities," Knavish said. "He is widely known for his excellent leadership, employee engagement, customer focus, strategic vision and innovation capabilities. In addition, Dave's high-energy and engaging personality have made him not only a trusted colleague but also a friend to many throughout PPG."

Axalta Names William M. Cook to Board of Directors

Axalta Coating Systems appointed William M. Cook to its Board of Directors, effective immediately.

Cook will serve on the Company's Audit Committee and Environment, Health, Safety and Sustainability Committee.

"As a former chairman and CEO of a similarly-sized industrial manufacturing company, Bill is a proven executive with a compelling track record of driving growth, building a business, and serving global customers across industries, while delivering substantial returns to shareholders," said Charlie Shaver, Axalta's chairman of the Board. "With his breadth and depth of experience, he brings a unique business perspective and invaluable insight to our Board as we look to continue to grow our business and seek new opportunities to create and deliver shareholder value."

Cook most recently served as executive chairman of Donaldson Company, Inc. until 2016, and prior to that served as chairman, CEO and president of Donaldson for more than 10 years. During his 35-year career at Donaldson, Cook held various roles of increasing responsibility, including SVP, International; CFO; and SVP, Commercial and Industrial.

Since 2008, Cook has been a director of IDEX Corporation serving as lead director and a member of the Audit Committee. Cook has also been a director of Neenah, Inc. since 2016, serving as non-executive chair since May 2019 and on the Audit Committee.

Previously, Cook served on the Board of Directors and Audit Committee of Valspar Corporation from 2010-2017.

Cook's appointment is the culmination of a search process conducted by the Board to replace Andreas Kramvis following his decision not to stand for re-election at the 2019 Annual General Meeting.

The company also announced the departure of Lori Ryerkerk from the Board following her appointment as CEO of Celanese Corporation.

With the appointment of Cook and resignation of Ryerkerk, Axalta's Board remains at eight directors.

Shamrock Technologies Announces Leadership Change

Shamrock Technologies announced that Al Pape has left the company.

William B. Neuberg, principal owner and chairman of Shamrock, will take over the duties of president.

Shamrock Technologies was formed in 1941 by Neuberg's father, William D. Neuberg.

"We thank Mr. Pape for his leadership and service to Shamrock and wish him well," Neuberg said. "As the principal owner, I have always been actively involved in guiding the direction of the company.

"My passion has always been to bring new and exciting products to our customers," he continued. "Shamrock developed micronized wax and the use of recycled PTFE in printing ink. These innovations and service to customers have helped create the multi-national corporation Shamrock is today and will allow us to continue to provide new and exciting products in the future." CW

CEPE Annual Conference to be held in Malt Sept. 18-20

Aug. 19-23, 2019
Advances in Emulsion Polymerization and Latex Technology
Location: Davos Platz, Switzerland
Venue: Hotel Belvédere
Contact: Dr. F. Joseph Schork
Email: DavosCourse@gmail.com
Website: davoscourse.com

Sept. 11-13, 2019
Spray Finishing Training
Location: Toledo, OH
Venue: Owens Community College
Phone: 800-466-9367 ext. 7320
Email: sprayworkshop@netscape.net

Sep. 18-20, 2019
CEPE Annual Conference and General Assembly
Location: St. Julian's, Malta
Phone: +49 511 99 10 281
Website: www.european-coatings.com

Oct. 1-3, 2019
ABRAFATI 2019
Location: Sao Paulo, Brazil
Venue: São Paulo Expo Exhibition & Convention Center
Phone: 55 11 4083 0504/ 0505
Email: abrafati.2019@abrafati.com.br
Website: http://www.abrafati2019.com.br/

Oct. 7-9, 2019
62nd Polyurethanes Technical Conference
Location: Orlando, FL
Venue: The Gaylord Palms Resort & Convention Center
Email: Sarah_Scruggs@americanchemistry.com
Website: www.polyurethane.americanchemistry.com

Oct. 8-11, 2019
Practical Wood Coatings Formulation and Application Course
Location: High Point, NC
Venue: Wood Coatings Research Group
Phone: 336-802-1132
Email: r.obie@woodcoatingsresearchgroup.com

Oct. 20-23, 2019
34th Biennial Western Coatings Show and Symposium
Location: Las Vegas, NV
Venue: Paris Hotel and Casino
Phone: 714-974-4511
Email: westerncoatings@earthlink.net
Website: www.westerncoatingsshow.com

Nov. 5-8, 2019
SEMA Show
Location: Las Vegas, NV
Venue: Las Vegas Convention Center
Email: semashow@semashow.com
Website: www.semashow.com

Nov. 18-20, 2019
CHINACOAT 2019
Location: Shanghai, China
Venue: Shanghai New International Expo Centre (SNIEC)
Email: info@sinostar-intl.com.hk
Website: www.china

Nov. 20-22, 2019
Greenbuild International Conference and Expo 2019
Location: Atlanta, GA
Venue: Georgia World Congress Center
Email: info@greenbuildexpo.com
Website: www.greenbuildexpo.com

Dec. 3-6, 2019
Practical Wood Coatings Formulation and Application Course
Location: High Point, NC
Venue: Wood Coatings Research Group
Contact: r.obie@woodcoatingsresearchgroup.com
Phone: (336) 802-1132
Website: www.woodcoatingsresearchgroup.com

2020

Feb. 16-21, 2020
2020 Waterborne Symposium
Location: New Orleans, LA
Venue: Sheraton New Orleans
601-266-4475
Fax: 601- 266-6265
Website: www.psrc.usm.edu/waterborne
Email: waterborne@usm.edu

March 12-14, 2020
PaintIndia 2020
Location: Goregaon, Mumbai
Venue: Bombay Exhibition Centre
Contact: moritz.schuermeyer@vincentz.net
Phone: +49 511 9910-278
Website: www.paintindia.in

March 31-April 2, 2020
American Coatings Show
Location: Indianapolis, IN
Venue: Indiana Convention Center
Website: www.american-coatings-show.com

May 5-7, 2020
Coatings for Africa
Location: Johannesburg, South Africa
Venue: Sandton Convention Centre
Phone: +44 (0) 1737 855 162
Website: www.coatings-group.com

May 19-21, 2020
UTECH North America 2020
Location: Chicago, IL
Venue: Renaissance Schaumburg Convention Center Hotel
Contact: dhershfield@crain.com
Website: www.utech-north-america.com
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Blades

Products & Services

Company Name	Page	Website
AC Media LLC	11, 12	www.american-coatings-show.com/callforpapers
ACT Test Panel Technologies	51	www.acttestpanels.com
American Machining Inc.	13	www.ibcresource.com/video
Arkema Coating Resins	21	www.arkemacoatingresins.com
BASF	17	www.basf.com
Chemark Consulting	69	www.chemarkconsulting.net
Conn and Co. L.L.C.	19	www.connblade.com
Custom Milling and Consulting	55	www.cmcmilling.com
Engineered Mills, Inc.	7	www.EMImills.com
Engineered Polymer Solutions	37	www.epscca.com
EMD Performance Materials	Cover 3	www.emd-pm.com
Evonik Resource Efficiency GmbH (Tego)	35	www.tego.de
Ferro Corporation	3	www.Ferro.com
Hockmeyer	39	www.hockmeyer.com
keim additec surface usa llc	5	www.keim-additec.de
Little Joe Industries	14	www.littlejoe.com
Lubrizol Advanced Materials Inc.	41	go.lubrizol.com/aptalon
Q-Lab	43	www.Q-Lab.com
R.E. Carroll	59	www.recarroll.com
Shamrock Technologies Inc.	Cover 2	www.shamrocktechnologies.com
Shepherd Color	53	www.shepherdcolor.com
Siltech Corporation	15	www.siltech.com
Specialty Polymers, Inc.	57	www.specpoly.com
STR Industries	91	www.strindustries.com
Sun Chemical	9	www.sunchemical.com
Troy Corporation	Cover 4	www.troycorp.com
Wanhua Chemical Group Co.Ltd.	45	www.ytpu.com
Western Coatings Symposium	29	www.westerncoatings.org

PPG CORAFLON ADS Coatings Restore Flying Saucer in Mars, Pennsylvania

PPG has donated PPG CORAFLON ADS (air-dry system) coatings, including primer, metallic topcoat and clearcoat, to refurbish the flying saucer that has been a fixture in downtown Mars, Pennsylvania, since the early 1980s. The new coating system is expected to last a minimum of 15 to 20 years.

The spaceship, which measures about 9 feet (2.7 meters) in diameter and weighs nearly 2,000 pounds (907 kilograms), was removed by crane from its perch in the Mars town square near the end of March 2019. Oesterling's Sandblasting & Painting in nearby Butler, Pennsylvania, sandblasted and recoated the saucer, with the Mars Historical Society choosing the silver-metallic color.

Experts from the PPG TRUEFINISH industrial coatings business recommended PPG Coraflon ADS coating system for its durability and texture. The system is formulated with an advanced fluoroethylene vinyl ether (FEVE) fluoropolymer resin to provide decades of corrosion protection and brilliant chalk- and fade-free color on skyscrapers, storefronts and other high-visibility architectural applications.

The restored flying saucer was reinstalled on May 23 in time for the Mars Exploration Celebration being held May 31 through June 2 and sponsored for the first time by the PPG Science Education Council. The event is an extension of the town's Mars New Year celebration, which was held on March 21. A new year begins on the planet every 678 days.

Mars Exploration Celebration is a science, technology, engineering and math (STEM) event that is hosted in conjunction with NASA. Attractions will include a flight simulator, robots, rockets and a professional drone show featuring 100 drones flying over Mars. ***CW***

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