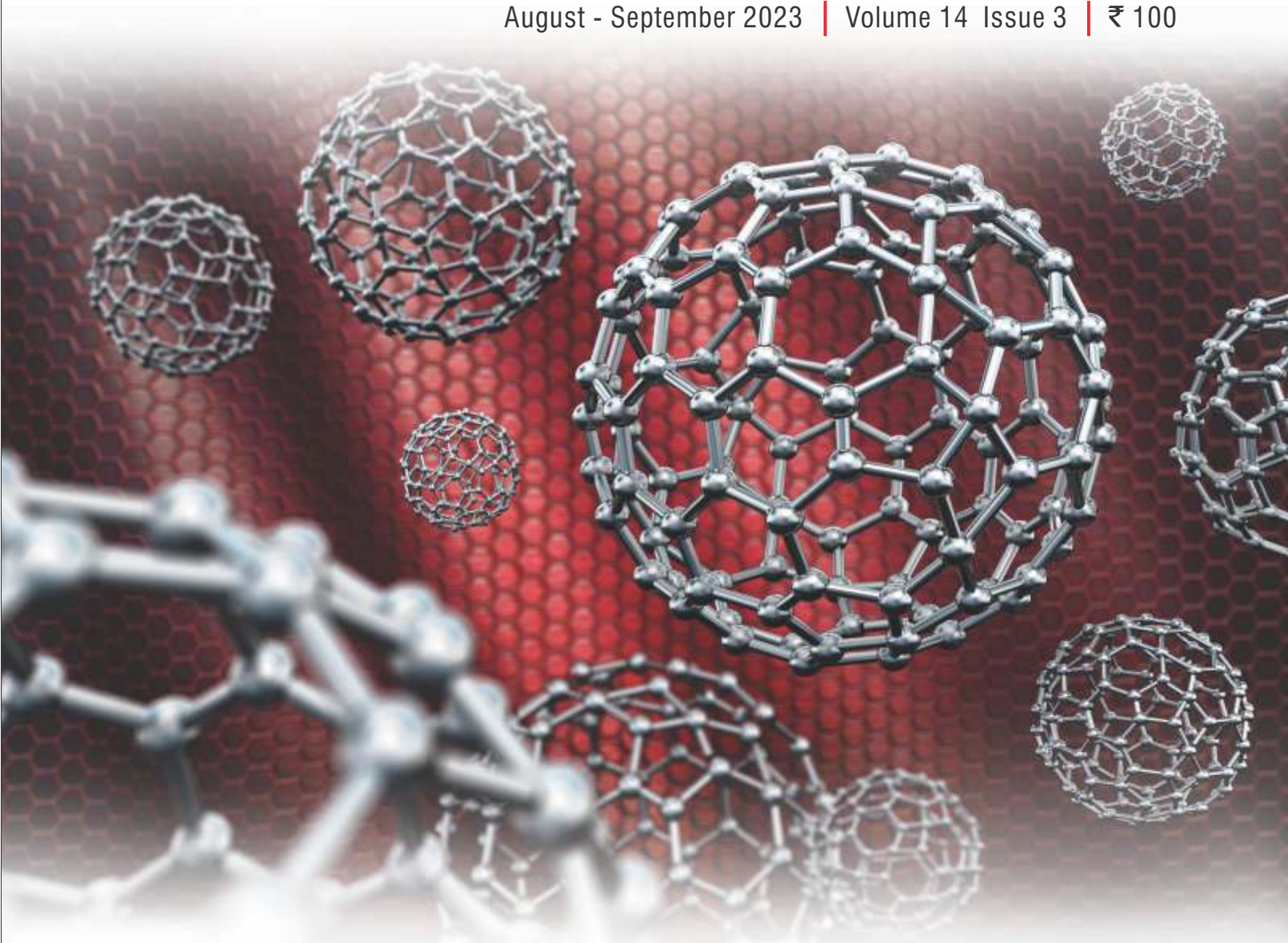




COATINGS AND ANTI CORROSION ENGINEERING REVIEW

August - September 2023 | Volume 14 Issue 3 | ₹ 100



Nanoparticles show significant potential for much stronger, tougher and durable coatings

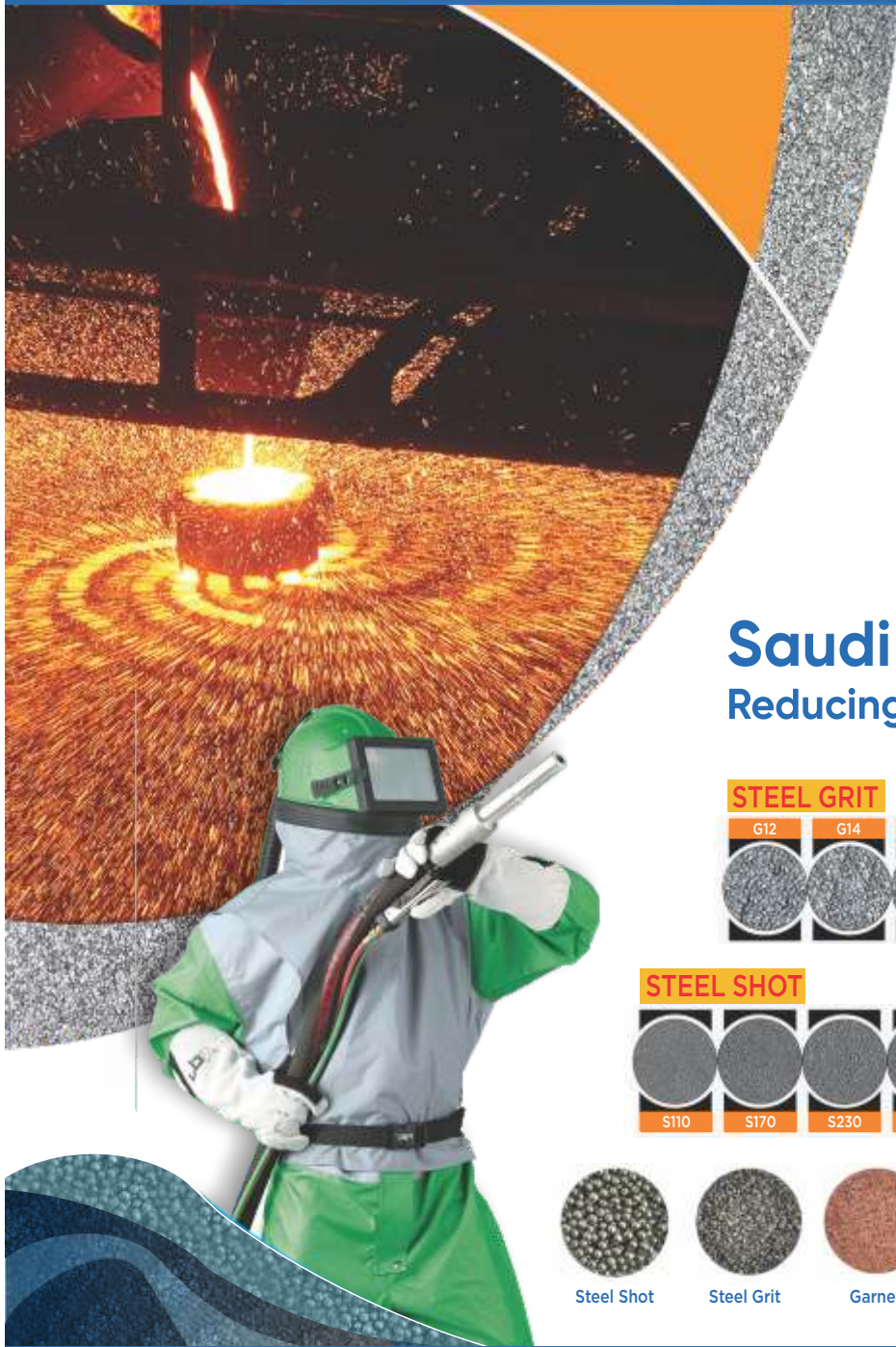


Interview
Mr Saurabh Agarwal
*Managing Director,
Kamdhenu Paints*

Technical Feature
**External 3-layer polyethylene coating
for water carrying steel pipes**

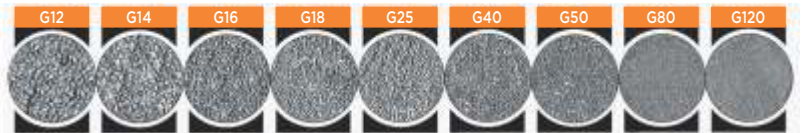


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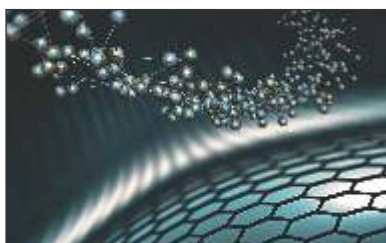
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Abrasion Testing

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From the Editor-in-Chief...

India has made history with Chandrayaan-3 lunar rover's landing on the moon's south pole. Congratulations to the relentless efforts of our unsung scientists who made it possible, with a wish that we reach further out into the universe!

Nanocoatings can play a major role in protecting satellites and objects in space orbits. A research team from the University of Surrey recently invented a nanocoating that can reduce the operating temperatures of space-qualified structures from 120°C to 60°C.

The nanocoating, named the Multifunctional Nanobarrier Structure (MFNS), can be used alongside a spacecraft's sensors and advanced composite materials thanks to its custom-built, room temperature application system. Nanomaterials are no longer only the purview of expensive medical, satellite, or stealth bomber coatings.

Nanomaterials have the potential to overcome challenges and this technology has also led to breakthrough advancements within the coating industries. Nanotechnology can be used for formulating functional smart coatings like super-hydrophobicity, anti-icing, anti-fogging, anti-reflective, anti-fouling, self-healing, anti-bacterial, anti-corrosion and anti-graffiti, etc. Extremely small nanoparticle raw material additions can give paints, varnishes, and adhesives enhanced properties not found with simple barrier chemistries.

A primary growth factor for the global nanocoatings market is the broad spectrum of applications that nanocoatings have across a multitude of industries. According to Precedence Research, the global nanocoatings market size was estimated at US\$ 12 billion in 2022 and is expected to surpass around US\$ 66.35 billion by the end of 2032 and registering growth at a compound annual growth rate (CAGR) of 18.7% from 2023 to 2032.

Ongoing developments in nanotechnology have led to the creation of more cost-effective and efficient nanocoatings, enhancing market demand in the process. In this issue, the main story delves upon the relevance of nanocoatings within the industry, as also with all our regular features and columns.

Jolly Lonappan
Editor-in-Chief



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The time has arrived for ceramics to finally take centre stage. Jyoti Ceramic Industries has specially developed ceramic filled polymer based coating compounds, "Aluma Coat®-BR" brushable / sprayable and "Aluma Coat®-TW" trowelable.

Aluma Coat® - TW

A trowelable, easy to apply protective coating, comprising of sintered sapphire-hard ceramic micro beads, doped in polymer resins designed to resist corrosion, abrasion and moderate surface impact. It gives a rough textured surface finish and can withstand maximum service temperature up to 150°C/302°F.



Aluma Coat® - TW



Mineral Crusher Coated with Aluma Coat - TW



Inner Base of Dust Collector Coated with Aluma Coat - TW

Aluma Coat® - BR

A brushable / sprayable easy to apply coating designed to protect surfaces from severe turbulence, corrosion, erosion and chemical attacks. It gives a satin smooth, high-gloss surface finish and can withstand maximum service temperature up to 150°C/302°F



Aluma Coat® - BR



Motor Shaft Coated with Aluma Coat - BR



Butterfly Valve Coated with Aluma Coat - BR



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PPG launches low-temperature cure electrocoats for automotive manufacturers

PPG (ppg.com) has announced the launch of PPG ENVIRO-PRIME® EPIC 200R coatings, a suite of electrocoat (e-coat) products that cure at lower temperatures than competing technologies. The products provide sustainability benefits for customers, including lower energy use and reduced CO₂ emissions at manufacturing facilities, notes a press release from the company.

temperatures, providing a more sustainable solution without sacrificing manufacturing throughput or coating performance.”

As part of its growth strategy, PPG is focusing on partnering with customers to provide industry-leading innovations and digital solutions that provide productivity and sustainability benefits. In 2022, 39% of PPG's sales



PPG ENVIRO-PRIME® EPIC 200R electrocoat products cure at lower temperatures than competing technologies, providing sustainability benefits for customers including lower energy use and reduced CO₂ emissions.

“This is a game-changing technology,” said Garry Grant, PPG global product manager, substrate protection products, Automotive Coatings. “Conventional e-coats typically require higher oven temperatures to cure over thicker substrates and complex assemblies, resulting in uneven appearance and variations in color. The PPG ENVIRO-PRIME EPIC 200R platform ensures well-cured films at lower baking

were from sustainably advantaged products – the company aims to increase that to 50% of total sales by 2030 under its new environmental, social and governance (ESG) targets.

PPG is a pioneer in e-coat, which has been used in automotive and industrial applications for nearly 60 years and is a key innovation leading to significantly reducing auto body corrosion

FPro G gun: a concentrate of innovations in 445 grams of aluminum

Sames Kremlin (sames-kremlin.com) completes its premium range of low pressure paint spray guns with the FPro G, a gravity-fed model that stands out for its ergonomics, high application quality and disposable cups, notes a press release from the company.

Intended for general industry and professional bodyworker, the FPro G promises its users a very high level of finishing. Its number one asset: the vortex technology. The rotating paint stream is dispersed into finer droplets, resulting in a more even spray pattern and a better transfer rate. The result: a flawless application, without 'orange peel' effect, even in hard-to-reach areas.

The FPro G has also been designed for user comfort. At 445 grams for the forged aluminum body, it is among the lightest guns on the market. The curves of its handle and trigger adapt themselves to the hand and fingers, the center of gravity is perfectly balanced.

A major innovation, thanks to a magnetic assistance, the trigger force at the end

of the stroke is reduced by 40%. It weighs no more than 900 grams, which in case of intensive use, the difference in comfort will be major.



PHOTO: SAMES-KREMLIN

Sames Kremlin completes its premium range of low-pressure paint spray guns with the FPro G, a gravity-fed model that stands out for its ergonomics, high application quality and disposable cups.

The gun itself can be combined with two 0.6-liter rigid buckets (one regular, one pressurized) and two disposable buckets (250 and 750 ml). It also offers a range of adapters for most gravity guns.

These disposable cups are rounded at the top: mixing the paint is easier, accumulation in dead zones is impossible, and

the end result is better. They are light: 100 grams lighter than the rigid version. They are equipped with a watertight lid for storage without drying between uses, ideal for frequent color changes.

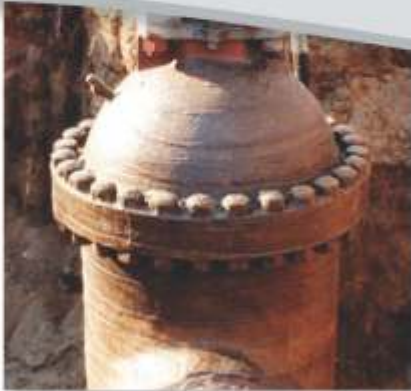
The FPro G replaces Sames Kremlin's M22G and is available in four versions (HVLP, LPLV, conventional and pressurized), it is offered with six nozzles with a diameter of 1.2 to 2.2 mm. Sames Kremlin thus has a complete premium range: a gravity gun, a pressure gun (FPro P) and a suction gun (FPro S).

and extending vehicle lifespan. It is a water-based technology, providing outstanding substrate protection for cars,

appliances and airplanes and is applied at over 95% efficiency, minimizing material waste.

Trenton offers three Wax-Tape® brand anticorrosion wrap systems.

High-quality, easy-to-apply wraps that protect irregularly shaped fittings and require minimal surface preparation.



Belowground applications

Wax-Tape® #1

Anticorrosion Wrap:

A very durable wrap that uses a thick, non-stitch bonded synthetic fabric and has no clay fillers, so it stays conformed to irregular profiles. The wrap requires no abrasion blasting, can be backfilled immediately and is compatible with cathodic protection.



Aboveground and belowground applications

Wax-Tape® #2

Self-Firming Anticorrosion Wrap:

A unique, microcrystalline-wax-saturated wrap that slowly firms up to provide excellent aboveground and belowground protection. Comes in a variety of colors and usually requires no outerwrap.



High-temperature applications

Wax-Tape® HT-3000

High-Temperature Anticorrosion Wrap:

Designed for operating temperatures up to 230°F (110°C), Wax-Tape® HT-3000 wrap can be used on high-temperature oil and gas piping, on compressor station discharge piping, beneath thermal insulation and in high ambient temperature conditions.

Only Trenton offers Wax-Tape® brand anticorrosion wrap systems, with primers, wraps and outerwraps.

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Trenton Advisor

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Sprayroq releases all new corrosion-resistant polyurethane lining: SprayShield Aqua Guard

Sprayroq (sprayroq.com), the industry-leading innovator in structural and protective polyurethane linings, has announced the release of its latest technology: SprayShield Aqua Guard, a highly moisture-tolerant, corrosion-resistant lining for municipal, storm, and treatment assets. SprayShield Aqua Guard is specifically designed for cities to effectively manage and protect their critical water infrastructure, ensuring sustainable and long-lasting operations for years to come.

Traditionally, municipalities

benefits SprayShield Aqua Guard's innovative design creates a robust barrier against corrosive substances present in water and wastewater systems. This protection significantly reduces the risk of material degradation and extends the lifespan of critical assets.

Sprayroq is dedicated to sustainability and environmental responsibility. SprayShield Aqua Guard is engineered to produce zero VOCs (volatile organic compounds) and is safe for potable water, ensuring that it aligns with eco-conscious



SprayShield Aqua Guard is specifically designed for cities to effectively manage and protect their critical water infrastructure, ensuring sustainable and long-lasting operations for years to come.

have faced significant challenges in maintaining and preserving their water and wastewater assets due to the harmful effects of moisture and corrosion. Other spray-applied linings do not provide the needed protection against some of the harshest elements, leading to frequent repairs, increased maintenance costs, and downtime. SprayShield Aqua Guard was specifically designed to address these challenges head-on, providing a reliable, cost-effective, and efficient solution.

Amongst the key features and

principles while safeguarding vital water resources. The easy-to-install nature of the lining simplifies the maintenance process for municipal water authorities. This leads to reduced downtime during maintenance activities, minimizing disruptions to the water supply and wastewater treatment processes.

By significantly extending the service life of water and wastewater assets, Sprayroq's SprayShield Aqua Guard allows municipalities to save on long-term maintenance costs and allocate resources more efficiently for other

Dunn-Edwards Corporation announces extension to Decoglo® line

Dunn-Edwards Corporation (dunnedwards.com/product/decoglo/) has introduced an additional sheen for Decoglo® – an interior paint for cabinets, doors, and trim, which is designed to be paired with the Decoprime® interior primer. The pair provides a fast drying, block resistant finish, notes a press communique from the company.

Formerly launched in July 2022 with a semi-gloss finish, Decoglo has been a popular choice among customers, resulting in Dunn-Edwards decision to make the product available in an eggshell finish as well. Decoglo is designed to be used on properly prepared interior wood substrates, including furniture.

“Decoglo differentiates Dunn-Edwards from competitors with its ultra-premium quality and key features, like its scuff and chemical resistance and lacquer like finish and hardness. We're thrilled that the additional eggshell sheen is now available for Decoglo users, giving them a wider range of options during the selection process,” said Dave Heiligenthal, Senior Product

essential projects.

SprayShield Aqua Guard was developed to provide quick application and stand-alone corrosion-resistance capabilities that provide an answer to problems our customers experience every day. “This product will allow our contractors to work directly with their municipalities to provide a



Decoglo is designed to be used on properly prepared interior wood substrates, including furniture.

Manager at Dunn-Edwards.

The advanced urethane modified acrylic technology in Decoglo provides an exceptionally hard and durable finish. Decoglo outperforms competitor products in scuff resistance, which can be defined as the physical damage that typically occurs on the surface of the finish. Decoglo is a fast-drying product. It is block resistant and stands up to room temperature and elevated room temperatures, preventing painted surfaces from sticking together or peeling from the surface. A high-quality paint Decoglo is formulated with ingredients that enhance flow and leveling. The end result is a smooth surface with a glossy finish.

solution for maintaining assets, providing enhanced corrosion protection, and executing a quick return to service time that saves valuable resources,” said Jeremy Alexander, President of Sprayroq. “We are eager to introduce SprayShield Aqua Guard to our customers and look forward to hearing of its success.”

PHOTO: SPRAYROQ

PHOTO: DUNN-EDWARDS



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G6 Materials launches new thermally conductive epoxy product line

G6 Materials Corp (g6-epoxy.com), a high-tech company with expertise in advanced materials and developing innovative composites for a wide range of industrial uses, has launched a new thermally conductive G6-EPOXY® product line.

in electronic devices, power modules, lithium battery heat management, and LED lighting applications. By efficiently transferring heat away from sensitive components, epoxy resins enhance the performance, reliability, and longevity of devices, ensuring they



G6 Materials Corp's G6-EPOXY® resins have a variety of uses that include bonding, sealing and coating.

The first new product is named "G6E-TSHV" and is a high thermally conductive, non-electrically conductive epoxy, while the second new product is named "G6E-TSAL" and is a thermally conductive, non-electrically conductive, low viscosity epoxy. Both new products are available in various size formats.

"We are excited to release this new line of products. We strive to develop new formulations to provide solutions for our customers and to address the problems that they face when working to develop advanced products and emerging technologies," said Daniel Stolyarov, the President, CTO & Co-CEO of the Company.

Epoxy resins play a vital role in thermal management due to their exceptional thermal conductivity and insulation properties. These versatile materials efficiently dissipate heat, making them essential

operate optimally even under challenging conditions. The growing demand for compact and high-powered electronics further highlights the significance of epoxy resins in addressing thermal challenges and promoting technological advancements.

The Company's G6-EPOXY® resins have a variety of uses that include bonding, sealing and coating. Particularly, they can be used when soldering is not practical or when soldering requires heating adhesive material. G6-EPOXY® resins have the following unique properties:

The ability to work in broad temperature ranges, including reliability up to 600 degrees Fahrenheit;

Reliable adhesion to a variety of materials including plastics, metals, glass, and ceramics; a reduction in overall density, weight and cost; the ability to resist moisture, solvents and oxidants with exceptional

Self-programming 3D paint robots with data logging for heavy industry

Ventherm A/S (ventherm.com) is a Danish provider of spray booths and paint facilities for heavy industries such as wind power, offshore, defense, transportation, agricultural and other machining industry. Providing paint

solution it is also possible to adjust painting parameters such as angles, speed, and paint pressure for each surface type. This is a game-changing robotic solution within heavy duty industry, the press release notes. The benefits include high



Ventherm's new robot solutions allow the user to create robot programs without stopping the production.

facilities to clients worldwide, they have introduced an automatic programming and 3D scanning paint robots for the heavy duty industry. The new robot solutions allow the user to create robot programs without stopping the production. Ventherm's robot solution works by scanning the unpainted part in 3D and from the scan the software automatically generates a program planning the most optimal paint paths. Along with the size and shape of each individual part, the position and orientation are also considered by matching the 3D scan with the initial CAD drawing of the part. As a result, the program is optimized for each individual part.

With Ventherm's robot

flexibility and surface quality – increased production capacity by ensuring a constant and smooth workflow; optimal paint paths – no human robot programming; reduced costs for personnel - controlled by app or PC.

Ventherm gives one the option to base actions on valid, traceable and real-time data. Get a visual overview of the performance of the entire production line with a custom-made dashboard; receive a report daily/weekly/monthly/annually with key data ensuring an optimal performance of production/investment; forecast service and maintenance. Data logging includes an overview of for instance: temperature, paint consumption, energy consumption, and emission.

durability; and do not require a heating oven during curing time and can be used in the

bonding of sensitive components at room temperature.

C&W Specialist Equipment is now part of TQC Sheen.

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CRISIL Rating : SME 1 'Highest'

Real-time control for non-contact coating thickness measurement

coatmaster AG (coatmaster.com) has announced the launch of its all-new, fully-digital coatmaster® Flex for real-time non-contact coating thickness measurement optimally integrated into the production process, notes a press release from the company.

Alongside its already well-known Advanced Thermal Optics sensing capability, the

newly optimized coatmaster Flex now offers superior WiFi connectivity, an enhanced battery management system and fundamentally revised software which promotes greater process control and automation. The fast and robust measuring process – featuring SpectralBlue®

technology for completely disturbance-free operation, plus the large measuring distance and high repeatability remain the same.

The new WiFi module enables wireless connectivity with the cloud of up to 100m range from the nearest access point – however, the capability to integrate and operate the device with a local server also remains an option. Meanwhile, the new state-of-the-art battery management system allows even more measurements to be taken with each individual charge.

Among the advantages offered by the revised software are automatic email notifications about the production process, allowing greater and more immediate control over coating quality and powder consumption. New production tasks can also be managed directly in the cloud – this means that staff on the coating line only need to measure. Bidirection-



The newly optimized coatmaster Flex now offers superior WiFi connectivity, an enhanced battery management system and fundamentally revised software which promotes greater process control and automation.

al communication with the coating lines means that new tasks can now also be automatically transmitted from the coating line to the coatmaster Flex. Continuous information on the applied coating thickness is automatically synchronized with customers' coating or ERP systems -

without even having to connect a single cable or establish a Bluetooth connection.

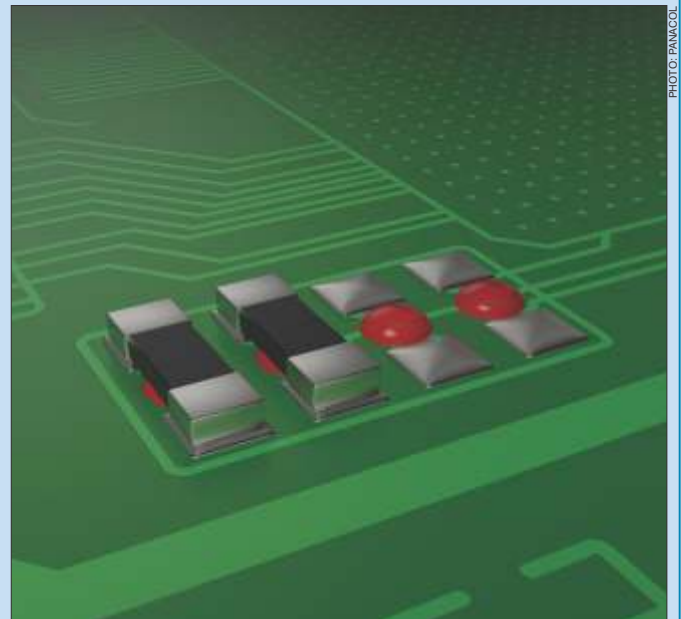
Andor Bariska, Co-Founder & Co-CEO of coatmaster AG said: "With this new generation coatmaster Flex, saving up to 30% on materials usage just became even easier. By taking coating thickness measurement into the digital age, we are empowering the industry towards greater productivity and profitability with real-time information about their processes."

Fast-curing SMD adhesive for precise dispensing

Panacol (panacol.com) presents its new Structalite® 5604, an extremely fast-curing adhesive which is specifically developed for bonding SMDs to printed circuit boards. The adhesive is based on epoxy resin and is, despite its high viscosity, suitable for jet application, notes a press communique from the company.

This adhesive is cured with heat. The thermal cure occurs within minutes, even at low temperatures. When fully cured, the adhesive is extremely temperature resistant. It can withstand short-term temperatures of up to 270°C, making it suitable for reflow soldering processes.

Structalite® 5604 is particularly



The red Structalite® 5604 is ideal for fixing SMDs and electronic components.

Structalite® 5604 is a one-component epoxy resin adhesive that contrasts well with green PCB material due to its red color. This makes it possible to ensure visual inline inspection. The one-component adhesive can be dispensed in production through jetting, valve dispensing or screen printing. Its ideally adjusted viscosity and high thixotropy index enable high-speed dispensing, precise dot profiles, and non-slumping wet adhesion prior to curing.

shock-resistant and durably adheres to FR4 printed circuit boards, metals, and epoxy-based molded materials. Due to its high glass transition range of >115°C, the adhesive is ideal for electronic component assembly. It does not lose adhesion or softens at elevated temperatures. As Structalite® 5604 was developed specifically for use in electronics, it has high ionic purity and thus provides optimum protection against internal corrosion.



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BioPowder: Expanding beyond the European market

With the collaboration with Dorfner, BioPowder expects to enter and serve new markets, offering formulators novel solutions with functional, aesthetic, and environmental advantages

BioPowder (bio-powder.com), a responsible producer and supplier of high-grade fruit stone powders and bio-based abrasives, has announced a strategic alliance with Gebrüder Dorfner GmbH & Co. Kaolin- und Kristallquarz- und-Werke KG (Dorfner), leading experts in the refinement and application of minerals and filler systems. The partnership combines BioPowder's core competency in sustainable plant-based additives with Dorfner's expertise in application engineering, creating product development opportunities and unlocking new areas of research.

Kathrin Schilling, Managing Director of BioPowder, said, "We are delighted to deepen our working relationship with Dorfner in this manner. They have been a reliable partner and I am certain our complementary offerings will pave

the way for new product grades that cater to a diverse range of chemistries. Through this collaboration, we expect to enter and serve new markets, offering formulators novel solutions with functional, aesthetic, and environmental advantages."

Specifically, the two companies will develop a brand-new line of plant-based functional fillers and color particles that can complement conventional quartz and kaolin particles. Obtained from agricultural side-streams, these natural additives work as colored granules or ultra-fine fillers in coatings, composite materials, or flooring systems. Customers can also leverage Dorfner's cutting-edge surface treatment and application lab capabilities to develop bespoke lines of Olea FP (Functional Powders) according to their specific requirements.

unlock the potential of bio-additives for eco-friendly developments in the market and beyond."

The story of BioPowder began many years ago when Ms Schilling and her co-founder in Spain began with a mission to upscale olive oil byproducts. All the leftover side streams from olive oil mills, such as pulp, shell, and olive stones, were traded over the years for bio-fuel. At the same time there were requests from the market, especially existing ones, to further upscale the olive oil byproducts. That was how BioPowder was born back in 2016, when they decided to open a factory in the South of Spain, right at the center of the olive cultivating region in Europe.

"BioPowder offers a line of superior, top-grade additives that fit into a variety of applications, ranging from cosmetics to food and feed, besides material science applications," said Ms Schilling. "It is any application where a conventional plastic, mineral, metal additive, or any other solid powder, is substituted by bio-based additives — which are much more sustainable in terms of its carbon footprint." The technology used is called micronization, which is essentially a combination of different cleaning, grinding, sieving, and classification steps, and it enables us to achieve specific particle sizes — right down to micron ranges of very fine powders, where the particles are not even visible to the naked eye. Due to a variety of grain sizes,



Kathrin Schilling, Managing Director, BioPowder.

these powders can create very diverse textures and aesthetic effects. When it comes to coatings and composites, these powders have several major utilities like for matting, texturizing, anti-slip effects, and reinforcements as functional fillers.

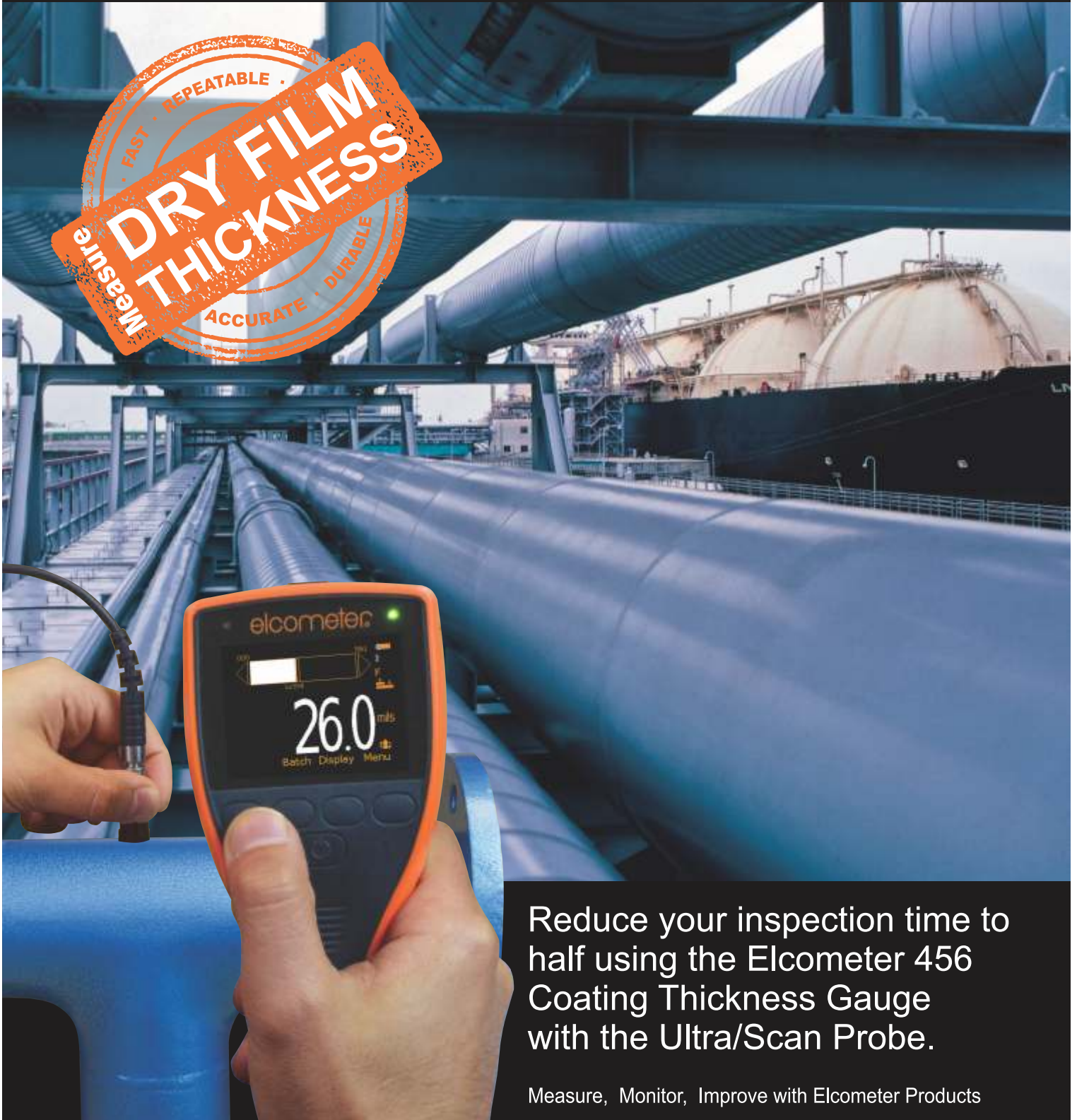
Dorfner, is a leading producer of quartz and kaolin powders and granules. The quartz particles are used as fillers for coatings and other applications. In recent years, the market has shifted towards a more sustainable approach specifically for plant-based additives and more and more non-mineral particles, said Ms Schilling. "This is precisely what BioPowder specializes in and so we decided to join forces, leading to an extended product offering."

The main idea is that BioPowder supplies plant-based olive stone particles, and Dorfner, who is a specialist in surface treatment of particles, treats the olive stone powders — making them hydrophobic and impregnating or dyeing them



When it comes to coatings and composites, these high-grade fruit stone powders have several major utilities like for matting, texturizing, anti-slip effects, and reinforcements as functional fillers.

Schilling added, "At BioPowder, we believe in taking sustainability to the next level while setting new standards for product and service quality. This collaboration represents a significant change in the way both our businesses address the needs of the paints, coatings, and composites market. And together, we will



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with certain coloring techniques. “The result is a complementary and fully sustainable product line to their existing treated mineral particles,” said Ms Schilling. “This opens up new markets for both of our companies. Our goal is always to cater to the end customer in the best possible way, not only in terms of particle size, but also in terms of what’s required for their specific chemistry.”

The market for these products are manufacturers of coatings and composites. Most manufacturers use mineral fillers, polymeric additives, or polyethylene and polypropylene powders in their paint, usually as binders or for creating certain matting and texture effects. “And in view of the microplastic replacement debate, any manufacturer who has a minimum consciousness in this regard tries to find a more sustainable alternative to prevent the release of microplastics in the environment once the paints are applied. Some examples include road markings and marine coatings, which release a very significant amount of microplastics once applied. This can be countered by using our fully compostable granules that do not require any industrial recycling. At the same time, once these granules are incorporated in a matrix (in a polymeric formulation), they remain stable and there’s no risk of degradation in the formulation,” explained Ms Schilling.

Special properties of olive stone powders

Olive stone powders possess certain unique characteristics. For one, the olive stone is extremely hard, measuring between 3.5 and 4 on the

Mohs scale. This exceeds the hardness of most biomasses and most mineral particles, said Ms Schilling. “It creates a very high resistance, especially abrasion resistance in paints and coatings, and helps to increase the product’s life span. It has been proven that when used in a road marking or flooring product, the renewal periods can be extended significantly. Studies on the matting effect have shown that polyethylene can be replaced completely by BioPowder Olea FP. In fact, the same matting and opacity effect can be achieved even when the Olea FP is used at a significantly lower dose. And there are also very interesting ways of creating surface textures with our olive stone powders — for anti-slip and decorative or aesthetic effects. In Europe, for example, we have customers in the film industry that create coatings exclusively for film sets, where very specific textures are required. And when it comes to the road markings, there’s a need for the road marking to stand out from the remaining asphalt to be obviously seen.”

In Europe, all companies over a certain size are obliged to make a sustainability report on an annual basis. The European Union is moving fast in the direction of new regulations to restrict and to forbid the use of intentionally added microplastics. Paints and coating materials that require disposal at the end of life will follow suit within a very short time. “Generally speaking, the regulations are very similar all over the world,” said Ms Schilling. “The list of hazardous substances of prohibitive chemicals is becoming longer



BioPowder helps companies replace conventional blasting media such as plastic, garnet, silica/sand, and glass with biodegradable options.

in practically all countries around the world. This is a major advantage for BioPowder because our particles’ carbon footprint is very small compared to that of mineral powders and polymeric powders in paints and coatings.”

Biodegradable grits and abrasives

Surface technology today often requires sophisticated abrasion methods to maintain texture and cleanliness of the surface material. Different finishing processes, e.g. shot blasting, de-flashing or smoothing, require abrasive media in different grain sizes and shapes. Also, hardness and stability play essential roles when choosing the most effective material. BioPowder provides innovative and fully natural blasting grit solutions to enhance abrasive processes while reducing the ecological footprint.

“We help companies replace conventional blasting media such as plastic, garnet, silica/sand, and glass with biodegradable options,” said Ms Schilling. Specialized finishing machines often require tailored grit solutions to ensure optimal workflows and to prevent blockages and damages. Moreover, no harmful residues and dust formation must occur to guarantee workplace safety and cleanliness at all times.

To cater to those needs, the

company has developed a new line of natural high-performance grits and abrasives made from refined olive stones and walnut shells. BioPowder’s olive stone grits have a hardness in the range of +/- 3.5 (Mohs scale) and can be customized to any particle size range. Thanks to very low moisture absorption capacities, the grits remain stable in humid environments. They are consequently suitable for (high-pressure) water jet applications. These grits are 100% biodegradable and compostable and therefore easy to dispose of. In addition, their stability makes them reusable in certain systems. This translates into significant cost savings.

Processes to clean tools, vehicle parts, and machines require powerful solids to rid the metal surface of undesired coverings such as corrosion, paint, or lacquer. Any sanding or blasting application intended for rust removal can be upgraded with plant-based abrasive grits from renewable resources. These corrosion removal grits are well suited for industrial users with modern air or water jet technologies.

BioPowder is working with partners around the world, including India and the United States, to expand the reach of its offerings beyond the European market.



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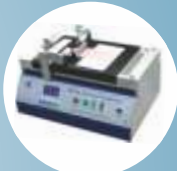
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'Housing for all,' real estate and a buoyant automotive sector to drive the growth trajectory

Kamdhenu Colour & Coatings Limited, (a wholly owned subsidiary of listed company Kamdhenu Ventures Limited) is engaged in manufacturing and marketing of decorative paints under the brand name Kamdhenu Paints. Mr Saurabh Agarwal, Managing Director, Kamdhenu Paints, in a chat with C&ACER

What kind of growth is Kamdhenu Paints envisaging the next five years?

Kamdhenu Paints has been able to successfully penetrate into Indian markets because of the quality and value proposition of our product offerings. For the next five years, we aim to expand our dealership network and tap into newer markets. We generated a revenue of Rs 250 crore in FY23 and looking at our growth trajectory, we have envisioned to register a four-fold revenue of Rs 1,000 crore by FY28. We have articulated a business strategy to achieve this.

How do you plan to execute your expansion programs? E.g. growth into South and Western India, further growth in the North and Eastern parts of India...

Kamdhenu Paints has planned to enhance its market share in the South and West region of the country. To achieve this we will expand our product portfolio with the launch of new and innovative products. We will further tap the deep markets in North and East region by increasing our dealership and distribution network. Our aim is to increase our existing dealership network of 4,000+ across the country to 8,000+ in the next five years. The key objective is to increase market share from unorganized players, and tap into tier II and tier III cities. We are also eyeing to expand our pan-India visibility through robust and aggressive advertising

and promotions.

What are Kamdhenu Paints' main strengths?

Our main strength lies in our ability to deliver superior quality yet economically viable products. Kamdhenu Paints' mantra of ensuring quality is delivered at affordable rates is very well complimented by our nationwide dealership and distributor network. To facilitate the distribution of our products, we have built a strong network of over 4,000+ dealers across the country. Moreover, we have registered over 20,000 painters, with more than 5,000 actively procuring from us. This wide reach allows us to serve customers in both urban and rural areas.

At our core, environmental sustainability is a priority and we offer a diversified and eco-friendly product portfolio. Our range includes premium exterior emulsions, premium interior emulsions, premium dual emulsions, economical emulsions, undercoats, putty, specialized coatings, construction chemicals, wood coatings, and more. By providing environmentally conscious solutions, we are actively contributing to a greener and healthier future.

How big is the Indian paint market size and how is it faring?

The Indian paint industry today is worth over INR 62,000 crore (US\$ 8 billion), and is the fastest-growing major paint market in the



PHOTOS: KAMDHENU PAINTS

Mr Saurabh Agarwal, Managing Director, Kamdhenu Paints.

world, with a consistent double-digit growth over the last two decades. It has over 2,000 paint manufacturers, with nearly all global majors present in the country.

It has a near-75% share of architectural paints and a 25% share of industrial paints, with an equitable fast-paced growth across all segments, from architectural to powder,

from automotive to coil, from high-performance to general industrial, from refinish to wood, and from packaging to plastic.

What are the emerging trends in the paint industry?

The market will be fueled by the rapidly rising household income and the fast-growing demand from smaller towns and rural areas because of

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increased customer awareness. The architectural sector is going to lead the overall paints and coatings market in terms of value, between 2021 and 2026.

'Housing for all,' real estate and a buoyant automotive sector will further drive the growth trajectory.

What are some of the unique products of Kamdhenu?

With over 40 SKUs across 10+ product categories, we offer a comprehensive selection to suit various applications and preferences. Kamdhenu Paints has a wide range of decorative paint products that includes exterior and interior emulsions, acrylic distempers, water based and solvent primers, synthetic and GP enamel, wood finishes, aluminium paints, textured to designer finishes, stainers, PU wood finishes and metallic finishes. Our unique products are Kammo dual series – the dual paint which can be used on both exterior as well as interior walls and also, we have best range of high end emulsion for interior, we have Kammo Hi Sheen and for exterior we have Weather Supreme. Both these products are unique in terms of quality when we compare them with other peer companies.



Do you have a R&D department where research is done?

We have a world class R&D department at our production unit at Chopanki, Rajasthan and is equipped with latest technology. Our R&D undertakes various initiatives to innovate and introduce new products and further enhance its features. It is often the first stage in the development process. The goal is typically to take new products and services to the market and add to company's bottom line.

Are you targeting the global market and if so which areas and how?

Currently we are focused on developing and growing our existing domestic market. We already have a strong hold of the Northern and Eastern markets and have plans to go deeper into Western and Southern markets.

Where are the Kamdhenu Paints' production units located and how are the paints marketed throughout the country?

We have our very own state-of-the-art manufacturing plant in Chopanki (Rajasthan) which produces interior and exterior emulsions, stainers, colourants, designer paints, construction chemicals, water proofing chemicals and other



water based speciality products. It has a capacity of 36,000 KL per annum which enables us to sufficiently cater to the growing demand for high-quality paints in the country. In addition to our own manufacturing capacity, we have also established strategic outsourcing partnerships, resulting in an additional production capacity of 50,000 KL per annum. This ensures that we can effectively cater to the diverse needs of our customers.

A brief history of Kamdhenu Paints like when was it started, under what circumstances, and how has it grown over the years, etc.

Established in 2008, our entry strategy in initial years was focused on affordable variants like powder-based paints, putty, distempers etc. to first gain the confidence and loyalty of the dealer and painter network.

After having achieved rapid growth and a good base and with dealer relationships cemented, we decided to prioritize premium offerings, gradually reducing the low-priced dealers to focus on premium dealers.

With renewed focus on premium products, innovative

ideas such as rewarding schemes and incentives and a refreshed branding and advertisement campaign, the company has been able to achieve 43% share of premium products and increased the dealer count to 4,000+ as on date.

Our focused strategy is to set base in the smaller Indian towns identifying an underserved gap in the paint industry. We have leveraged Kamdhenu Group's deep networks through the steel business to attract professional and loyal dealers and painters in these towns, creating a niche market for itself.

We have signed ace Bollywood celebrity and entrepreneur, Preity G. Zinta as our Brand Ambassador for decorative paints. This collaboration will help enhance the brand's pan-India reach and recall, helping catapult the brand as the preferred consumer choice. Preity G. Zinta's inclusion as the Brand Ambassador is set to blend perfectly with the ethos of the brand, aptly representing a modern woman who performs every role seamlessly with her wide appeal across demographics.



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Belzona restores mammoth pipeline through cold bonding

A mammoth pipeline in a petroleum production facility in Thailand suffering from thin wall defects along the weld joints was restored using Belzona 1111 (Super Metal), ensuring the long-term protection of the pipeline's integrity

Belzona's polymeric repair and protection materials are suitable for extending the in-service life of assets in a multitude of industries, including equipment in the petrochemical industry which often functions in harsh environments. Belzona's products are suitable for both small-scale assets and extremely large projects, such as the recent restoration of a mammoth pipeline in a Thai petroleum production facility.

What was the problem?

The facility, based in the north of Thailand, found that a huge pipeline carrying high-pressure water for injection into oil wells was suffering from thin wall defects. The pipeline in question was made out of 12 meter pipe lengths that had been welded together. However, upon inspection it was found that the 2,000 psi water contents

and the weld filler material used had resulted in internal corrosion defects at every circumferential weld joint. This caused the deterioration of pipe wall thickness, risking high pressure leaks.

Why was Belzona chosen?

The Customer had used Belzona previously and had a good relationship with the local Distributor, Pan Mechanic Engineering Co., Ltd. They were very impressed by Belzona's cold bonding capabilities when they were demonstrated by the Distributor on a defective joint, leading to their agreement to undertake the repair of the entire pipeline, requiring an estimated 5,000-7,000kg of Belzona 1111 (Super Metal).

Due to the massive scale of the project, it was decided to complete the repair in three



The pipeline was exposed to corrosion at the joints where sections had previously been welded together.



Belzona's cold bonding solutions had previously repaired other areas of the pipeline.

stages. More than 1,000 joints were repaired in 2020 and the remaining defects were addressed in November and December 2022. The joints repaired in stage one were demonstrating excellent

performance in service and the Distributor also invited two Technical Services Engineers from the Belzona Asia Pacific Office to observe the second stage of the project.

Why was Belzona 1111 (Super Metal) specified?

The use of welding had been problematic in the past, leading to the Customer's preference for a cold bonding solution. The Distributor initially proposed the use of Belzona SuperWrap II to restore pipe wall strength, but testing found that attaching carbon steel reinforcing plates using Belzona 1111 (Super Metal) as a bonding agent would be more appropriate. The simpler cold bonding



Belzona repaired a pipeline made out of 12 metre pipe lengths in the petrochemical industry using cold bonding.

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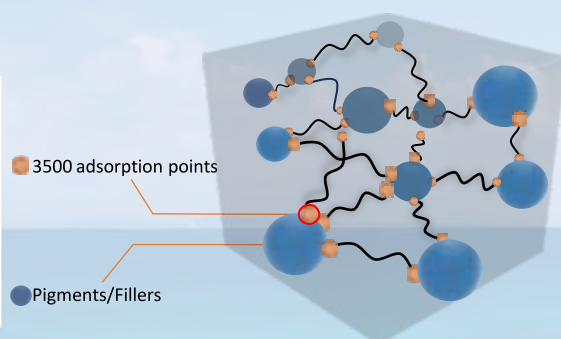
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Associative Mechanism with Pigments/Fillers

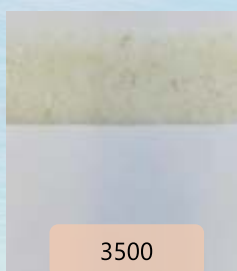
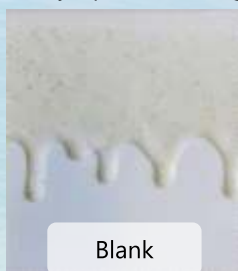
DISPARLON 3500 associates to pigments/fillers and make cross-bridged network.

Pigment/Filler type	Thixotropy, Viscosity Increase
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Treated Fumed Silica	+
Untreated CaCO3	++
Treated CaCO3	+
Zinc Oxide	++

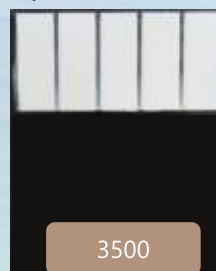
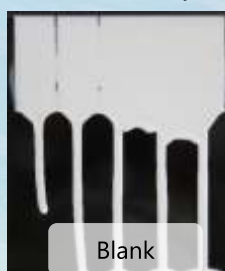


Application Data

Polyspartic Coating



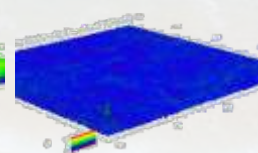
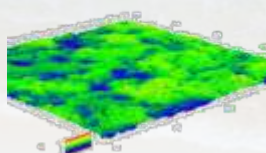
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Belzona 1111 (Super Metal) was applied as a bonding agent.



The plates were held in place by a fixed hoist to allow the product to cure.



The completed application restored strength to the pipeline wall.

repair would be more cost effective and ensure a faster return to service in line with the Customer's requirements.

How was the solution applied?

The surface was prepared using garnet blasting and Belzona 9111 (Cleaner/Degreaser) to achieve an average minimum $\geq 75 \mu\text{m}$ (3mils) profile and SA2.5 surface cleanliness for maximum adhesion. The atmospheric conditions were then tested to ensure that the relative humidity was below the maximum permitted 85% needed for the application to take place.

Welding rods were used to create a shim between the steel plates and the repair area to control the thickness of the application. The welding rods were bonded to the steel reinforcing plates with a small quantity of Belzona 1111 (Super Metal) and the repair area was identified using masking tape. Belzona 1111 (Super Metal) was first applied to two of the four plates and the damaged pipeline joint, and held in place using a fixed hoist while the product cured. Once the first two plates had bonded, the final two plates were applied and allowed to cure, fully encompassing the

circumferential joint.

What was the result of the application?

The Customer was delighted that the Belzona repair restored the integrity of the joints and protected the pipeline from future thin wall defects. The success of such

a large-scale project led the Customer to indicate an interest in applying Belzona solutions to other pipelines at their facility. This could include similar cold bonding applications or the specification of Belzona SuperWrap II for more complex pipe geometries. Polymeric repair and protection materials are ideal for facilities in the oil & gas and

petrochemical industries due to their easy application and quick return to service with no hot work required.



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1 Cost Advantages for Coatings Manufacturers:

By combining the unique properties of Intelli-ion® with the established phosphate inhibitors, coatings manufacturers can optimize their formulations while reducing overall costs. This synergistic 'co-blend' approach allows for lower loadings of both Intelli-ion® and phosphate-based inhibitors, resulting in significant savings in inhibitor expenses, transportation, and storage.

2 Enhance Customer Satisfaction with Superior Performance:

Intelli-ion®'s advanced technology goes beyond traditional corrosion inhibition. Its unique electrochemical properties provide a smart, 'on-demand' response - safeguarding the substrate for longer. This mechanism extends the coating's performance and has reached the highest (C5) level of corrosion protection - reducing the risk of premature failures and enhancing end-user customer satisfaction.

3 Achieving CSR Targets with Sustainable Technology

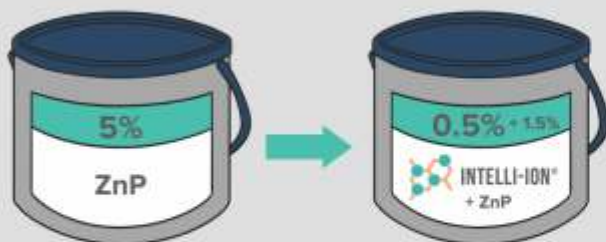
As the coatings industry embraces 'greener' practices, Intelli-ion® takes center stage with its sustainable technology. Free from heavy metals and chromates while delivering superior corrosion protection. When incorporated, Intelli-ion removes hazard warning labels associated with other corrosion inhibitors, while delivering:

- Reduced CO₂ emissions per liter of paint
- Environmental benefits to end-customers during application and disposal of empty containers
- Offer customers increased product lifecycle of metal assets

4 Increase Market Share with New Product Lines:

In a competitive coatings market, introducing a new product line with Intelli-ion® sets manufacturers apart from their competitors. Its advanced technology and exceptional performance create a compelling selling point. Position your product as a premium, high-performance choice that outshines traditional inhibitors. Differentiate from competitors and drive market growth with Intelli-ion®.

Example cost of Intelli-ion® in use:



This example offers up to:
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cost savings
on anti-corrosives

11 power tips to control corrosion and increase quality by 2X

“Do you know there are approximately 22,000 automotive components, paint plating and coating manufacturers in Asia? And competing with these existing and upcoming manufacturing units is becoming difficult day by day. Manufacturers are unable to earn as much profit as they expect,” notes Mr Vidur Malhotra, head of sales at Testronix Instruments, who has authored this book – *11 power tips to control corrosion and increase quality by 2X*.

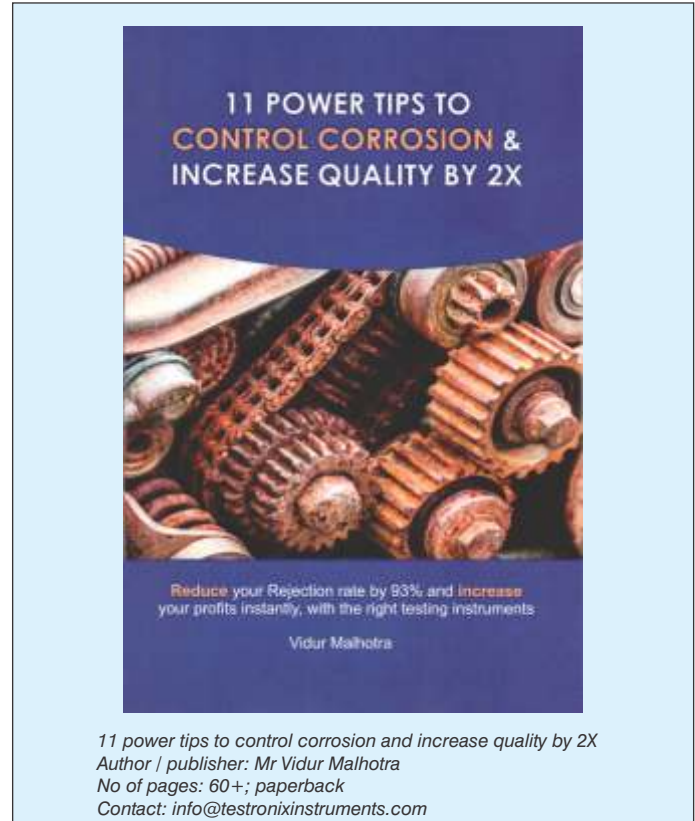
“If you are a manufacturer who wants to learn how to produce world class products and solutions, which comply to international standards, eliminate wastage, reduce rejections, and yet reduce production costs, then, this book is for you!” exclaims the young and enthusiastic Mr Malhotra. “The purpose of this book is to fill this gap in knowledge and give you the right solutions in just a few minutes. These solutions can help you manufacture 100 percent rejection-proof products and build a 100 percent happy clientele.”

He notes, according to the latest research, if automotive companies keep continuing with their old practices of manufacturing for the next four years, they will run out of business soon. Hence, learning new processes and keeping abreast with new industry trends has become the need of the hour. This

book has consolidated his 11 years of experience in the field of testing instruments in a nutshell and provides invaluable information that has helped more than 1,700+ manufacturers earn pure profits.

Spread across 11 chapters, besides the introduction and conclusion, the book delves into topics like everyday problems of automotive components and paint plating manufacturers; about the environmental testing; what manufacturers don't know about testing instruments; how to calculate the ROI (return on investment) of investing in laboratory testing instruments; 7 coating testing instruments that can set you up for the next 15+ years; when testing instruments should never be ignored while setting up a fully functional laboratory; which is the single most important test in your industry; quick tips to control corrosion instantly; and how to make sure you are not being cheated.

Mr Malhotra notes that if you are planning to buy a salt spray chamber, you must read this book as it holds the secret to help you as it will help you reduce material rejection costs; reduce corrosion instantly without much effort; ensure compliance and meet international regulations; ensure that the product's quality is not compromised; enhance quality and research and



development. “Even if some businesses own laboratory testing instruments, they do not know how to use the results and laboratory reports effectively or some do not even know what type and brand of testing instruments they should invest in,” notes Mr Malhotra. “I hope I have

been able to convey all my knowledge and experience of testing instruments through this book.”

Though the MRP of the book is marked at Rs 2,199, Mr Malhotra offers this book free-of-cost to our readers. His contact is: info@testronixinstruments.com

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ACCELERATED WEATHEROMETER (QUV)
ASTM G 154, ISO 16474



SALT SPRAY CHAMBER
ASTM B 117, ASTM G 85,
ISO 9227



SCRATCH HARDNESS
ASTM D 2197, D 7027,
BS 3900



AUTOMATIC PULL OFF ADHESION
ASTM D 4541, ISO 4624



HOLIDAY DETECTOR
ASTM D 5162, 62,
NACESP0188



MECHANICAL PROPERTIES OF PAINT FILMS
ASTM D 412, 638, 695 882,790,
1002, 2370 & ISO 527



TABER ABRASION TEST
ASTM D 4060



HUMIDITY TESTER
ASTM D 2247, ISO 6270



IMPACT TESTER
ASTM D 2794, ASTM
G 14, ISO 6272



VISCOSITY
ASTM D 562



HOT AIR OVEN



**AGEING TEST IN CYCLE
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1. Paint Characterizations, Specific gravity, % NVM, % Vol Solids, VOC, Viscosity & Drying time.
2. Flexibility Test, Pencil Hardness Test, Cross Hatch Adhesion Test, Shore Hardness D & A .
3. Chemicals Immersion Test.
4. Water Vapor Permeability and % Water Absorption Test.
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6. Aluminium Composite Panels (ACP).

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Nanoparticles show significant potential for much stronger, tougher and durable coatings

Ongoing developments in nanotechnology has led to the creation of more cost-effective and efficient nanocoatings, enhancing market demand in the process

While India was preparing for Chandrayaan-3 lunar rover's landing on the moon's south pole, marking a historic achievement, a research team from the University of Surrey was in the process of inventing a nanocoating that can reduce the operating temperatures of space-qualified structures from 120°C to 60°C.

The nano-coating, named the Multifunctional Nanobarrier Structure (MFNS), can be used alongside a spacecraft's sensors and advanced composite materials thanks to its custom-built, room temperature application system.

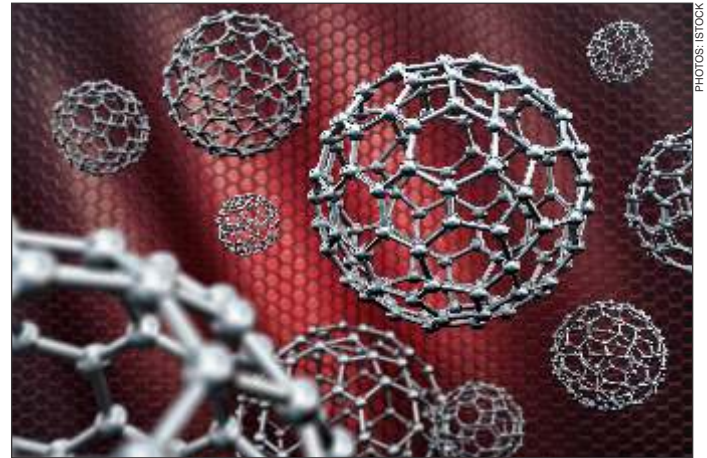
Professor Ravi Silva, a corresponding author of the study and Director of the Advanced Technology Institute at the University of Surrey, said: "Our new nanocoating is able to not only provide radiation and thermal protection but also harvest energy for use at a

later date."

Spacecraft must account for huge variations of solar illumination and space radiation to ensure that their payloads work as designed. Spacecraft temperature is maintained by delicately balancing radiation and external weather with heat produced internally.

Paolo Bianco, Global R&T Cooperation Manager at Airbus Defence and Space commented: "Our collaborative research with the University of Surrey has yet again proved fruitful with this latest development of a nanocoating to protect satellites in orbit."

Nanomaterials are no longer only the purview of expensive medical, satellite, or stealth bomber coatings. Rather, these tiny structures, thinner and more complex than the width of a single hair, have infiltrated applications where seemingly ordinary coatings are made stronger, more



PHOTOS: ISTOCK

lasting and more resilient with a wide variety of cleverly tailored characteristics for our ever-changing world.

In fact, nanotechnology has changed the landscape of industrial energy conservation, computer science, biomedicine, electronics, diagnostic biosensors, drug delivery systems, imaging probes, and paints/coatings/adhesives.

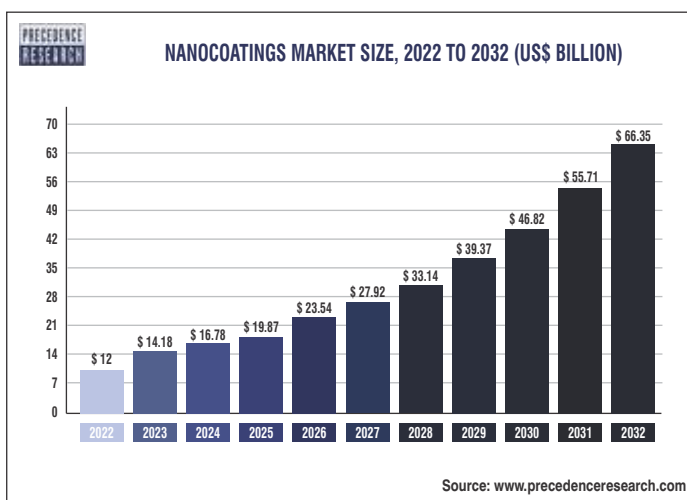
The most dramatic and sophisticated nanotechnology advances have been made in the medical field. However, intriguing innovations have also been made in coatings, paints, and adhesives. They offer unique contributions when dispersed in coatings. For example, they can be used for formulating functional smart coatings like super-hydrophobicity, anti-icing, anti-fogging, anti-reflective, anti-fouling, self-healing, anti-bacterial, anti-corrosion and anti-graffiti, etc. These unique properties are the outcome of outstanding aspect ratio, excellent surface

interaction and high modulus. Extremely small nanoparticle raw material additions can give paints, varnishes, and adhesives enhanced properties not found with simple barrier chemistries.

Since nanomaterials have the potential to overcome challenges, this technology has led to breakthrough advancements within the coating industries. With relevance to the coating industries, nanoparticles have shown significant potential for much stronger, tougher and durable coatings.

A primary growth factor for the global nanocoatings market is the broad spectrum of applications that nanocoatings have across a multitude of industries.

According to Precedence Research, the global nanocoatings market size was estimated at US\$ 12 billion in 2022 and is expected to surpass around US\$ 66.35 billion by the end of 2032 and registering growth at a compound annual growth rate



(CAGR) of 18.7% from 2023 to 2032.

A recent study conducted by Fairfield Market Research suggests that the global nanocoatings market is projected to achieve indexing a notable rate of growth over the forecast timeline. Moreover, various technological advancements have also been pivotal in fuelling market growth prospects for this global industry.

Ongoing developments in nanotechnology have led to the creation of more cost-effective and efficient nanocoatings, enhancing market demand in the process.

New advances in processing even allow nanoparticles to combine as stand-alone coatings deposited as thin films with tougher adhesion and surface characteristics. Research is underway to develop extremely fine in-situ nanostructures within coatings to provide enhanced physical and mechanical properties.

A wide variety of enhancements have been made to traditional paints and coatings using nanoparticles. Sometimes these additions can affect the intrinsic physical

and chemical baselines of resins and coatings, requiring careful attention to the concentration of these additions to achieve desired improvements without ruining the existing desired characteristics.

Some companies have developed portfolios of nanomaterial additions for paints, but more importantly, also developed corresponding patented processing technologies for incorporating those materials to improve coating properties such as corrosion resistance and self-cleaning characteristics without damaging existing characteristics.

Some promising nanoparticle additions are still in the laboratory stage. A team from Rensselaer Polytechnic Institute developed a powerful nanoglue that uses molecular chains to bond surfaces together and can work at very high temperatures. The nanoadhesive is only 1 nm thick—at least 1,000 times thinner than adhesives in current use.

Biofouling is the most serious coating problem that maritime industries face today. The solution has economic,

environmental and financial implications. Current ship paint technology uses 26–76% by weight of copper oxide additives. Five percent by weight CuO nanocontainers are sufficient to obtain even better antifouling and corrosion results, leading to a dramatic reduction of copper in the paint, resulting in less copper pollution.

The use of Bromosphaerol is also extremely important because it is a natural product compatible with oceanic environments. The self-healing nature of these systems results in a more durable coating. The increase in surface contact angle at the coating surface due to nanomodifications reduces drag resistance of the ship, increasing speed and reducing fuel consumption and air pollution.

In recent years, many commercial successes have also been realized through a wide variety of nanoparticle technologies. Large, multinational corporations and small, niche coating producers alike are investing in nanotechnology research and enhancing their existing products with clever additions of nanomaterials.

ferric oxide and silicon or titanium dioxide nanoparticles. Some oxide nanoparticle raw material additions also improve scratch resistance.

Antimicrobial properties where pathogens are killed on contact include nanoparticles of silver, titanium dioxide, and zinc oxide in many coating chemistries used in a wide variety of public buildings and hospitals. Fire-retardant properties can be added to wood coatings through the addition of nanoclays or titanium dioxide nanoparticles.

Enhanced electrostatic spray-painting performance can be achieved through the incorporation of fullerenes or carbon nanotubes, allowing for better deposition and more homogenous flow characteristics.

Smart coatings take significant advantage of nanoparticles. While coatings using nanoadditives are not necessarily smart coatings, many smart coatings have very specific characteristics imparted by nanomaterials. Smart coatings are an improvement over traditional functional coatings in that they exhibit characteristics as a response to external stimuli as opposed to continuously reacting regardless of the environment. Some examples of smart coatings include coatings that respond to the presence of chemicals, volatile organic compounds (VOCs), or carbon emissions and scavenge or otherwise neutralize them.

While many traditional coatings provide inherent corrosion resistance, smart coatings contain nanoadditives that release a corrosion inhibitor only when a corrosive influence is detected. Self-healing



Some examples of successful commercial applications include tungsten oxide nanoparticles in automotive paints to provide electrochromic and photochromic properties. Shading and targeted coloring can be achieved by adding carbon black, zinc, or

coatings contain microcapsules filled with polymeric material that is released only when cracking or other physical damage is detected.

Stringent regulations, and growing end-use industry applications

Stringent regulations concerning environmental conservation, and volatile organic compound (VOC) emissions have led to a greater use of nanocoatings. Several countries have begun to impose stricter norms on various industries to lower the environmental impact that conventional coatings generally have. Additionally, there is an increasing need for products with enhanced durability, that resist environmental factors, and are easy to clean. This has led to a higher use of nanocoatings in consumer goods.

Moreover, the role of nanocoatings in various end-use industries such as the healthcare sector has gained prominence in recent years, particularly since the onset of COVID-19. Nanocoatings can act as antimicrobial agents on medical devices and equipment, thus mitigating the spread of pathogens. Factors such as this are expected to bolster market growth prospects for the global nanocoatings market.

Growth opportunities across regions

With the United States at the forefront, North America is expected to account for the majority share of the global nanocoatings market. This can be attributed to the presence of key industries in the region, the adoption of technological advancements, and regulatory standards. Europe, led by Germany, France, and the UK, is another key market in the

nanocoatings space.

Additionally, Asia Pacific is slated to index a substantial rate of growth in the coming years owing to increasing investments in healthcare and construction, the expansion of the automotive and electronics industries, as well as robust industrialization.

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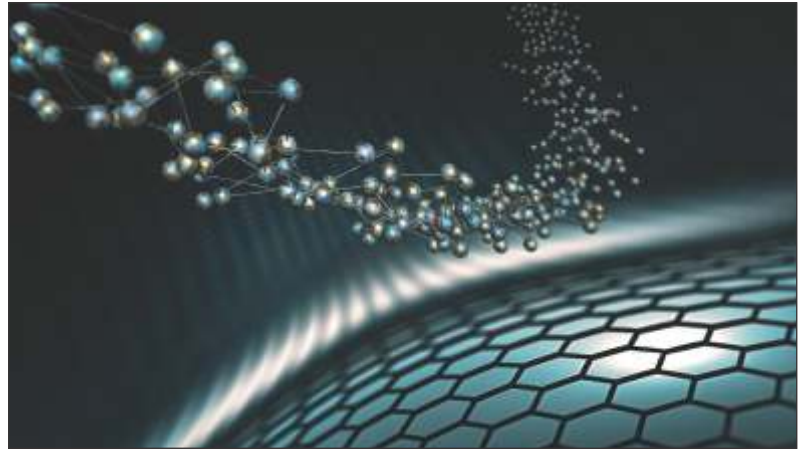
For instance, a nanocoating can make a surface scratch resistant, improve hardness, or make it resistant to bacteria.

Anti-corrosive coatings: When applied to a metal, the coating stops chemical compounds coming into contact with corrosive materials, this stops processes like oxidation.

Waterproof and non-stick clothing: A hydrophilic coating can be applied to various pieces of clothing, whilst the non-stick has applications in furniture, electricals and glass.

Anti-bacterial coating: These coatings help to inhibit the growth of microorganisms, which is particularly suitable for areas such as public transport.

Thermal barrier coating: This type of coating is particularly prevalent in the aviation industry and is normally applied to metallic surfaces. The elevated temperatures



that planes work at have opened up the possibility of the coatings' use in high powered automobiles.

Anti-abrasion coatings: The main application of this coating is to prolong the life cycle of the surface by lessening the amount of friction that occurs.

Self-healing coatings: The filled nano-capsules inside this coating help repair the surface should any scratching occur. They can be found in everyday items including phones and automotive paints.

Anti-reflection coatings: This coating does not increase transmission, rather it just reduces the reflection on the incident side

Anti-graffiti coatings: These are invisible to the naked eye and prevent costly expenditure to the government and companies in cleaning up graffiti.

A wide variety of enhancements have been made to traditional paints and coatings using nanoparticles. Sometimes these additions can affect the intrinsic physical and chemical baselines of resins and coatings, requiring careful attention to the concentration of these additions to achieve desired improvements without ruining

the existing desired characteristics.

Some key companies in the global nanocoatings market include Nanovere Technologies, Nanofilm, P2i Limited, Nano-Care Deutschland AG, Bio Gate AG, Nanophase Technologies Corporation, Nanogate, and Buhler AG, to name a few. Key players in the global nanocoatings market have been involved in new product launches and are implementing other growth strategies such as collaborations and acquisitions to strengthen their respective market position.

NanoTech Inc. launches flagship product, Nano Shield Cool Roof Coat

NanoTech Inc. launched their flagship product, the Nano Shield cool roof coat, a coating designed for application on existing commercial roofs, which cuts HVAC consumption in a building by 30-40%, significantly reducing energy costs while simultaneously curbing scope 1 carbon emissions. Like other coatings on the market, the Nano Shield cool roof coat is designed to remediate and extend the life of a commercial roof by creating a watertight seal. Unlike other coatings on the market, NanoTech's flagship coating leverages breakthrough technology to stop 95% of

heat transfer through the roof surface, reducing the temperature inside the building by up to 30°F.

Over 90% of all S&P Fortune 500 companies have published Net Zero pledges, committing their organizations to curb their carbon emissions footprint by 2050. To achieve this, many organizations are looking for quick wins with an immediate and significant impact in the carbon reduction space. Since a full 40% of all U.S. CO₂ emissions are driven by HVAC systems, reducing HVAC operation cycles attacks the problem at its source.

“As an organization, our mission is to develop materials that increase climate resiliency for our end customers while positively impacting their bottom line,” says NanoTech Inc. CEO, Mike Francis. “Our cool roof coating creates sustainability with a return and is just the first in a series of groundbreaking products we intend to launch in the green buildings space in coming months.”

Gerdau Graphene launches two performance-enhancing graphene additives for water-based paints and coatings

Gerdau Graphene, the nanotechnology company pioneering advanced graphene-enhanced materials for industrial applications, has announced the commercial availability of two new cutting-edge additives specifically formulated for the paint and coatings industry: NanoDUR and NanoLAV. The new additives, produced with the company’s proprietary G2D technology, utilize graphene nanoplatelets to deliver unprecedented performance improvements for water-

based paints and coatings — without altering pH levels. The additives also reduce or eliminate the need for some traditional manufacturing inputs, additives, and processes, which can lower production costs while improving sustainability and reducing environmental impact.

“Until recently, it has been virtually impossible for coatings manufacturers to upgrade product performance, slash manufacturing costs, and improve sustainability at the same time — it simply couldn’t be done. Now, the application of carbon nanomaterials, such as graphene, in commercially available additives has made this possible and will act as a game-changer for the industry,” said Alexandre de Toledo Corrêa, CEO of Gerdau Graphene. “NanoDUR and NanoLAV represent the new performance, economic, and sustainability edge for coatings manufacturers, enabling them to leapfrog competitors across the value chain. These are the newest in our growing portfolio of graphene additives and we’re excited to partner with industry leaders to develop even more novel, powerful applications for graphene.”

NanoDUR: enhanced durability for low- and high-traffic surfaces — NanoDUR is a water-based graphene additive that demonstrates excellent dispersion and dramatically increases paint and coating durability. NanoDUR-enhanced paints and coatings demonstrate an extraordinary ability to withstand wear and tear, weathering, and other external factors that can lead to degradation over time while maintaining physical and chemical properties, such as



color, and adhesion, as well as a strong resistance to chipping, flaking, cracking, fading, and peeling.

NanoLAV: improved washability and moisture-resistance in tropical and subtropical regions — NanoLAV is a graphene additive specifically designed for water-based architectural paints. With excellent dispersibility, NanoLAV increases the washability and moisture-resistance of painted or coated surfaces, enabling them to withstand cleaning or washing without degrading, dissolving, peeling, or fading when exposed to water, mild detergents, or other cleaning agents. The washability of a paint or coating is important in applications where hygiene is crucial, such as hospitals, schools, and kitchens, and in locations that are prone to stains, dirt, and other contaminants that accumulate on surfaces.

Forge Nano launches Atomic Armor, the company’s latest proprietary nanocoating technology

Forge Nano has also introduced Atomic Armor™, the company’s proprietary nanocoating technology that enables atomic level engineering and nanoscale surface engineering to build better materials. When

applied to lithium-ion batteries, Atomic Armor™ improves existing materials resulting in higher capacity and safety, while making batteries charge faster and last longer — all at a lower cost.

“Forge Nano has grown rapidly over the last few years with unique technology and product offerings that are poised to transform a range of industries for a more sustainable future,” says Paul Lichty, CEO, Forge Nano. “We are in the midst of a once-in-a-generation transformation toward a future that is electric, and our new brand identity brings to life our commitment to make this transformation happen, today, with Atomic Armor™.”

Atomic Armor™ is the application of Atomic Layer Deposition (ALD) coatings done with the speed, precision and know-how that will unlock a product’s performance and scale beyond anything imaginable. Forge Nano has built a portfolio of equipment and tools to apply Atomic Armor™ onto nearly any surface and form factor. It works by creating a custom nano shield to prevent negative reactions, while simultaneously enhancing material surfaces to improve functional properties.

External 3-layer polyethylene coating for water carrying steel pipes

Authors: Emran Siddiqui, Technical Manager, 3M R&D Center, Bangalore and Debiprasad Mishra, Sr Specialist, 3M R&D Center, Ahmedabad

Synopsis

Underground steel pipeline are efficient and cost effective mechanism to transport water. Since stainless steel pipes are expensive and do not offer flexibility to withstand high pressure and variety of challenges in pipeline construction, usually mild steel pipes are used. However mild steel is prone to quick corrosion. Wet soil coupled with available oxygen provides the environment for corrosion of mild steel. Corrosion is accelerated due to potential difference between the pipe surface and the soil. 3-layer polyethylene coating system is a robust and long-lasting corrosion protection coating technology for mild steel pipes. However some application and testing parameters are highly critical to understand and to effectively implement with strict control through a reinforcing contractual specification. Pipeline coating application and pipeline construction projects are administered through a contractual specification and tendering process and hence there is a need to implement strict compliance through control plans and reinforcements on sign off. This write-up describes few important quality control test parameters and their significance on long term performance of coating system while pipeline is in service. At the coating application stage, steel surface preparation, steel temperature at the coating

application and selection of good quality coating system components (materials) are extremely important. Contractual specification test requirements should be of the highest practically possible standards in order to assure long term performance and have enough tolerance for the dilution factors during pipe transportation, handling, bending and back fill operations. Often pipeline construction is done in warm ambient condition and impact of backfill material plays an important role and is quite detrimental to the resistance of applied coating system. Adhesion of the primary FBE coating, flexibility, resistance to cathodic disbondment and interlayer adhesion are extremely critical for the long-term performance. Infrastructure facilities and calibration of manufacturing and testing equipment are equally important. 3M scientists invented fusion bonded epoxy powder coating technology in 1951 and have helped regulatory agencies to develop test methods and regulatory specification to facilitate easy testing and decision making on the quality of applied coating system. This knowledge and support is still available through 3M Application Engineering experts.

Water demand and supply

It is well known fact that water is scarce commodity, and its availability of potable water is diminishing by the day. At the same time, the population is



PHOTO: 128RF
IMAGE FOR REPRESENTATIVE PURPOSE ONLY

increasing which means lesser amount of water will be available per person.

According to the study “Charting Our Water Future” conducted by McKinsey & Company, the ever-expanding water demand of the world’s growing population and economy, combined with the impacts of climate change, are already making water scarcity a reality in many parts of the world—and with it we are witnessing severe damage to livelihoods, human health, and ecosystems. In just 20 years, the report shows, demand for water will be 40 percent higher than it is today, and more than 50 percent higher in the most rapidly developing countries. Historic rates of supply expansion and efficiency improvement will close only a fraction of this gap. Unless local, national, and global communities come together and dramatically improve the way we envision and manage water, there will be many

more hungry villages and degraded environments—and economic development itself will be put at risk in many countries. By 2030, demand in India will grow to almost 1.5 trillion m³, driven by domestic demand for rice, wheat, and sugar for a growing population, a large proportion of which is moving toward a middle-class diet. Against this demand, India’s current water supply is approximately 740 billion m³.

States such as Uttar Pradesh, Rajasthan, Gujarat, Maharashtra, Chattisgarh, Andhra Pradesh and Tamil Nadu are expected to face worst water scarcity and respective governments are taking necessary steps to build water infrastructure for the future. Central Government has launched schemes such as JNNURM and many multilateral banks such as World Bank, Asian Development Bank etc, are providing funding to improve water infrastructure



PHOTO: 12BRF

IMAGE FOR REPRESENTATIVE PURPOSE ONLY

Water pipelines: some facts

“Aging water pipelines tend to rupture at a rate of 35.9 breaks each year for every 100 kilometers. For newer pipelines with the rate is more than three times lower.

Corrosion damage (internal and external) is recognized as a major mechanism contributing to pipeline breaks.

(Source: Chlorine Chemistry Council (<http://c3.org>))”

“Aging water mains have been reported to leak at rates of 150-300 l/hr/km with newer mains having lower leak rates of 50 -75 l/hr/km” (Source: A.C. Twort, F.M. Law, F.W. Crowley and D.D. Ratnayaka: "Water Supply", Fourth Edition, Arnold, 1994)

“A leak of only one liter per minute corresponds to more than 525,000 liters per year.” It is important to manage the available water efficiently and effectively by use of best technologies while building water transportation system i.e pipelines which must be protected from the harsh effects of corrosion (externally and internally) and avoid frequent breaks/leakages and thereby avoid loss of precious water.

What is corrosion

Oxidation of iron into iron

oxide is defined as corrosion by the Nernst equation. Iron metal in unoxidised form exhibits metallurgical properties required for the steel pipeline. When iron is oxidised, it loses metallurgical property and becomes loose rust and corroded pipeline is deemed for bursting or leakage failure.

In presence of water and oxygen, corrosion reaction is very fast and grows exponentially. When corrosion happens at one spot in the steel pipeline, electric potential difference is created between the earth and weak spot in the metal. This will set up anode and cathode reaction, because earth has low soil resistivity. Moistened air or moistened earth works as electrolyte. This situation is more complicated when chloride ions are present due to chemical contaminants in the back fill.

How does it impact water pipelines

Corrosion causes metal loss in steel pipes and induces leakage. It has several impacts on water supply.

- Risk of contamination of water
- Risk of water borne disease
- Reduced hydraulic flow

- Increased cost and effort of water treatment

- Water shortages / outages.

- Property damages

- Increased operation and maintenance cost

Corrosion control system

A comprehensive corrosion control system should be there, to mitigate the effects of corrosion and associated losses. It should include a robust corrosion protection coating and cathodic protection system.

External corrosion protection coating

3-layer polyethylene coating system: 3-layer polyethylene coating system is relatively newer design and technology. First layer is fusion bonded epoxy powder coating, second layer is polyethylene based grafted hot melt adhesive and final layer is a high-density polyethylene-based compound. All these materials are engineered to meet many functional needs and provide long term corrosion protection during service of pipeline. The primary layer which is fusion bonded epoxy coating is the main corrosion protection layer. Middle layer of grafted adhesive is needed to bond top layer with the FBE primary layer. Top layer of polyethylene is required to provide good mechanical protection to the FBE layer. Most 3-layer coating specification require that FBE primer thickness should be at least 200 microns. Although, 3-layer coating is a robust design, but few application parameters and discipline in application process control is extremely critical for continued long term protection and avoid service life issues like leakage and contamination.

Quality assurance: Regula-

tory organisations like AWWA, CSA, ISO and DIN have created a robust contractual specification which directs all the stake holders to adhere to requisite discipline in order to assure that consistent quality assurance is not diluted.

Application process specification has two main sections, first application process qualification tests which will validate that given process set up will ensure consistency in applied coating system during entire course and length of application. Secondly regular production tests - this directs production coating personnel and inspection agencies to adhere to expected frequency and witness of quality tests during production coating on the shift operations. Considering pipeline construction environment, expected life and pipeline service operations, important test parameters are selected, and acceptance criteria are defined. In case of 3-layer polyethylene coating system, FBE primer layer is hidden and hence it is difficult to make observations on the primer layer during pipeline construction. For example, cracks on FBE layer will not be visible, when 3LPE coated pipeline is bent. One of the very common and recurring problem which is noticed at the time of pipeline construction is the gapping due to hoop stress. During application process, molten polyethylene compound comes as a web from the extruder and is spirally wrapped onto the rotating pipe. This causes hoop stress upon cooling and often results into gap between coating system and the steel surface. This remains visible at the cut back regions of the coated pipe. Among the long list of quality control tests, the most critical are three tests parameters which are directly

Sr. No.	Test parameter	Water boards	Upgrade specs	Meaning to the pipeline owner	Benefit of improvement, to the pipeline owner
1	Flexibility for FBE coated pipe	2.0 deg/PD @ zero C	3.0 deg/PD @ minus 30C	FBR primer, underneath adhesive and PE, may have limited flexibility. A less flexible FBC primer layer could crack during field bending and this defect will not be visible	A more flexible FBE primer coating ensures long term corrosion protection performance. Even if pipeline terrain requires sharp bends
2	Resistance to cathodic disbondment for 3LPE coated pipe	24h CD @ 3.5 V and @ 65C, Should be less than 7.0mmr	24h CD @ 3.5 V and @ 65C, should be less than 6.5mmr	Resistance to CD, is a measure of continued adhesion of coating system, in the operating service condition of the pipeline	Lower CD test value, is indication of higher performance. If we strengthen the specs with maximum 5.0mmr for 24h CD test @ 3.5V and @ 65C, would be better
3	Wet adhesion, hot water soak adhesion test for 3LPE coated pipe piece	Acceptable criteria is rating 1 for 24h HWSA test @ 75C	Acceptable criteria is rating 1 for 24h HWSA test @ 75C	Wet adhesion test simulates continued adhesion during common moisture ingress during service life of the pipeline	If we strengthen the specification to conduct HWSA test at 95C, would be better. Many specs call for 28 days HWSA test @ 75C

Table 1

linked to the long-term service life of the constructed and operational pipeline. These are illustrated in above mentioned table 1.

Important things; a must for pipeline owner:

- FBE powder should have wide application window and is always stored at temperature below the recommended storage temperature by the manufacturer
- Incoming steel pipes are inspected, and surface preparation is in strict compliance with the contractual specification
- Salt contamination test is a very important criterion. About 2,000 psi RO water wash is needed to get salt contamination level below the specs. There should not be any residual acid

- Minimum recommended dwell time for acid wash and for RO water wash to be maintained. This may require moving water wash station
 - Dry air with a dew point of minus 40C should be used. A device is needed to test dew point, once in every shift
 - Very strict control on the temperature of steel surface
 - Minimum FBE primer thickness with respect to anchor profile
 - Single Layer FBE coated pipe should be tested for 48h CD @ 65C, 95C HWSA, and pull off adhesion test.
- Flexibility test for the single layer FBE coated pipe: Even though, actual pipeline project is for 3-layer polyethylene coated pipes, but some tests should be done on the single layer coated pipes. Contractual specifications

- demand that at the beginning of every shift, one pipe should be coated only with FBE primer and cured as per recommended application procedure given by respective FBE manufacturer. Flexibility test of FBE coated pipe should be done either by using CSA.Z245.20 Clause 12.11 procedure or by using ISO 21809-1 procedure. Following are convenient and practical method to follow this procedure:
- Pipe rings are cut from the area near cut-back
 - Use sawing to make cold cutting in machine direction (parallel to the axis of pipe)
 - Chamf the coating at the edges
 - Condition the test panels at minus 30C for minimum of 60 minutes
 - Mandrel is selected to

- perform 3.0 deg/PD bending test
- Perform the bend by using the bending machine shown in the picture
 - Make visual observations for the hard cracks in the middle of bent panel
 - Minimum of three panels should be tested. Hard crack in any of the three panels will direct to repeat the tests by using fresh panels.
 - In case crack appears repeatedly, selected pipe needs to be rejected and application parameter need to be reviewed. Bending failure indicates under cure or over cured coating.
- Resistance to cathodic disbondment test:** Resistance to cathodic disbandment test is an accelerated test and represents long term life condition of the buried

pipeline in service. This test measures adhesion of coating under accelerated conditions of corrosion. Environmental parameters which increase rate of corrosion are voltage difference, temperature and concentration of electrolyte (which is soil under buried condition). In order to accelerate



Bending machine.



3.0 deg bent panels.



Stop watch for 10 minutes observation.

Air Cooled Aftercooler



80%
Moisture
removal from
compressed
air

Compressed air is cooled to approx. 9°C above ambient temperature

Customizable with
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Blastline Air Cooled Aftercoolers are designed to work on most models of air compressors. To select the appropriate model, simply determine compressor horse power and select model from the chart.

Ratings:

Maximum working pressure: 250psi
Maximum working temperature: 121°C

Air Compressor Horsepower	Internal Airflow Maximum CFM	Model Number
50-75 HP	539	BL-450
100-125 HP	785	BL-600
150-200 HP	1569	BL-1000
225-350 HP	2300	BL-1600



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the corrosion speed and measure the ability of coating system to resist the accelerated condition, regulatory agencies have designed this test. A much higher voltage (3.5 volts) than normally occurring is selected. While under normal buried condition, pipeline temperature could be below 25C, but an increased temperature of 65C is selected for the test. A much higher concentration (3.0 %) of the electrolyte is considered to accelerate the corrosion under the test. This test is carried out in a laboratory for 48 hours.

Although, this test has to be done for both 3-layer polyethylene coated pipes and single layer FBE primer coated pipes, but test results from single layer FBE primer coated pipe is true indication of how good FBE primer is applied. CD test should be done either by using CSA.Z245.20 test procedure or by using ISO 21809-1 test procedure. Following are convenient and practical method to follow this procedure:

- Pipe rings are cut from the area near cut-back
- Use sawing to make cold cutting and make test panels of 4 in X 4 in size
- Seal the edges by using sealant
- Use a drill to create 3.0 mm diameter initial holiday in the center.
- Bond a piece of hollow plastic pipe (about 3.5-inch diameter) to create a cell
- Fill about 4 inches height with 3% Sodium Chloride solution
- This cell can be kept inside an oven or on the heated sand bath
- Connect this cell to the CD tester which is programmed



A CD test cell.



CD test panel after test is completed.

to 48 hours test at 65C

□ After completion of 48 hours, cell need to be removed and plastic pipe piece needs to be dismantled. Test panel need to be conditioned at 21C for atleast 60 minutes.

□ Using a Stanley knife, try to remove the coating starting from the edge of intentional holiday created. Usually, a skilled operator does this job. If applied coating resists this accelerated corrosion condition, less amount of coating could be removed.

□ Average value of disbanded diameter is calculated and then 3.0 mm (initial intentional holiday diameter) is subtracted. Final computed value is divided by 2 to determine the resistance to cathodic disbondment in mmm (radius in millimeter). Lesser value means better performance. Most contractual specs demand that this value should be less than 6.5 mmm

Resistance to CD is highly dependent on the application conditions. Higher pipe temperature (before epoxy spray) will ensure better resistance. Higher coating thickness of FBE primer will also show better resistance. This also depends on the

formulation of FBE material. Some FBE materials have inbuilt adhesion promoter.

FBE adhesion to pipe

surface: FBE primer is the most important layer in the applied 3-layer polyethylene coating system. FBE adhesion should be like structural bonding. FBE powder coating is a thermosetting epoxy resin and on application of heat, powder melts and forms a structural bonding. Structural bonding is needed to have long term uncompromised coating integrity. In order to ensure good bonding, steel surface preparation is done by using abrasive blast cleaning followed by phosphoric acid wash. Acid cleaned anchor profile is further treated with chromate solution and then heated to about 220 C prior to epoxy spray. When electrostatically charged epoxy powder particles hit the heated steel surface, it melts, flows and makes a continuous film which cures to form a thermoset coating. There are two methods of testing structural bonding strength. One is overlap shear test. This

test should give atleast 4000 psi test value to certify that bond is truly structural, however it is practically difficult to follow this method for the coated pipe. Regulatory agencies direct the applicators to follow ASTM test procedure for pull-off adhesion test. This is often called as Dolly test and is easy to perform on the test panels cut from the coated pipes. Usually a 2 inch X 6 inch cut piece is needed to follow this test procedure. Test procedure uses aluminium dollies which should be bonded onto the applied FBE surface with the help of a two-part structural epoxy adhesive. Depending upon the manufacturer of the epoxy adhesive and formulation, epoxy adhesive may take 2 days to 7 days for full cure. Adhesive curing can be accelerated by keeping dolly bonded test panels in a tabletop oven. After full cure of epoxy adhesive, extra adhesive can be removed by using a cutter provided by the test tool supplier. After epoxy adhesive is fully cured, Dollies could be pulled by using the



Overlap shear test; two steel.

Conclusion

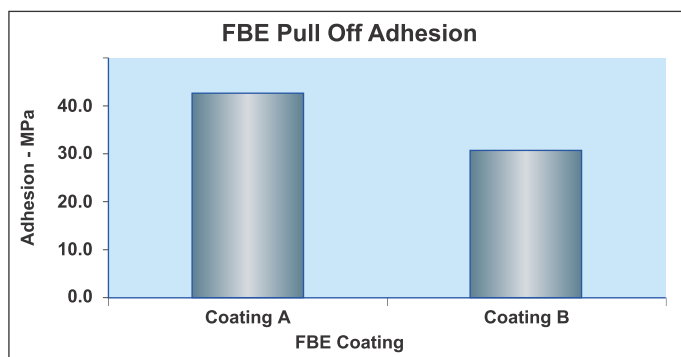
"With pipeline coatings, it takes about at least 10 years to find out if a coating has problems. That's about how long it takes for widespread failures to occur, at which point people begin to stop using the coating."

3-layer polyethylene coating systems have demonstrated their usefulness in mainline pipe coating. Properly applied 3-layer polyethylene coating system, provides very durable applied coating. Often in pipeline projects, there is a delay in the timeline between coating application

tester such as Elcometer or equivalent. Test equipment displays the measured value of pull off adhesion in Mega Pascal. Any test value above 30 MPa is considered as acceptable pull off adhesion value. Above are pictures and chart reported by a third-party laboratory in Canada. Two different types of FBE products are compared in this chart.

process and pipeline construction. 3-layer polyethylene coated pipes are proven to resist the weathering during stock piling at the dump site or at the ROW.

Key to success is selection of a good FBE primer and discipline in adhering to coating application requirements. Thickness of FBE



primer and surface preparation plays an important role. In addition to the quality of line pipe coating, field joint coating are equally important. Many reported case histories show higher rate of failures from poorly applied girth-weld coating. One of the reason is that girth-weld coatings are applied in the field during pipeline construction stage and is hard to ensure good discipline of quality control.

The advantages as discussed above are leading to a definite shift towards adoption of 3-layer polyethylene coating systems. Several pipeline companies around the world have already adopted this coating system and many more are in the process of adopting the same. Several international standards have been developed to regulate the performance of the coating and ensure long term protection of pipelines. This will not only lead to longer service life but also eliminates the risks associated with other types of coatings while in service.

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Antimicrobial paints increasingly in demand due to increased attention being paid to health and hygiene: Future Market Insights Inc.

Future Market Insights (FMI) has forecast the decorative paints market value to surpass US\$ 60.27 billion in 2022. The decorative paints industry is expected to be driven by the growing construction of residential, commercial, and institutional buildings across the world. The market is likely to witness a 5.4% CAGR during the coming assessment period of 2023 and 2033.

Surging demand for interior decorations, and renovating residential houses, coupled with urbanization, industrial growth, and expansion of infrastructure are some of the factors driving the decorative paints industry. FMI has projected the market valuation to reach US\$ 108 billion by 2033 end. The decorative paints market represented nearly 45% of sales in the paints and coatings industry in 2022.

Decorative paints will become more popular if they have unique finishes and textures. Metallic finishes, textured surfaces, and even 3D-printed patterns will become possible with paints manufactured by manufacturers. Consumers will be able to create visually appealing and personalized spaces thanks to these innovations.

Antimicrobial paints are increasingly in demand due to increased attention being paid to health and hygiene. Painting surfaces can inhibit bacterial growth, mold, and other microorganisms, contributing to a healthier

indoor environment. As a result of anti-allergenic paints, pollutant and allergen levels in the air are helped to decrease, thus improving the quality of the air.

The use of decorative paint in a smart home can be integrated with electrical and heating control as well as the display of digital content on painted surfaces. Painting spaces with this integration will improve their aesthetics and functionality, improving their immersive quality.

Artists or designers collaborating with paint manufacturers will drive innovation in decorative paints. A wide range of color palettes, patterns, and artistic effects can be created, allowing consumers to express themselves individually.

Decorative paints market growth comparison

Demand for decorative paints grew at 5% CAGR between 2018 and 2022. In the current scenario, the overall domestic consumer space is witnessing a significant rise due to urbanization.

The development of low volatile organic compound (VOC) paints will become more important as environmental concerns rise. In the future, eco-friendly decorative paints will be developed using sustainable materials and manufacturing processes.

As technology is integrated into paints, smart paints will emerge. Paints with self-cleaning properties, self-healing capabilities, or color-



PHOTOS: i23RF

changing capabilities will be available in the future. For example, dirt-repelling paints can prevent stains, and scratch-healing paints repair minor damage.

A significant role will be played by digitalization in decorative paints in the future. Using virtual reality or augmented reality tools, consumers can visualize and customize their paint choices. It enhances the overall customer experience by allowing them to preview different color schemes and finishes before they make a decision.

Backed by this, the market has been projected to register sales growth at a 5.4% CAGR over the forecast period, from 2023 to 2033. Expansion of construction sector will continue boosting decorative paint sales in India, China, and GCC countries. Introduction of low VOC paints has been among the primary product innovations in the paints industry. A higher focus on sustainability will fuel

demand for VOC paints in the decorative paints market.

Urbanization impacting decorative paints sales

Rapid urbanization, improving the standard of living, and growing interest of customers towards improving the aesthetic appeal of their homes and residential buildings have led to increasing demand of decorative paints.

Powered with high disposable income, consumers' demand preference has shifted to paints with highly resilient characteristics along with a modern taste of estheticism. This change in demand pattern is expected to work as a catalyst for the global decorative paints market growth.

Owners of commercial buildings such as office buildings, hotels, malls, and others spend a willingly on the renovation of their buildings every three to five years. This also includes expenditure on exterior paints



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and wall paints in order to maintain the visual aesthetics of their facilities.

Growth in the number of commercial buildings and skyrocketing construction of affordable housing projects are further anticipated to boost the demand for wall paints and exterior paints in the coming years.

As per FMI, the demand for decorative paints will be especially high in the Middle East and Africa, Eastern Europe, and Asia Pacific. The paint industry will continue to benefit from nanotechnology. The incorporation of nanoparticles into paints can improve the paint's durability, UV resistance, and thermal insulation properties. A longer-lasting and higher-performing decorative paint will be the result of these advancements.

According to FMI, the United States decorative paints market is expected to grow at a 4.8% CAGR. Revenue generated in the market will be pushed by a high rebound in construction projects. Moreover, growth in the construction of residential and commercial buildings will continue pushing demand for decorative paints.

Green paints will likely grow

demand for decorative paints

Environmental-friendly and low-VOC paint products will dominate the market. Driven by the implementation of stringent regulations and changing consumer preferences, sales of low-VOC paints are expected to pick up in the United States.

With the increasing focus on environmental sustainability and more stringent government regulations on harmful substances, the demand for water-based paints is expected to grow. These factors have encouraged manufacturers to produce water-based decorative paints. The market for decorative paints is expected to grow due to the rise in water-based paints' demand.

Start-ups in the decorative paints market

Changing market conditions and technological advancements create exciting new trends for businesses. Startup ecosystems across the world are gaining traction with the decorative paints industry.

Some key startups in the decorative paints market include: Paints and Coatings, India based firm offers products such as paints and



coatings for walls, emulsions, enamels, primers, etc. The company offers an extensive selection of decorative paints and wood coatings to its customers.

Rathi Decor, is an online service for booking painting services. Provides a wide range of services, including exterior painting, polishing, interior painting, texturing, coatings, industrial painting, stroke painting, waterproofing, and many other services. By filling out their details, users can request quotes based on their requirements. Depending on the budget, users can then book and avail the service. As a painting service provider, it aims to provide an end-to-end solution.

Circouleur, provides paint recycling solutions. A company specializes in the production and transformation of unused paints. This company has a wide range of paints that can be used for a variety of interior decoration projects. As a result, its paint emits fewer volatile organic compounds and ensures a better indoor environment.

Competitive landscape

Key market participants are focusing on mergers and acquisitions strategies, coupled with product

development by investing in research and development to boost their market presence. Some of them are emphasizing on increasing the production capacity to enhance their annual turnover.

For instance: In May 2023, Kamdhenu Paints introduced the Weather Classic Advance paint to enhance its exterior emulsion portfolio. Compared to previous emulsions, the new one is less likely to pick up dirt and has a high SRI value. The warranty is also five years long. Weather Classic Advance is a 100% acrylic, elastomeric paint that prevents dirt, dust and extreme weather conditions from accumulating on the exterior walls. It also comes with a soft sheen. Anti-dirt pick-up properties and water resistance make the product ideal for outdoor use. In areas with moderate humidity or dry weather, Weather Classic Advance is ideal.

In June 2023, PPG opened a Color Creation Lab in China in partnership with vehicle maker Chery Automobile. It will be staffed by PPG color stylists and Chery designers who will work together to develop color recommendations tailored to specific vehicle designs. Final materials will be used to produce the vehicles.





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Majority of global maritime industry underestimates the negative impact of biofouling despite latest advice from IMO

Almost two thirds (59%) of the shipping industry underestimate the negative environmental impacts of biofouling, with as much as one in four claiming to know little about the issue, a new report by Jotun has found.

Biofouling is caused by the build-up of micro-organisms, plants, algae, and other small aquatic animals on the hull of a ship which can result in significant operational impacts. The marine growth which clings to the underside of a ship's hull, reduces speed and maneuverability, causes the captain to power up and use more fuel to compensate for speed loss, and in extreme cases, can damage the hull.

The survey of 100 shipping industry professionals, conducted by Lloyd's List on behalf of the specialist marine coatings manufacturer in May this year [2023], follows on from the recent GloFouling

report published in partnership with the International Maritime Organization (IMO). This found that maritime transportation is responsible for 3% of the world's total Green House Gas emissions but should vessels operate with a clean hull free from biofouling, CO₂ emissions could be slashed by a fifth and fuel spend reduced by 19%.

The latest research by Jotun shows that the industry has a long way to go before achieving such gains. Just over a third of shipping companies (38%) said they invest in biofouling solutions outside of dry-docking, a process which tends to be conducted in five-yearly cycles.

Lack of awareness and cost-limitations were cited as the main reasons why 62% of shipping companies only invest in biofouling solutions

during the dry-docking period. However, the GloFouling report showed that a ship could save as much as \$6.5m on fuel costs over a five-year period by adopting proactive hull and propeller cleaning.

Morten Sten Johansen, Global Marketing Director, Hull Performance Category at Jotun, said: "If the shipping industry took a more proactive approach to hull cleaning, we as an industry could save as much as 198 million tonnes of CO₂, according to global estimations published by the IMO in 2022. This is more than six times the volume produced by the nation of Norway annually.

"However, an issue which is often overlooked is the potentially catastrophic impact biofouling can have on biodiversity through the spread of invasive aquatic

species, such as Pacific oysters which are plaguing European coastlines. The responses to our survey showed that this is still an incredibly misunderstood issue, with only 14 percent believing it posed a significant risk.

"As well as being more fuel efficient and lowering emissions, proactive cleaning would reduce the risks ships pose to international waterways and maintain the shipping industry's right to operate."

The survey highlighted the positive impacts of new Carbon Intensity Indicator (CII) regulations, with 88% of shipping industry professional saying they expect tackling biofouling to form part of their strategy to improve fuel efficiency, reduce greenhouse gas emissions and support environmental policies.

Morten Sten Johansen added, "It's encouraging to see the impact new policies are already having on the industry and it's likely that we'll face more regulatory challenges in the future. Decarbonization is vital and adopting new regulations to deliver the long-term goals of the Paris Agreement requires significant collaboration from industry and policymakers.

"But as we're a global industry, it is imperative that we take a united international approach if we are to succeed in reducing emissions, preserving fuel and protecting the oceans' biodiversity."



PHOTO: 123RF

Introducing Limitless: GLIDDEN Paint by PPG's 'Anything but Yellow' 2024 Color of the Year

PPG (ppgpaints.com) has announced GLIDDEN® paint by PPG's 2024 Color of the Year: Limitless (PPG1091-3), a fresh warm hue that holds both the power of a primary color and the essence of a neutral. This “anything but yellow” honey beige tone offers limitless applications – consumers can use Limitless anywhere they'd like a neutral to create an updated, on-trend look, complementary to any design style.

Both the Glidden and PPG Paints brands by PPG chose Limitless – a modern neutral that is “anything but yellow” – for their joint 2024 Color of the Year selection. The versatile, honey beige hue can be used

in multiple design aesthetics and spaces.

“We are entering a new era of explosive creativity and change. Consumers are using color in even more unconventional ways than ever before and they need a palette that offers versatility to work with both new and existing decor,” said Ashley McCollum, PPG color expert, Glidden brand. “Limitless understands the assignment and embodies this perfectly.”

“This modern neutral is as adaptable as its name implies and is taking the place of cool neutral tones that are so last year,” McCollum said. “With the selection of Limitless, gray is officially cancelled. What

can we say – warm neutrals just hit different.”

As a nod to the hue's adaptability and consumers' readiness to enter their creative eras, Glidden color stylists see this “boujee beige” showing up across exterior and interior commercial and residential spaces, styles and textures.

Because Limitless pairs equally well with warm and cool tones, Glidden color experts recommend using it anywhere and everywhere to give your space the glow up it deserves. As an interior color, it works on all four walls, accent walls, trim, and cabinets. For extra style, Glidden color experts

recommend painting unconventional places too. Limitless can be used to paint ceilings or all four walls and ceiling, abstract or geometric shapes and interior doors to achieve a look that's both unique and on-trend.

“Think of Limitless as a fresh and energizing take on a neutral. Limitless can be your main room color or act as an invigorating pop against warm or cool tones,” McCollum said. “Apply Limitless to exterior doors and even all-over exterior and trim to add curb appeal, and get ready for TFW (that feeling when) your house is the main character of your block.”

A trusted partner to the DIYer and professional painter, PPG produces hospitality industry insights for architects and builders to create spaces for luxury, comfort and impact. The company's color experts have aligned on Limitless as the Color of the Year for both the Glidden and PPG Paints brands in 2024.

“Warm neutrals are here to stay, replacing cool tones like gray for both DIY and pro segments in 2024 and beyond,” said McCollum.



Both the Glidden and PPG Paints brands by PPG chose Limitless – a modern neutral that is “anything but yellow” – for their joint 2024 Color of the Year Selection. The versatile, honey beige hue can be used in multiple design aesthetics and spaces.

Scientists at IIT Bombay develop new technique for measuring the coating performance

How often have we not encountered corrosion in some of our devices? Although there would be some coating to prevent them, the performance of the coated material deteriorates over time. These can affect the overall performance of the device itself.

A key process responsible for this is the oxygen reduction reaction (ORR), one of the fundamental processes in electrochemistry. This is responsible for the reduction of molecular oxygen to water that occurs at the cathode in various electrochemical devices like fuel cells, metal-air batteries, and electrolyzers. In other words, the oxygen molecules from the surrounding environment react with electrons and hydrogen ions to form water.

Scientists have been studying the interactions at the interface between the coating and cathode. In practice, there are established methods to evaluate the viability of a coating for corrosion protection. However, an improved quantitative method to characterize the coating performance was lacking.

In a breakthrough for electrochemical research, scientists at the Indian Institute of Technology Bombay (IIT Bombay) have combined a recently developed hydrogen potentiometry (HP) method with conventional electrochemical impedance spectroscopy

(EIS) to build an innovative approach for measuring the coating performance. Their method allows quantifying buried interfacial reaction rates. This pioneering technique offers a deeper understanding of how reactions occur at the interfaces between materials, which has significant implications for various fields, including energy conversion and corrosion prevention.

“Since the interface is buried, a complementary non-destructive electrochemical technique to monitor in-situ interfacial changes and provide quantitative information to co-relate and deepen the fundamental understanding derived from the hydrogen potentiometry method was needed. My postdoctoral work on using non-linear EIS to characterize the degradation of Li-ion batteries gave me the idea to combine it with the HP technique to build a robust approach to measure ORR kinetics,” says Prof Vijayshankar Dandapani as the motivation behind this research.

Mr Rasmi Ranjan Tripathy, PhD scholar and the first author of the paper notes that the choice of an alkaline electrolyte is very critical and

has a two-fold purpose. “It allows for stable steady-state hydrogen charging currents on the back side of the hydrogen permeable membrane vital for ensuring dynamic electrochemical equilibrium conditions on the front side. This was tough to achieve using an acidic electrolyte due to adsorbate-related challenges. Secondly, for real-life applications on industrial metals such as iron and zinc, only an alkaline electrolyte will work as it allows the formation of a thin passive layer and prohibits active metal dissolution typical in an acidic environment that contributes to unwanted side reactions,” explains Mr Rasmi Ranjan Tripathy.

The experiment involved a model interface made of PMMA {poly(methyl methacrylate)} and Pd (palladium) where the

inhibited oxygen reduction reaction (ORR) kinetics were observed. The presence of a physisorbed polymer at the buried interface caused a cathodic shift of 50 mV in potential compared to bare Pd. This shift was clearly visible in the I(U) curve, a graphical representation of current versus potential that can be derived from the hydrogen potentiometry (HP) method. Furthermore, electrochemical impedance spectroscopy (EIS) revealed a 26-fold decrease in the RCT (charge transfer resistance) value, which reflects the inhibiting effect of the physisorbed polymer.

In a subsequent analysis of a severely inhibited interface, the scientists applied octane thiol as a self-assembled monolayer on Pd, with a topcoat of PMMA. This configuration led to an even more pronounced cathodic



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PHOTO: DR VIJAYSHANKAR DANDAPANIS IITB

shift of 190 mV compared to the model PMMA/Pd interface, indicating a significantly inhibited reaction. The corresponding EIS measurement showed a 100-fold decrease in the RCT value, confirming the heightened inhibition.

The ground-breaking aspect of this combined approach lies in its interface sensitivity, which enables scientists to anchor specific functional groups to metal substrates through chemisorption. This opens avenues for quantitatively measuring ORR rates and assessing the effectiveness of protective coatings in real-world applications. For instance, thin layers of industrially relevant metals,

such as iron and zinc, are currently being deposited on the exit side of the Pd membrane over which polymer coating will be bonded to mimic an interface that is of commercial interest. This will allow the technique to be used as a standalone tool for providing crucial input to simulation programs, aiding in the selection of appropriate coatings for various practical applications.

“The primary aim of these kinetic measurements is to provide input data to a computer program that can predict the corrosion rate of organic coatings. Such simulated coating lifetime will guide in appropriate choice of polymer coating for on-field

application in the mobility, oil and gas pipeline, infrastructure, marine, and packaging industries. More importantly, we believe this approach could go beyond corrosion-related applications and find use for example in hydrogen sensing where the ability to quantitatively measure atomic hydrogen-induced interfacial electrochemical changes can be exploited. With the growing interest in transitioning to a hydrogen-based energy economy, this work finds relevance and scope for future research in applications related to hydrogen in materials,” says Prof Dandapani emphasizing the importance of this work.

These advancements in

understanding interfacial reactions provide researchers with invaluable insights into the behavior of materials and their performance in electrochemical systems. With further refinement and application, this novel combined approach has the potential to revolutionize fields such as energy conversion, corrosion prevention, and material science, contributing to more efficient and sustainable technologies.

As scientists continue to explore the hidden intricacies of interfacial reactions, we move closer to unlocking the full potential of electrochemical processes and paving the way for innovative solutions in diverse areas of science and industry.

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NETL develops coating technology to protect pipelines from corrosion and improve safety and reliability

Pipeline corrosion can cause catastrophic failure events such as explosion hazards and emissions of environmentally damaging substances like methane from natural gas pipelines. An invention reported by researchers from the Natural Energy Technology Laboratory (NETL), USA, can help protect against corrosion in natural gas, hydrogen, and carbon dioxide (CO₂) pipelines. The innovation is a new self-healing cold spray coating for internal pipeline corrosion protection.

According to NETL's Ömer Doğan, who worked on the innovation with NETL researchers Joseph Tylczak, and Margaret Ziomek-Moroz, and Zineb Belarbi, internal pipeline corrosion is a common problem.

"Internal corrosion in pipelines primarily is due to the presence of water, carbon

dioxide, and hydrogen sulfide contained in natural gas," Doğan explained. "Internal corrosion can eventually result in leakage, cracks, and rupture of the pipeline leading to explosion hazards and methane emissions."

Traditional approaches to fighting pipeline corrosion included use of inhibitors or organic coatings such as fusion-bonded epoxy and polyurethane. Injection of inhibitors in natural gas or CO₂ pipelines is challenging because of the difficulty of transporting the inhibitor along the pipelines. The main disadvantage of using organic coatings for internal pipeline protection is that they have poor abrasion resistance and can form a corrosion focal point.

Doğan said another approach is to use sacrificial coatings to protect pipelines and

equipment from internal corrosion. A sacrificial coating, or anode, undergoes oxidation more than the metal surface it protects, effectively stopping oxidation on the metal. However, the existing sacrificial coatings tend to dissolve too fast in natural gas pipelines.

"The invention consists of a new zinc-rich material that creates an effective protective layer which resists dissolution compared to existing zinc sacrificial coatings," Doğan said. "This new material can be applied to steel structures in a cold spray process to protect them from the effects of corrosion."

Cold spray is a high-energy solid-state coating and powder consolidation process for application of metals, metal alloys, and metal blends for numerous applications. Cold spray uses

Just some of the features and advantages of the new zinc-rich coating approach compared to existing approaches include its ability to:

- Remain stable regardless of temperature/pressure changes of the service environment.
- Not form defects during cold spray deposition resulting in its extended life.
- Self-heal when damaged by forming protective corrosion products.
- Not require a periodic application (long life).
- Be used as structural material to repair used/damaged pipeline.

A Report of Invention (ROI) was disclosed June 30, 2023, and assigned 23N-12.



Internal corrosion can eventually result in leakage, cracks, and rupture of the pipeline leading to explosion hazards and methane emissions.

an electrically heated high-pressure carrier gas, like nitrogen or helium, to accelerate metal powders through a supersonic nozzle for particle adhesion. The coating can be applied to the interior of a pipeline by using a robotic cold spray device attached to a pipeline pig.

NETL is a U.S. Department of Energy national laboratory that drives innovation and delivers technological solutions for an environmentally sustainable and prosperous energy future. By using its world-class talent and research facilities, NETL is ensuring affordable, abundant and reliable energy that drives a robust economy and national security, while developing technologies to manage carbon across the full life cycle, enabling environmental sustainability for all Americans.

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parts2clean 2023: Parts cleaning – multiple tasks along the process chain

As a key component of manufacturing processes, parts cleaning ensures the quality and function of increasingly compact and complex products. The required technical cleanliness however cannot be generated with just a single cleaning step at the end of the process chain – instead, it needs to be performed along the entire chain. The exhibitors at parts2clean (parts2clean.de/en) will provide information about the different factors that need to be taken into account, at the same time presenting solutions for adapted, efficient and sustainable preliminary, intermediate and final cleaning. The supporting program at the 20th edition of the leading international trade fair for industrial parts and surface cleaning, running September 26 – 28, 2023 at the Stuttgart Exhibition Center in Germany, will also impart substantial know-how and expertise in the field.

Components for innovative products are becoming increasingly compact and complex in virtually all sectors of industry. At the same time, the demands on the performance and reliability of products are increasing. This results in a significantly higher sensitivity of the parts to contamination and machining residues from the production process.

The particulate and film cleanliness required for high quality and the safe functioning of the products can thus not be achieved with just a single cleaning step at the end of production. Rather, it is necessary to evaluate each processing step, for example milling, forming, coating or assembling, with regard to its

influence on the technical cleanliness of the entire product. “The tasks in parts and surface cleaning have not only become more diverse in recent years, but also more demanding,” reports Christoph Nowak, Project Director at Deutsche Messe AG. “For the changed spectrum of tasks, exhibitors at parts2clean will present future-oriented solutions optimally adapted to the respective production step, component geometry and material, as well as contamination and cleanliness requirements. And that's regardless of whether it's a matter of preliminary or intermediate cleaning or final cleaning.” This approach ensures that the required results are achieved in a stable, efficient and sustainable manner, even in high-purity cleaning applications, such as those found in the semiconductor supply industry, medical technology, sensor technology, electronics, aviation and aerospace, plus a range of electromobility areas.

Everything for process – secure, efficient and sustainable cleaning

Parts2clean features every segment of industrial parts and surface cleaning, including all the relevant suppliers. The range of products and services includes equipment, systems, media and process technologies as well as containers and workpiece carriers for fluid-based processes and energy-efficient drying as well as solutions for water treatment and bath care. This also includes options for optimizing existing processes and designing them to be more energy-efficient. Technologies



for dry cleaning will also be presented, for example CO₂ snow blasting, plasma, laser, vibration, compressed air and vacuum bake out processes. Other areas include the control, monitoring and inspection of cleaning, rinsing and drying processes, as well as the achieved cleanliness. Innovative solutions will also be presented in the segments of cleaning automation, including parts handling, and for the digitization and intelligent integration of cleaning processes in connected production environments. Topics such as a cleanliness-compatible manufacturing environment, for example clean rooms, cleaning services and technical literature complete the range of offerings. In addition to the exhibitor presentations, the sophisticated supporting program offers visitors a wide range of information, impetus and valuable knowledge for designing cleaning processes that are future-proof and sustainable, adapted to the respective requirements. This includes the special show “Technical Cleanliness”, organized jointly with the CEC (Cleaning Excellence Center). In addition to presentations

on current trends and developments and an exciting program of lectures, the German Industrial Parts Cleaning Association (FIT) will be presenting a highlight at its special show area: the presentation of the 2nd FIT2clean Award. This annual award, which is endowed with 10,000 euros, honors outstanding achievements and innovative solutions in industrial parts cleaning.

The three-day integrated Expert Forum at parts2clean, whose technical coordination is being handled by the Fraunhofer Cleaning Business Unit and the FIT, is one of the most popular sources of knowledge internationally. The simultaneously translated presentations (English/German) delivered by high-ranking experts from industry and associations, as well as from science and research, offer a wealth of information on basic principles, solutions for optimizing cleaning processes, various developments and trends in industrial parts and surface cleaning, as well as on benchmark applications in selected industries and innovations in cleaning technology.



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SEP 15 – 16, 2023	15th INT CONF ON SURFACE PROTECTIVE COATINGS AND PAINT COATINGS	Hotel Lalit Mumbai, India	SSPC India	T: (91-22) 35113458 E: sspcindia1@gmail.com W: sspcindia.org
OCT 2 – 5, 2023	ADIPEC	Abu Dhabi, UAE	dmg events	T: +971 2 444 4909 E: enquiry@adipec.com W: adipec.com
OCT 04 – 06, 2023	PAINTEXPO EURASIA	Istanbul Expo Center Istanbul, Turkiye	Artkim	E: sales@artkim.com.tr W: artkim.com.tr
OCT 04 – 06, 2023	SURTECH EURASIA	Istanbul Expo Center Istanbul, Turkiye	Artkim	E: sales@artkim.com.tr W: artkim.com.tr
OCT 04 – 06, 2023	PAINT & COATING JAPAN	Makuhari Messe Tokyo, Japan	RX Japan Ltd	E: materialweek-e.jp@rxglobal.com W: material-expo.jp
OCT 09 – 11, 2023	GULF COATINGS SHOW	Expo Centre Sharjah, UAE	NurnbergMesse GmbH	W: gulf-coatings-show.com
OCT 25 – 28, 2023	CORCON 2023	Mumbai, India	AMPP India Chapter	W: corcon.org
NOV 15 – 17, 2023	CHINACOAT / SF CHINA	Shanghai New Intl Expo Centre Shanghai, China	Chinacoat Exhibition Ltd	E: exhibiion@new-expostar.com W: chinacoat.net
FEB 22 – 24, 2024	PAINTINDIA 2024	Bombay Exhibition Centre Mumbai, India	NovaExpo Exhibitions and Conferences (India) Pvt Ltd.	E: paintindia.expo@colorpub.in W: paintindia.in
MAR 03 – 07, 2024	AMPP ANNUAL CONFERENCE + EXPO	New Orleans Louisiana, USA	AMPP	W: ace.amp.org
MAR 26 – 28, 2024	EUROCOAT 2024	Paris Expo, Porte de Versailles, France	Infopro-Digital	W: eurocoat-expo.com
APR 09 – 12, 2024	PAINTEXPO 2024	Karlsruhe, Germany	Leipziger Messe	T: +49 341 678 0 E: info@leipziger-messe.de W: leipziger-messe.de
APR 16 – 18, 2024	MIDDLE EAST COATINGS SHOW	Dubai World Trade Centre Dubai, UAE	dmg.events	T: +971 4 4453773 E: paddyoneill@dmgevents.com W: middleeastcoatingsshow.com
APR 30 – MAY 02, 2024	AMERICAN COATINGS SHOW 2024	Indiana Convention Center Indianapolis, Indiana, USA	American Coatings Association	E: chames@paint.org W: American-coatings-show.com
JUN 12 – 14, 2024	COATINGS EXPO VIETNAM 2024	SECC, Ho Chi Minh City, Vietnam	VEAS	E: info@veas.com.vn W: coatings-vietnam.com

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