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COATINGS AND ANTI CORROSION ENGINEERING REVIEW

April - May 2023 | Volume 14 Issue 1 | ₹ 100



The importance of corrosion control in infrastructure and industry



Interview
Dr Sadegh Parvizi
*Principal Engineer,
McDermott International Inc., UK*

Technical Feature
**ISO/ASME compliant composite pipe
repair system – "Belzona SuperWrap II"**

New Products & Processes

Industry News

Case Study

Company Profile



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Coal Slag
Garnet
Steel Shot
Steel Grit
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Painting Hoods
Airline Filters
Blast Suits
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CO Monitor
Dead Man Handle



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Thermometer & Gauges
Pocket Weather Meters



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SURFACE PROFILE
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SHORE HARDNESS
PRSHD A PRSHD D

ULTRASONIC THICKNESS
UTG C UTG M UTG P

DEW POINT (Td, RH, T)
DPM S DPM A DPM D

SOLUBLE SALT TESTER (BRESLE PATCH)
ADHESIVE PATCH LATEX ADHESIVE PATCH POSIPATCH

COATING THICKNESS ON METALS (F & FN)
Cabled Regular Micro 0° Probe Micro 45° Probe 90° Telescopic Probe

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RTRH1 - Measures peak height (HL)
RTR 3D - measuring common 2D/3D profile

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BARCOL HARDNESS TESTER

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PINHOLE DETECTOR LPD

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Manual Pull Off Adhesion Tester AT-M

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From the Editor-in-Chief...



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Indian economy is driven through multiple economic sectors and infrastructure is one of the major sector contributions to continuous growth. The infrastructure sector in India is poised to grow at a CAGR of 8.2% by 2027. In order to meet India's aim of reaching a US\$ 5 trillion economy by 2025, infrastructure development is the need of the hour.

Infrastructure forms an integral part of the country's economic ecosystem. India is now the most populous country in the world with 60 percent of its population below 25 years of age. This leads to a natural path of infrastructure development. The people are the market and hence to become a developed nation infrastructure development is a priority and not an option. There has definitely been a significant shift in the industry that is leading to the development of world-class facilities across the country in the areas of roads, waterways, railways, airports, and ports, among others. The country-wide smart cities programs have proven to be industry game-changers. Given its critical role in the growth of the nation, the infrastructure sector has experienced a tremendous boom as a result of India's necessity and desire for rapid development. The expansion has been aided by urbanization and an increase in foreign investment in the sector.

At the same time, it is very imperative that all this industrialization, sustainability push, growth of infrastructure requires better corrosion management practices in India. The main feature in this issue talks about this subject, the importance of corrosion management in infrastructure and industry. The role played by Indian industry will be central to the country's progress and success as a nation. All this provides a major opportunity for the paints, coatings, corrosion mitigation sectors, and most important of all developing the right kind of personnel.

Wishing you happy reading with all our regular features and columns.

Jolly Lonappan
Editor-in-Chief



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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



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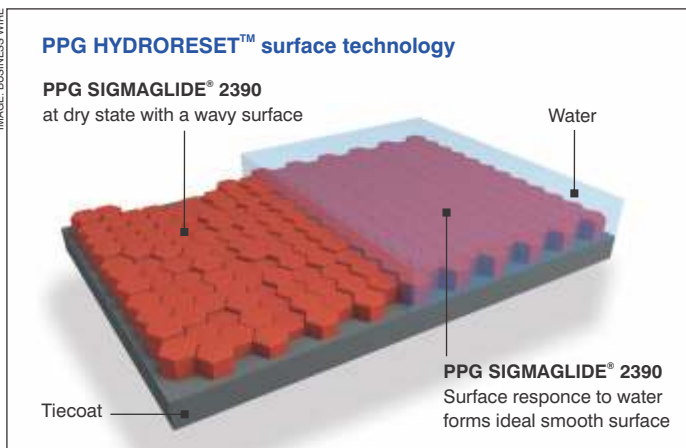
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PPG SIGMAGLIDE 2390 marine coating creates super-smooth, nonstick hull surface

PPG (ppg.com) has launched the PPG SIGMAGLIDE® 2390 marine coating, a breakthrough approach to help shipowners lower power consumption and carbon emissions and meet demands for higher performance with no adverse impact on the marine environment.

PPG Sigmaglide 2390 coating can help owners and operators to meet targets for reduction of greenhouse gas emissions under the International Maritime Organization's energy efficiency (EEXI and EEDI) and carbon intensity (CII) requirements, which went into

IMAGE: BUSINESS WIRE



PPG SIGMAGLIDE® 2390 marine coating uses revolutionary technology to create a super-smooth, almost friction-free surface, helping shipowners lower power consumption and carbon emissions.

The biocide-free fouling release coating is based on revolutionary PPG HYDRORESET™ technology, which modifies the coating when it is immersed in water to create a super-smooth, almost friction-free surface that marine organisms do not recognize and cannot adhere to, notes a press release from the company.

Based on third-party evidence following ISO 19030 and ITTC standards, this coating enables vessels to maintain a clean hull and reduce drag, achieving power savings of up to 20%, a speed loss performance of less than 1%, and up to 35% reduction in CO₂ emissions in comparison to traditional antifouling coatings. Actual performance will depend on ship model and operating conditions.

effect this year.

“PPG Sigmaglide 2390 coating is a unique formulation that paves the way for ship owners and operators to improve efficiency and reduce CO₂ emissions,” said Jan Willem Tegelaar, PPG global platform director, Marine Coatings. “The speed loss performance of less than 1% helps ships operate at an average one knot higher speed while remaining CII compliant.”

The exceptional fouling control performance of PPG Sigmaglide 2390 coating is achieved with no release of biocides into the oceans.

PPG Sigmaglide 2390 coating is also suitable for electrostatic application, which provides high transfer efficiency, leading to lower paint consumption. In service,

Evonik launches new TEGO® Flow 380 leveling agent for high-quality automotive clear coatings

Evonik's Coating Additives (coating-additives.com) business line is expanding its TEGO® Flow series with an efficient polyacrylate-based leveling agent. TEGO® Flow 380 is suitable for solvent borne coatings, especially clear coats. It is characterized by excellent anti-popping properties and good compatibility. The main applications are automotive and general industrial coatings, notes a press release from the company.



PHOTO: EVONIK

The main applications of the TEGO® Flow 380 levelling agent are automotive and general industrial coatings.

TEGO® Flow 380 consists of 100 percent active matter content and is based on a unique polymer technology. “The key here is controlled incompatibility,” explained Maximilian Morin, head of the Industrial & Transportation Coatings market segment.

Some degree of incompatibility with the paint is important for leveling performance, but too much can cause surface defects such as decrease in gloss or haze. “With TEGO® Flow 380, we have balanced the incompatibility well, resulting in an excellent performance,” said Morin. In addition, the new leveling agent supports recoatability, which is especially important

for automotive refinish applications.

Because of its low viscosity, TEGO® Flow 380 is particularly easy to incorporate into the formulation. “It can be used directly; dilution is not necessary,” said Michael Wang, Applied Research & Technology - Industrial & Transportation Coatings.

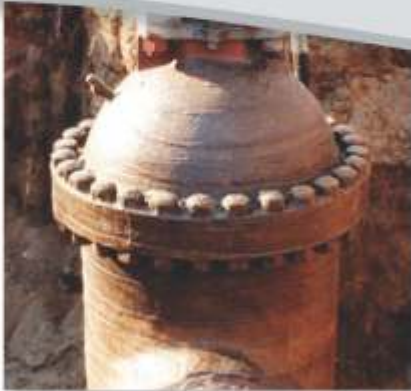
In addition, the new product is particularly sustainable: for one thing, it shows excellent performance even at low dosages. For another, the leveling agent emits little VOC (Volatile Organic Compounds), which makes it attractive for high-solids formulations due to its very low viscosity impact.

the coating can deliver up to 150 days of idle performance and an extended lifetime of more than 10 years with minimal maintenance

requirements. These benefits, combined with the power savings, provide an industry-leading return on investment for shipowners.

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

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Belowground applications

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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.



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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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Kennametal adds Blast Ninja™ to its portfolio of abrasive blast nozzles

Kennametal Inc. (Kennametal.com) announces an addition to its leading portfolio of abrasive blast nozzles for advanced surface preparation: the Blast Ninja™. Designed by Oceanit, a Honolulu-based 'Mind to Market' innovation company that develops disruptive technologies from fundamental science, the Blast Ninja is a premium nozzle delivering improved

operator safety while allowing them to work longer periods uninterrupted."

Dr Sullivan, Oceanit's Founder and CEO, said, "Blast Ninja is a great example of how methods and materials that were not available even 10 years ago can enable industrial tools to improve performance while reducing impact to the environment and society. We set out to



The Blast Ninja is a premium nozzle delivering improved productivity and enhanced hearing protection in a military grade product that is compliant with OSHA guidelines.

productivity and enhanced hearing protection in a military grade product that is compliant with OSHA guidelines, notes a press release from the company.

A game-changer for the abrasive blasting industry, the Blast Ninja reduces air exit velocity while maintaining particle velocity, resulting in a significant reduction in noise production at the source while maintaining blasting production.

"Blast Ninja offers a new level of performance, hearing protection, and productivity," said Nick Pflugh, Vice President, Engineered Wear Components, "We are excited to provide our customers with a solution that increases

create a disruptive technology in our labs that would protect operators while improving productivity. We took the fundamental aero-acoustic research from Mind to Market and are excited to see Kennametal make Blast Ninja nozzles the preferred choice for quiet nozzles."

The Blast Ninja proprietary technology leverages years of research conducted on jet engine noise reduction and was developed along with the U.S. Air Force Research Laboratory (AFRL) and the U.S. Navy's Office of Naval Research (ONR). Its patented design also offers enhanced hearing protection.

Compared to conventional

New dispersions™ from WACKER help hydrophobic waterproofing membranes do a better job of bridging cracks

The WACKER Chemical Group has developed two new hydrophobic dispersions for waterproofing buildings at low temperatures: VINNAPAS® 754 ED and VINNAPAS® 764 ED. VINNAPAS® 754 ED is used as an additive in two-part waterproofing membranes. It retains its crack-bridging ability at temperatures as low as -5°C. VINNAPAS® 764 ED, on the other hand, can accomplish the same feat even at -20°C, notes a press release from the company.

Preventing water and moisture damage is one of the most important challenges involved in the medium- and long-term upkeep of buildings. One option for protecting balconies, bathtubs and other surfaces from water penetration is to apply cementitious waterproofing membranes. When these set, they form a self-contained, water-repellent film which is flexible enough to bridge the cracks in the sub-floor that result when the building settles or when temperatures and other weather conditions fluctuate. Depending on the field of application, these types of waterproofing products may even perform at very low temperatures. Polymeric binders blended in during the manufacturing process provide the necessary



Crack-bridging test according to EN 14891: Waterproofing membranes formulated with VINNAPAS® 754 ED and VINNAPAS® 764 ED can compensate for cracks even at temperatures below freezing, thus reliably protecting the building from water penetration.

flexibility and hydrophobicity. Additives like these can constitute as much as 30 percent of the waterproofing membrane.

Neither product contains any additional solvents, plasticizers or film formers. According to an assessment by the German Federal Institute for Risk Assessment (BfR), this makes them suitable for contact with drinking water. VINNAPAS® 754 ED and VINNAPAS® 764 ED are ideally suited for formulating two-component waterproofing membranes for swimming pools, cellars and bathrooms, as well as water containers, canals, tunnels and more. When used properly, they provide long-term, reliable protection from water damage.

venturi nozzles (outputting 115dB), the Blast Ninja has up to 17dB quieter noise output. This allows operators for more productive usage time per OSHA guidelines.

In proper conditions, Blast

Ninja can meet OSHA's noise standard compliance 29 CFR 1910.95 of four hours of exposure, meaning that operators are protected and productive work time is improved.



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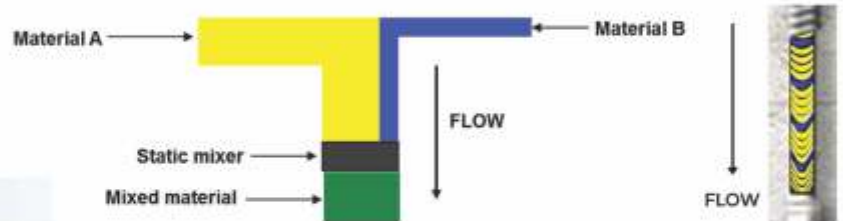
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Jotun's new all-climate intumescent hydrocarbon fire protection

Launched recently, Jotachar JF750 XT represents a step change in passive fire protection for oil, gas and energy industry assets. Developed using unique, patent pending technology to deliver exceptional performance when exposed to extreme environments, Jotachar JF750 XT delivers certified and proven all-climate performance, notes a press release from the Jotun (jotun.com).

PHOTO: 123RF



Jotachar JF750 XT is third party tested and certified to key industry fire and cryogenic spill protection standards.

The launch builds on five years of extensive internal and third-party testing, including real world exposure to a wide range of external environments including exposure at Jotun's Svalbard test facility, the industry's only Arctic testing station for coatings. Extreme climate testing has been extended to additional global test locations, including exposure to harsh desert and sub-tropical conditions at Jotun's Middle East and Asian test facilities.

Highly flexible, yet combined with certified durability to latest NORSOK M501 (2022) and UL2431 test regimes (without the need for additional topcoat), Jotachar JF750 XT complies fully with the industry's most stringent requirements.

Jotachar JF750 XT is third party tested and certified to key industry fire and cryogenic spill protection standards, including listing to UL1709 in addition to Lloyds Register and DNV Type Approvals for pool fire, jet fire and cryogenic spill protection.

Andy Czainski, Global Category Manager – Hydrocarbon Fire, Jotun Performance Coatings, said: "Oil, gas and petrochemical companies are increasingly

investing in facilities located or constructed in some of the world's most challenging environments. They need to be confident that their assets will have certified protection in the event of fire or cryogenic spill in such harsh conditions. Jotachar JF750 XT's proven all-climate performance means owners,

engineers and fabricators can be confident that assets are protected, at any stage of their project, even during exposure to some of the most extreme conditions on the planet."

Fast project completion with substantial efficiency improvements versus traditional materials are assured, as Jotachar JF750 XT features low installed thickness combined with the advantage of mesh free application.

With Jotun's self-reinforced flexible binder technology, Jotachar JF750 XT provides assurance that any risk of damage during construction, lifting and commissioning, or throughout the asset's life is minimized, even in the most challenging offshore and onshore conditions.

Bio-based, sustainable CERAFLOUR additives from BYK

For many years now, sustainability has been a key driver for BYK (byk.com) in its development of new additives. In addition to the obvious properties and effects of the product, questions regarding environmental impact, chemical basis, and energy consumption play a central role. BYK is introducing three additives from the CERAFLOUR product line that meet these requirements.

recommended for wood and furniture coatings as well as for architectural coatings.

CERAFLOUR 1004, on the other hand, has finer particles and results in a slight matting effect in combination with high transparency and a smooth, soft, and silky surface feel. It is recommended in wood and furniture coatings, in coil coatings and in architectural coatings.

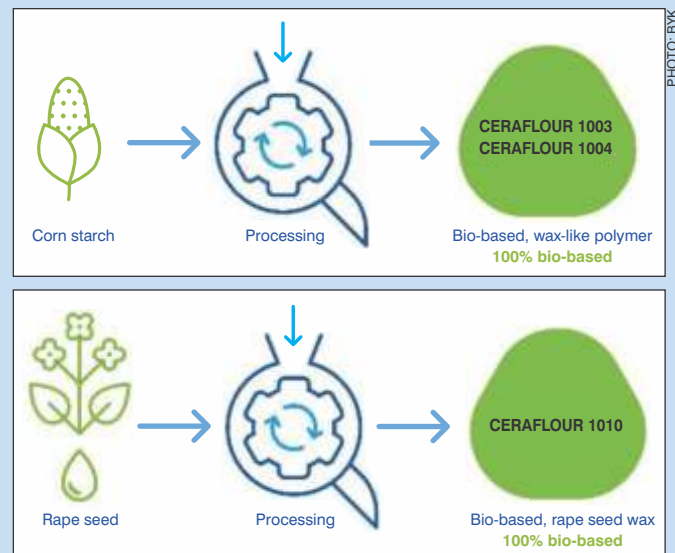


PHOTO: BYK

With the introduction of CERAFLOUR 1003 and CERAFLOUR 1004 – two corn starch based polymers with wax-like properties - BYK has further expanded its portfolio of sustainable additives. Both additives ensure good matting while maintaining high transparency, notes a press release from the company.

CERAFLOUR 1003 gives a slight surface texture and provides a similar matting effect at different observation angles and is especially

Another new bio-based additive being introduced is the CERAFLOUR 1010.

CERAFLOUR 1010 is a micronized wax – based on rape seed – and, besides excellent matting efficiency, it also offers very good mechanical resistance. This makes it ideally suited for modern wood coating systems such as natural look formulations, for use in general industrial coatings and in architectural coatings, the press release notes.



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CRISIL Rating : SME 1 'Highest'

PETRONAS introduces ProShield+, its first advanced material-based corrosion protection technology

PETRONAS (petronas.com.my) has launched a breakthrough product to address the perennial corrosion-related pain points that compromise asset integrity. Formulated using graphene material, which is an ultra-high barrier advanced material, ProShield+, is a paint additive for steel structures.

paint blending process and can be applied in the same way as other coats of paint. PETRONAS Senior Vice President of Project Delivery and Technology Datuk Bacho Pilonng said, "As a dynamic global player in the energy industry, PETRONAS is progressively stepping out and constantly pursuing innovation to address

business pain points and sustainability concerns. ProShield+, PETRONAS' first advanced material product, a result of dedicated research and development

in advanced materials, is part of PETRONAS' dynamic venture into growth areas to facilitate energy transition."

ProShield+ has been piloted and deployed at specific PETRONAS assets in both upstream and downstream sectors. Based on a simulated calculation, the application of ProShield+ to the structures can reduce overall carbon footprint by an average of 50 percent per platform per year and reduce maintenance spending of re-painting works by up to 66 percent per platform.

Under its advanced materials portfolio, PETRONAS has also developed graphene-based formulations that can be incorporated into lithium-ion batteries to boost



ProShield+ can be added to major paint systems to double the average lifespan of surface coatings to last up to 16 years.

Developed in-house, ProShield+, has been proven to strengthen coatings' resistance against harsh weather conditions and protect assets from corroding agents, notes a press release from the Malaysian company. Overall, the formulation contains three times higher water barrier properties than conventional epoxy paint and helps to improve adhesion as well as resistance against abrasion and ultraviolet (UV). It has also shown up to three times more improvement in abrasion resistance than conventional epoxy paint.

ProShield+ can be added to major paint systems to double the average lifespan of surface coating to last up to 16 years. It does not require any change to the existing

AkzoNobel launches new generation fillers to accelerate bodyshop performance

Bodyshops can now take advantage of a new generation of fillers from AkzoNobel's (akzonobel.com) Sikkens and Lesonal vehicle refinishes brands, which help to significantly improve productivity while lowering energy costs.

temperatures, infrared and 60°C curing, the new products speed up cycle times, which frees up space in the spray booth to ultimately lower energy costs by up to 85% when compared with a



The new fillers have been developed to help customers accelerate repair performance while tackling some of the major challenges they face.

conventional filler requiring pre-treatment and 60°C curing. In combination with the one-stop application method, it can also result in up to 80% shorter process

Known as Sikkens Autosurfacers Optima and Lesonal 2K Ultimate Filler, the one-stop, fast-drying filler systems have been developed to help save time and money, without compromising on quality, notes a press release from the company.

"Spiraling costs are among the biggest threats to bodyshops in the current economic climate," explains Patrick Bourguignon, Director of AkzoNobel's Automotive and Specialty Coatings business. "The new fillers have been developed to help our customers accelerate repair performance while tackling some of the major challenges they face."

Fast-drying at ambient

times when drying with infrared, allowing bodyshops to fit more jobs into a standard work day.

Continues Rob Lagendijk, Product Management Director for the Automotive and Specialty Coatings business: "In addition to the time and energy savings, less paint is needed for each repair – and there's less waste from not having to sand off as much material – so it makes for much more sustainable repairs."

Other benefits include enhanced corrosion protection – eliminating the need for time-consuming pre-treatment – which means technicians can start the job immediately, reducing the overall cost of repair.

performance, lifecycle, and thermal dissipation ability; as well as one that can be sprayed on composites to enhance mechanical properties.

These formulations are designed to meet customers' needs, market demands, and improve the quality and performance of existing solutions to the end users.



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Innovation in coating thickness measurement, hard shell, precise core – The new DMP series from Fischer



Fischer sets new standards with the DMP series, digital probes and new software.

With the world-wide launch of the new DMP series, Fischer puts an exclamation mark in tactile and non-destructive coating thickness measurement of magnetizable and non-magnetizable base materials. The DMP instruments are convincing in their robust, modern design and being equipped with digital probes and new software for extensive evaluations, notes a press communiqué from the company.

The measuring devices of the DMP 10-40 series are the perfect solution for fast and non-destructive coating thickness measurement on magnetized and non-magnetized base materials.

These devices shine with a modern look and come with numerous new features,

including an all-aluminum housing with IP64, a soft bumper to protect against falls, scratch-resistant and chemical-resistant display with Gorilla Glass, the ability to limit monitoring via light, sound and vibration, a replaceable and quickly rechargeable battery, and the simplest data transfers via USB-C and Bluetooth.

The DMP devices can be used for almost any measurement requirement in numerous industries. The DUALSCOPE®, DELTASCOPE®

and ISOSCOPE® models specialize in their respective fields of application, whether measuring electrically non-conductive layers on non-magnetizable, electrically conductive base materials or measuring non-magnetizable layers on magnetizable base

materials. The DUALSCOPE® itself combines both applications and thus offers highest flexibility in one instrument. Also part of the DMP instrument series are the FERITSCOPE® DMP30, for precise measurement of ferrite content, and the SRSCOPE® DMP30, for reliable measurement of copper thickness on printed circuit boards.

FERITSCOPE® DMP30

The advantages of these robust hand held devices are particularly notable in chemical plants, power plants, and process engineering plants. They are ideally suited for on site measurements of austenitic claddings as well as weld seams in stainless steel pipes, containers, boilers or other products made of austenitic or duplex steel. From a plating



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thickness of 3 mm, ferrite content determination can be carried out reliably and precisely, regardless of the properties of the base material.

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The SR SCOPE® DMP30 from the DMP instrument family has been specially developed for measuring the copper thickness on the top side of printed circuit boards. It is ideal for spot-checking the copper thickness reliably in the production process, incoming or outgoing goods.

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The new Tactile Suite software.



SR-SCOPE® DMP30 - First choice for copper thickness measurement.

connectivity via USB-C interface and Bluetooth. Additionally, with the help of the F-adapter, users can also continue to use the full performance of Fischer's analog probes and thus benefit from the largest probe portfolio on the market.

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Corrosion control in the refining industry

For the safe operation of a refinery, all the disciplines need to be together. Whether it is the accounting person or even the pay slip person, we all need to be on the same page or we will have a problem, says Dr Sadegh Parvizi, Principal Engineer, McDermott International Inc., UK.

From the proximity of assets to saltwater to the production and storage of hazardous chemicals, refineries pose unique challenges that require specialized training to combat corrosion. Dr Sadegh Parvizi, Principal Engineer, McDermott International Inc., UK, was in Mumbai as part of the AMPP Educational Team to conduct a program on Corrosion Control in the Refining Industry. In a chat with C&ACER, Dr Parvizi speaks about corrosion and metallurgical problems that occur in refineries.

What are the major issues in refinery corrosion?

As you will know - in oil and

gas - corrosion is the main issue for integrity and affects the entire plant.

Crude oil contains a number of contaminants. If it was just hydrocarbon, there would not have been a problem. But because of these contaminants, we are getting corrosion even after processing of crude oil. Some contaminants come from natural sources like sulfur, nitrates, and salt, especially magnesium chloride, calcium chloride and sodium chloride, etc.

And, when processed, we create more corrosive agents like hydrogen sulfide, cyanide, HCL, etc. That is why

we have to be careful about the pretreatment of crude oil. Crude oil is pretreated and then enters the distillation tower. I always assimilate every unit of the refinery to give them bucks about the outcome.

Take the example of the distillation tower. The CDU or crude distillation unit is like the heart of the refinery. If you are not talking about the CDU, you are not talking about refinery. Even after crude distillation, some fractions of contamination are still out there. It is not eliminated straight away.

Then we go to other units. All units have different types of



Dr Sadegh Parvizi, Principal Engineer, McDermott International Inc., UK.

corrosion. Upstream is different from refinery, because in upstream you are dealing with low temperatures. But in the refinery, we are dealing with high temperatures where the corrosion mechanisms are quite different.

So we need to protect this. Otherwise, our unit will suffer a lot and apart from financial loss if you are not careful, it can lead to unfortunate fatality.

It is therefore important to know where you can expect problems. By knowing the problem, you can mitigate it. It is for this, that such courses help.

What do you feel is the level of awareness about corrosion in refineries?

That is why we offer this course. The course actually gives a basic background about the type of mechanism and the mitigation method which has been known and experienced and also those



PHOTO: 123RF

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prevent corrosion in refineries?

In refineries, material selection plays a very important role. Design also plays a very important part. There are some areas where additives like corrosion inhibitors or chemicals are injected. For external protection,

or say atmospheric corrosion, coatings play an important role. Here 1,000s of square meters of surface need to be coated.

In some areas where we have buried or immersed structures, cathodic protection can be the solution. As I have said before, knowledge of the operator plays a very important part to maintain the integrity of the plant and keep it intact.

Can you elaborate when you say, knowledge of the operator plays a very important role?

You see the people from various disciplines play a part in operating the plant. There are process engineers, instrument engineers, inspection engineers, electrical engineers, all of them need to be aware of what's happening and what the influential mechanisms are. They need to be alert and have knowledge in what they are doing. Then, they can look after the plant very well. I always give a very simple example. If you give a high class car like a Rolls Royce to say someone who does not know how to drive, there will be a mess. If you don't know how to drive it or operate it

properly, it will simply end up as scrap.

A little background of yourself...

At present, I work for a company called McDermott as Principal Engineer. But my interest was to join the educational team of NACE (now AMPP) because my interest was in transferring whatever I have learnt over the years to the other young people. My company is very supportive in this and together, we see it as our social responsibility.

In my last few decades of experience, I have worked across various disciplines. Initially I was in the research and development and academics and did my MSc and PhD after which I joined an operating company and then an engineering company. So each company provided me with a certain kind of experience. When you change your position from this side of the table to the other, then we can put together and see what we can do to keep the plant safe.

What message would you like to give keeping in mind your years of experience?

There is one thing I always stress to keep the plant running properly. For the safe operation of a refinery, all the disciplines need to be together. Whether it is the accounting person or even the pay slip person, they all need to be engaged and should cooperate and interact together or we will have a problem. This is one thing that I have found in my forty years of experience, that if you miss the interaction with any of the disciplines, you will have a problem. This is one thing that I always stress.

mechanisms that are going to be introduced. They know, for example, the normal corrosion prevention techniques, like normal material selection, coatings, inhibitors, cathodic protection and also an idea of the design. I must also add one more item to this, that is the knowledge of operators and this is a very important role. One of the main things that needs emphasis is material selection and design which play a very important role because they are dealing with high temperatures.

And with high temperatures you know coating applications are limited. There are certain types of coatings, anyway, for external protection. But, we need to talk about process side failures that occur due to metallurgical changes, failures due to mechanical failures, and of course failures due to corrosion.

Have there been any such failures in refineries that has occurred due to corrosion?

Yes, very much. There are so many...

Any advances happening in the coatings sector for refineries?

The coatings technology has

developed unbelievably and is progressing. But for refineries, one of the problems is corrosion under insulation (CUI) and we need a specific coating for this and also for high temperatures. Coatings must have good durability for corrosion not to happen. And also because refineries operate in a very aggressive environment, there is an ISO classification for this. The coating system should comply with the CX category. This is something that is being used at the moment and there are many competitors in this line that are trying to do their best in this line.

Yes, there are new coatings coming in little by little. For example, earlier we used insulation for personal protection. Now, there are some coatings for high temperature resistance. These coatings you can apply directly and does not need insulation provided the process discipline don't require insulation for thermal conservation purpose. This is a very good progress.

Other than coatings, what are the important factors one must keep in mind to

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Game-changer German nanotechnology innovations by NanoQuinn in India

NanoQuinn's innovative nanocoatings provide long-lasting durability and efficacy for protecting assets against a variety of environmental factors, including rust, corrosion, moisture, water leakage, stains, and more

NanoQuinn, a division of Quinn Innovations Pvt. Ltd., has launched new range of game-changing nanocoatings for asset protection in India. These innovative nanocoatings provide long-lasting durability and efficacy for protecting assets against a variety of environmental factors, including rust, corrosion, moisture, water leakage, stains, and more. NanoQuinn's nanocoatings are environmentally friendly, making them an ideal choice for those who are conscious about their environmental footprint.

In today's world, protecting assets is essential for their longevity and functionality. The Indian market has recently seen the launch of innovative nanocoatings by NanoQuinn, a nanocoating partner of a German nanocoating giant. These coatings are aimed at providing long-lasting durability and efficacy for protecting assets such as metal, walls, electrical parts, and many more.

NanoQuinn's new range of nanocoatings includes anti-rust & corrosion coatings, moisture protection coatings, waterproofing coatings, anti-stain coatings for fabrics, and many others. These coatings are designed to provide maximum protection to assets against a variety of environ-

mental factors, including moisture, corrosion, rust, stains, and more.

One of the key benefits of NanoQuinn's nanocoatings is their ability to provide a high level of protection against rust, moisture, stain, etc. In India's humid climate, which can cause significant damage to assets such as metal structures, electrical equipment, and more, NanoQuinn's protective coatings are especially useful. They help businesses and individuals protect their assets from the harmful effects of surface damage and increase their longevity.

NanoQuinn's innovative nanocoatings provide effective protection to various industries beyond automotive. For example, the anti-rust and corrosion coatings can protect elevators and escalators, while also safeguarding pipelines in the oil and gas industry. Additionally, the moisture protection coatings can increase the longevity of electrical equipment and power transmission structures. NanoQuinn's nanocoatings have the potential to revolutionize the asset protection industry in India by providing reliable solutions for protecting assets against corrosion and other damaging factors.

The nanocoatings by



PHOTOS: NANOQUINN

One of the key benefits of NanoQuinn's nanocoatings is their ability to provide a high level of protection against rust, moisture, stain, etc.

NanoQuinn have long-lasting durability, making them an ideal choice for asset protection. With these coatings, individuals and businesses can now protect their assets for extended periods of time, without having to worry about frequent maintenance and repair costs. These coatings offer a long-lasting solution that will help assets maintain their aesthetic and functional value for years to come.

"NanoQuinn's nanocoating technologies are set to revolutionize the asset protection industry in India." According to Rajiv Sanghvi, Founder & Managing Director of NanoQuinn, the German innovator's range of nano technology powered coatings



Rajiv Sanghvi, Founder & Managing Director, NanoQuinn.

are a boon for those looking to protect their assets against various environmental factors. Additionally, he also shared that the company is developing its distribution network in India which will enable the company to reach every industrial prospects in India.

In conclusion, NanoQuinn's innovative nanocoatings provide a game-changing



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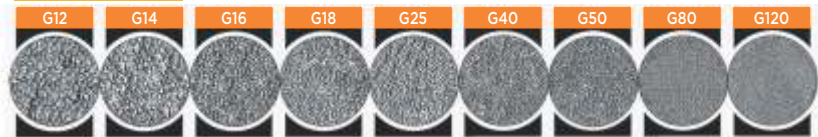


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NanoQuinn's coatings are aimed at providing long-lasting durability and efficacy for protecting assets such as metal, walls, electrical parts, and includes anti-stain coatings for fabrics, and more.

solution for asset protection in India. "With their long-lasting durability, efficacy, and environmental friendliness, these coatings are an ideal choice for those who are conscious about their environmental footprint. Whether you want to protect your metal structures, walls,

electrical equipment, or any other asset, NanoQuinn's nanocoatings have got you covered. So, make sure to consider NanoQuinn's nanocoatings when you are looking for a reliable and effective solution for asset protection," says Mr Sanghvi signing off.

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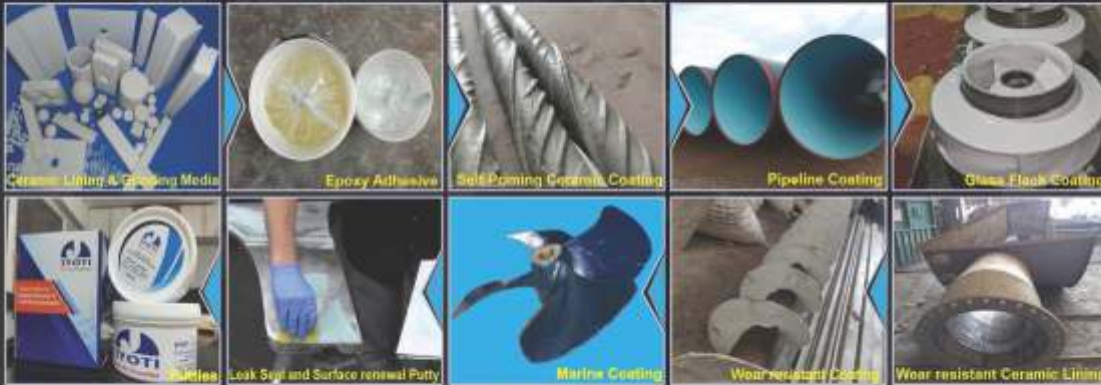
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The importance of corrosion control in infrastructure and industry

Infrastructure has experienced a tremendous boom as a result of India's necessity and desire for rapid development, and all this provides a major opportunity for the paints, coatings and corrosion mitigation sectors

Industrialization, sustainability push, growth of infrastructure requires better corrosion management practices in India said Padma Bhushan Dr V. K. Saraswat, Member, NITI Aayog, during the CII's launch session on 'War Against Corrosion,' in New Delhi recently. While releasing the 'CII Mission Report' on 'War Against Corrosion,' Dr Saraswat said, "The role played by Indian industry will be central to the country's progress and success as a nation. Dr Saraswat said that NITI Aayog and CII will form a high-level task force in line with the 'CII National Mission' on 'War Against Corrosion' and would work together to the success of this national mission.

Smt Ruchika Chaudhry Govil, Additional Secretary, Ministry of Steel, Government of India, said the launch of this national mission is most appropriate forum in the fight against corrosion. It would be imperative to be involved in this mission as steel is an important sector in the fight against corrosion. She said that the Indian steel industry has entered a new development stage, post de-regulation, riding high on the resurgent economy and rising demand for steel. Promoting policies and initiatives for attaining a corrosion free nation should be the goal of industries.

In a bid to support the National Mission on War Against Corrosion, Jindal



PHOTO: 128RF

Stainless signed a Memorandum of Understanding (MoU) with the Confederation of India Industry (CII). Applauding this move, Mr Abhyuday Jindal, Managing Director, Jindal Stainless, said: "Corrosion affects all walks of our life, from the safety of

infrastructure and loss of capital investment to contamination of ingestible and pollution precipitation. As per estimates, every year, corrosion costs India about 4% of its GDP. The maintenance and replacement of assets affected by corrosion are major deterrents to the growth of our economy. Since its inception, Jindal Stainless has been working towards this cause in various capacities, from sensitizing our stakeholders, fabricators, and other industries, to enhancing awareness across various legs of the government and key decision-makers. This partnership with CII is a natural alliance towards our core objective."

Dr U. Kamachi Mudali, Chairman, CII – Corrosion Management Committee, formerly Distinguished Scientist, Chairman & Chief Executive, Heavy Water Board, Department of Atomic Energy & Vice Chancellor, VIT Bhopal University, said that as India is growing to a faster



PHOTO: 128RF

pace with more industrialization, growth in public infrastructures, initiatives like Smart City, Solar Mission, Electric Mobility, Energy & Resource Efficiency, Sustainability, etc., would call for better management of corrosion so that the life expectancy, safety, reliability etc., can be enhanced and overall life cycle cost can be reduced. Towards this, corrosion and mitigation of corrosion loss will have a major share in the social and economic growth of the country.

As per the mission objective, CII - Corrosion Management Division (CMD) will work as a nodal agency to promote corrosion management practices across sectors in the country. It is estimated that 25–30% of corrosion could be prevented by following these measures and the life of equipment can be extended up to 250%. The CII National Mission on Corrosion Management will work on following goals:

Goal 1: To develop National Policies and Procedures in discussion with all stakeholders including NITI AAYOG and other concerned Government departments which helps mitigate economic losses and spur Nation Builders.

Goal 2: To facilitate the provision of corrosion expertise to governments, industries, and communities.

Goal 3: To prepare and make available corrosion-related standards/regulations etc.

Goal 4: To raise public awareness of corrosion and its mitigation.

Goal 5: To identify/develop best practices in corrosion management.

Goal 6: Promote the use of



PHOTO: 123RF

anti-corrosion solutions, products, and technology.

Infrastructure development

Infrastructure development is the foundation for a country's economic prosperity and helps in improving the quality of life of its citizens. Every rupee spent on infrastructure development has a multiplier effect of 1.2-1.5X on GDP, propelling the economy further. Infrastructure development also results in large scale employment generation along with providing boost to the related industries, while also achieving social goals of providing access to essential services and amenities to all citizens. Infrastructure sector includes power, bridges, dams, roads, and urban infrastructure development. In other words, the infrastructure sector acts as a catalyst for India's economic growth as it drives the growth of the allied sectors like townships, housing, built-up infrastructure and construction development projects.

India is expected to be one of the largest economies in the world by 2047 with a GDP of

about \$35- 40 trillion as per CII estimates from about \$3.5 trillion in 2022 which increased by about 2x since 2010. In addition, the country's industrial output has increased by 56% since 2010, which has supplemented the pace of urbanization which is expected to accelerate by 2047. This exponential economic growth in the country will drive the need, as well as be supported by the development of infrastructure.

In order to meet India's aim of reaching a US\$ 5 trillion economy by 2025, infrastructure development is the need of the hour. The government has launched the National Infrastructure Pipeline (NIP) combined with other initiatives such as 'Make in India' and the production-linked incentives (PLI) scheme to augment the growth of infrastructure sector. Historically, more than 80% of the country's infrastructure spending has gone toward funding for transportation, electricity, water and irrigation.

While these sectors still remain the key focus, the

government has also started to focus on other sectors as India's environment and demographics are evolving. There is a compelling need for enhanced and improved delivery across the whole infrastructure spectrum, from housing provision to water and sanitation services to digital and transportation demands, which will assure economic growth, increase quality of life, and boost sectoral competitiveness.

Hundreds of new cities need to be developed over the next decade. Over the next 10 years, demand for urban freight is predicted to increase by 140%. Final-mile freight transit in Indian cities accounts for 50% of the total logistics expenditures in the country's increasing e-commerce supply chains. India is said to become the third-largest construction market globally by 2022. Indian logistics market is estimated to touch US\$ 320 billion by 2025. The overall infrastructure capex is estimated to grow at a CAGR of 11.4% over FY21-26 driven by spending on water supply,

transport and urban infrastructure. Investment in infrastructure contributed around 5% of the GDP in the 10th five-year plan as against 9% in the 11th five-year plan. Further, US\$ 1 trillion investments in infrastructure was proposed by the India's planning commission during the 12th five-year plan, with 40% of the funds coming from the private sector.

“All this means more use of paints and coatings,” said Mr Sanjay Choudhury, Vice President and Business Head, Berger Paints Ltd. “In such a scenario, it is very imperative that we know the latest corrosion mitigation techniques, and if we work together we can reduce corrosion to some extent. Coatings accounts for around 2 to 3 percent of a project and if this is not done correctly, the whole project can be at stake. For this we need to

collaborate. For this we should collaborate, have communication and be committed to the particular endeavor. I call this the three Cs: Collaboration, Communication and Commitment. We need to share knowledge.”

In 1995, the per capita consumption of paint in India was 0.32 kg whereas the global average was close to about 11 kg and Asia Pacific was 9.7 kg. With lifestyle change over the last few years, we are currently sitting at around 4.1 kg of per capita paint consumption. However, the consumption in the rest of the world and even in Asia Pacific is much higher. In Asia Pacific, the consumption continues to be 9.5 kg and in

the European countries and US the consumption is 13 to 14 kg. The per capita consumption of paints in the US is about 16 kg, Singapore is close to 15 kg, Canada has 14 kg, Malaysia has 12 kg, Thailand has 8 kg, and China has around 7 kg. Even Indonesia is about 4.2 kg while India is currently at 4.0.

“This is where we have a huge scope,” said Mr Choudhury.

While short-term infrastructure development is well on its way, the development over the next 25 years should be driven by four fundamental objectives - high speed connectivity, safer transport, sustainable mobility, and high-quality customer experience. Achievement of these objectives over the AmritKaal will yield superior quality as well as quantity of infrastructure in the country, making it truly world-class.

“Infrastructure means use of steel and concrete,” said Mr Dhruv Shah, Head for India Business, Vector Corrosion Technologies (Canada). “RCC corrosion is one area which we have neglected the last many years. We cannot prevent corrosion, but if we control corrosion, or delay its onset, just imagine how much of our GDP we will be saving that otherwise would have been lost to corrosion.”

Said Mr Amish B. Jani, Vice President, Head – Reliability Corrosion, Reliance Industries Ltd, “A significant percentage of the damage in the industry is due to improper material



PHOTO: PICSWIRE/IBHUSHAN KOYANDE



PHOTO: I2BREF

selection, or lack of knowledge of corrosion concepts. The thought process should be on corrosion management as a whole, not just finding some solutions to some problems.”

“We are in the process of building structures left, right and center. But, when we face corrosion-related issues, it is not handled in the right manner,” said Dr Radhakrishnan Pillai, Prof, Dept of Civil Engineering, IIT Madras. “We end up repairing the structure again and again and again. It is only spending money, not investing money. We should think on how we can invest money in repairs, rather than spending money on repairs. Can we say, the repair should have a service life of 25 years? Yes, the technology is available and we need to put it in the tender document in the first line itself. Then, all the other things will fall in place. Doing repairs again and again only decreases the capacity of the structure.”

Dr Pillai also emphasized it is impertinent that we seek proper, professional guidance. He, says for example: “For a tooth problem, you do not go to an ophthalmologist,

or vice versa. When you go to a doctor, you do not say give me this red-colored pill or that. He decides what to do. But, when it comes to civil structures, we tell them what to use. Instead, we should tell them our performance requirement and let the professionals do the rest. Otherwise, every few years, we end up doing repair work.”

“All of us know, it is better to do a perfect job well the first time than to face a repair situation at a later stage. The entire corrosion related issues can be tackled at the start of conceptualization and with basic engineering in the initial stage,” said Mr V. R. Krishnan, Retired Chief Consultant, Engineers India Ltd. “The designer should have detailed knowledge about materials that he has to choose, on how it will perform, what are the environments it will face in its lifetime, what is the material deterioration that is likely to happen and what are the measures one can take to minimize various corrosive environments. Besides, one



PHOTO: 123RF

should know how to monitor corrosion, what are the measures that will be taken for retrofitting and how should the maintenance be done. I have seen disasters happen on site, I have also seen the quality of what is being done on site, which is so poor at times, and corrosion is one of the main issues that keeps coming up.”

“We need to talk about all the various protection and performance parameters right at the start from the design of the structure,” asserted Mr S. Ravichandran, National Business Development Manager, Berger Paints India Ltd. “We should not look at repair as a solution!”

To do all this, we need the right kind of personnel. That's where the crunch comes in. “We have a 1.3 billion population, but how many instructors?” said Mr K. B. Singh, Chairman, The Association for Materials Protection and Performance, India.

Mr Ravichandran said, we have very good products and solutions for various applications like quick dry coatings, heat resistant coatings, polyurea coatings that sets within five seconds, and even

wet surface paints. But there has to be somebody who knows how to do a proper application. He said: “If I don't have a proper person to stitch my shirt, I'm not going to be comfortable, irrespective of the type of cloth I have purchased.” The same goes here.

India's Infrastructure forms an integral part of the country's economic ecosystem. There has been a significant shift in the industry that is leading to the development of world-class facilities across the country in the areas of roads, waterways, railways, airports, and ports, among others. The country-wide smart cities programs have proven to be industry game-changers. Given its critical role in the growth of the nation, the infrastructure sector has experienced a tremendous boom as a result of India's necessity and desire for rapid development. The expansion has been aided by urbanization and an increase in foreign investment in the sector. All this provides a major opportunity for the paints, coatings, corrosion mitigation sectors, and most important of all developing the right kind of personnel.



PHOTO: 123RF

Clean technology lasers: The new tool in surface pre-treatment for superior coating adhesion

Laser systems remove corrosion, grease, residue, and existing coatings from metal surfaces quickly, with less preparation and mess than traditional techniques

Most manufacturers understand the value of pretreating metal surfaces of parts to remove corrosion, grease, residue, old coatings, or to roughen the surface of metals prior to coating. By ensuring the items are cleaned down to bare metal, manufacturers can avoid costly warranty issues that result when coatings peel, flake, bubble, or otherwise fail prematurely.

Unfortunately, the traditional techniques used for this purpose – such as sandblasting, dry ice blasting, and chemical stripping – are messy and require expensive consumables, as well as substantial time for preparation and cleanup. These methods are also drawing scrutiny from regulators like the EPA and OSHA since they can pose risks to the environment and applicators.

Today, a more effective alternative is utilizing industrial-grade, precision laser-based systems that can remove paint, contaminants, rust, and residues with a high-energy laser beam that leaves the substrate unaffected. Preparation and cleanup time are minimal, and the low-maintenance equipment can last decades.

According to Vincent Galiardi, owner of Galiardi Laser Clean, a surface cleaning operator based in St Charles County, Missouri, many people are surprised to learn that clean technology lasers are the most cost-effective, efficient, and safest method of industrial surface preparation.

“Many people are unfamiliar with the use of lasers to pretreat metal surfaces,” says Galiardi. “When I do a demonstration, at first the people in attendance are skeptical. But after I use the laser to treat a small area, everyone starts talking and getting excited. By the end, when I let them try the equipment, everyone is having a good time and saying how great the laser works.”

Given its effectiveness pretreating metal surfaces, industrial laser systems are increasingly being used in manufacturing facilities. The systems can be integrated into automated inline processing lines, or technicians can use mobile handheld units. With significant advantages in safety and efficiency, laser cleaning is poised to disrupt the surface pre-treatment market across more sectors.

Resolving conventional cleaning limitations

There are many applications in manufacturing that require pre-treatment of metal surfaces prior to coating. To improve coating adhesion, residue, oil, or grease must be removed before coating application. In some cases, a manufacturer may seek to further enhance coating adhesion by roughening the surface.

When defective metal parts are produced, instead of discarding the product, manufacturers can strip the

paint and re-coat the component.

To refurbish existing metal parts or recoat industrial infrastructure, removing the previous coating along with any corrosion is usually required to facilitate the new coating's adhesion to the surface.

To pretreat metal surfaces, sandblasting, dry ice blasting, or chemical stripping are traditionally used as industrial cleaning processes.

Sand blasting

Abrasive sandblasting involves forcefully projecting a stream of abrasive particles onto a surface, usually with compressed air or steam. The silica sand used in abrasive blasting typically fractures into fine particles and becomes airborne, which can cause serious or fatal respiratory disease.

When workers inhale crystalline silica, the lung tissue reacts by developing fibrotic nodules and scarring around the trapped silica particles, causing a fibrotic lung condition called silicosis. Estimates indicate that more than 1 million U.S. workers are at risk of developing silicosis and that more than 100,000 of these workers are employed as sandblasters.

In addition, particles are generated during abrasive blasting that further contribute to respiratory problems and other harmful health effects.



Laser systems remove corrosion, grease, residue, and existing coatings from metal surfaces quickly.

“When sand or any other media is used to knock off particles from a substrate, there is always a byproduct that has the potential to become airborne and inhaled,” says Galiardi. “Besides the sand, this could be the particles you're removing – the coatings, plating, anodizing, corrosion, and even lead paint.”

“Industry has needed a cleaner, safer surface pre-treatment solution for a very long time,” adds Galiardi. “Sandblasting is inherently unsafe for operators. The silica glass used in sandblasting is toxic. An operator must wear a full HEPA suit when sandblasting to avoid breathing in particulates.”

Sandblasting also is time-consuming to clean up since the sand essentially scatters everywhere, even though it is usually considered a “fast” cleaning method.

PHOTOS: LASER PHOTONICS



Laser systems remove corrosion with less preparation and mess than traditional techniques.

Safe, effective laser cleaning

Laser-based systems have significant advantages over these traditional methods, including ease of use in which an operator simply points and clicks a high-energy laser beam at the surface. The substrate is not affected by the laser, and the systems do not create any mess or byproducts. The approach is eco-friendly, energy-efficient, and completes the job in half the time of traditional methods when preparation and cleanup are considered.

“In our experience, laser cleaning is as fast at removing rust or old coatings as other methods, but without the same amount of cleanup,” said Galiardi. “When we treat a surface with lasers, any fumes or dislodged particulate is extracted into a HEPA filter and the job is done. There is no media [sand, dry ice, chemicals] to replenish or clean up.”

Galiardi Laser Clean uses laser systems made by Orlando, Florida-based Laser Photonics (laserphotonics.com), a leading provider of patented industrial grade CleanTech® laser systems for cleaning and surface conditioning. The American-made systems function either as mobile standalone units or can be integrated into production lines.

The laser systems are available in portable and stationary models ranging from 50 to 3,000-watts (a

4,000-watt version is in development) with chamber sizes from 3' x 3' in size to 6' x 12'. The systems can also be installed in manufacturing lines in cabinets or operated by a robotic arm.

Galiardi says that laser pretreatment of metal surfaces can be used to streamline various manufacturing processes. Corrosion, for example, can begin to accumulate within a very short time on new parts, depending on the material and environmental conditions, and should be removed prior to coating.

For one major auto manufacturer, Galiardi Laser Clean was asked to remove rust from conveying system components used to transport cars through the manufacturing process. The components were corroded due to being left outside during a 6-month delay in the project. When it was time to install the items, the provider wanted to first treat the surfaces and return the components to a “like new” appearance.

In another example, Galiardi was asked to remove rust from over 400 transmissions in a couple of days. The laser systems are particularly effective when reaching into tight spaces that are hard to reach by hand. By masking the area to protect vulnerable parts, the laser can be applied without affecting the rest of the assembled product. “No other parts [of the transmission] had to be removed and nothing had to be cleaned afterwards,” he says.

Galiardi's company also utilized the laser system to remove cleaning oils from truck chassis. “We used the laser to remove the oil right before painting so it was a bare metal object going with nothing on it that would affect the coating,” he says.

Industrial plants that need to recoat existing metal structures also need to remove rust before painting. According to Galiardi, he removed corrosion from a very large storage tank using the CleanTech laser system in about half the time of the alternative being considered, an abrasive disc grinder.

“Disc grinders basically just chip off [the rust] and it becomes airborne and makes a mess. Grinders can also be dangerous because sparks or debris can shoot off the wheel or catch an article of clothing,” he says.

With clean laser technology, there is now an environmentally friendly alternative to abrasive blasting and chemical stripping for surface pretreatment. The approach is safer for operators and highly adaptable to a wide range of manufacturing and industrial applications.

“As people become more aware of laser-based systems and compare them to traditional methods, they need to factor in prep and cleanup time, which can significantly impact project cost. When the improved operator safety, equipment longevity, and lower maintenance of laser systems are also considered, the clean laser technology has a much higher ROI,” says Galiardi.

The longevity of low-maintenance laser systems further adds to their value, increasing ROI, and making replacement unnecessary for decades.

“CleanTech laser systems can last for 50,000 to 100,000 hours. That's many decades working eight-hour days. After purchase, there's virtually no maintenance necessary,” concludes Galiardi.

Dry ice blasting

With dry ice blasting, dry ice pellets are used as the abrasive. The challenge is that dry ice blasting is often not abrasive enough to sufficiently remove paint or corrosion from the surface of metals. Since dry ice is an expensive consumable, the costs can escalate when cleaning metal surfaces in higher volumes.

Chemical stripping

With chemical stripping, harsh, even toxic chemicals are used to strip metal-based objects of paint, rust, and other contaminants to bare metal. However, for operators, exposure to corrosive acids and noxious chemical fumes is inherently dangerous. The process can also be time-consuming to prepare the proper chemical bath, achieve the required level of cleaning, and dispose of the waste. In addition, disposing of toxic chemicals is costly and closely regulated by agencies like OSHA and the EPA.

ISO/ASME compliant composite pipe repair system – "Belzona SuperWrap II"

Belzona's Senior Technical Service Engineer, Yusuke Nishi, details the properties and testing process behind Belzona's compliant pipe wrap system, Belzona SuperWrap II. The compliant repair solution is designed to restore the strength of holed, weakened and corroded pipe and tank walls

Abstract

In the past, the repair of deteriorated pipework involved the welding of plates and sleeves, the use of bespoke clamps or the partial replacement of the faulty section. In recent years, however, the use of polymeric composite materials for the repair of pipes has gained worldwide support and interest. The main reasons for this are: the composite repair can be based on engineered structural calculations in accordance with internationally recognised standards; unlike welding, it is a safe cold process that can be carried out in areas where hot work is prohibited; it can be carried out at lower cost and provide long repair life sufficient to be taken as a permanent repair.

This paper describes Belzona SuperWrap II, including

details of various tests conducted on the system to comply with both ISO 248171 and ASME PCC-2 (Article 401)², the two major international standards for composite pipe repair.

Introduction

Pipelines, especially those of large diameter, can efficiently transport large volumes of liquids and gases over long distances. Operating over long distances through various landscapes, environments and conditions, pipelines can be subject to internal and external effects from numerous factors. Differences in height cause internal pressure fluctuations, while changes in temperature cause the pipe material to expand and contract; from these behaviours, pipelines are subjected to physical loads such as bending, shear, torsion and fatigue. At the

same time, the inner walls of the pipes can be exposed to corrosion and chemical attack, depending on the chemicals involved in the media. Similarly, under conditions of inadequate protection, pipes are also subject to external corrosion.

These effects, acting alone or in combination, can cause damage to the pipe wall in the form of metal loss and eventually lead to through-wall defects, leading to leakage problems. Leaks can also have disastrous consequences, meaning shutdowns and environmental impact. For this reason, it is incumbent on facility owners and operators to take proactive precautions to prevent the worst from happening.

Belzona SuperWrap II composite repair

Belzona SuperWrap II is a pipe repair technology based on a polymer-based composite of epoxy resin and reinforcing fibres, using a wet-wrapping technique in which the resin-impregnated reinforcing fibres are wrapped directly around the pipe defect and cured.

Two material properties are key to the development of composite materials for the repair of wall thinning and leakage defects in pipes: mechanical strength and stiffness. Mechanical strength depends on the maximum tensile stress that a material can withstand without failure and is determined from its

tensile strength. Stiffness, on the other hand, refers to the elastic deformation of a material when a force is applied and is defined by the Young's modulus (also known as tensile modulus or modulus of elasticity). In the case of polymeric composites, the mechanical strength and stiffness depend to a large extent on the properties of the reinforcing fibre. The resin is responsible for transferring the load between the reinforcing fibres. The success of a composite repair also depends on the adhesive strength of the resin, as it must be integrated with the pipe substrate.

In the development of the Belzona SuperWrap II, several combinations of resins and reinforcing fibres were considered. In the end, a two-component epoxy resin with 100% solids content, consisting of a phenolic novolac base (main agent) and an amine solidifier, was chosen. The main reason for this was the emphasis on the fact that epoxy resins can achieve better adhesion and mechanical strength compared to other functional polymer groups, including polyurethanes, methacrylates, alkyds, vinyls and polyesters. The possibility of forming highly cross-linked polymer matrices, which are the basis for excellent heat and chemical resistance, should also be supplemented as one of the reasons for concluding that phenolic novolac epoxy



Image 1: In-field application of Belzona SuperWrap II on a corroded pipeline.

resins are the best choice.

In general, epoxy resins are slow to cure at low temperatures, but when heat is applied, the reaction is activated and the resin cures in a shorter time. Taking into account the temperature conditions at the time of application, which tend to be affected by climatic differences, two types of resin were initially developed (Belzona 1981 and Belzona 1982 resins), followed by Belzona 1983 resin with improved heat resistance (see Table 1). Today, three different types of resin are available, allowing the user to select the most suitable material depending on the temperature conditions.

	Belzona1981 resin	Belzona1982 resin	Belzona1983 resin
Application temperature	5~20°C	20~40°C	5~40°C
Max service temperature	60°C	80°C	150°C

Table 1: Usable temperature ranges for each resin.

The most suitable reinforcing fibre material was selected on the basis of the material's mechanical strength and stiffness, as well as its workability (cutting, resin impregnation, on-site handling, etc.). After carefully considering all the pros and cons of each material, it was decided to use a hybrid fibre, a combination of carbon fibre and glass fibre, which is produced as Belzona 9381 to be an optimized reinforcement fibre sheet for Belzona SuperWrap II. Belzona 9381 reinforcing sheet has a two-layer construction, with carbon fibre on the front and glass fibre on the back, to maximize the benefits of both fibres and to achieve the most

efficient distribution and arrangement in terms of physical properties and workability. This is because the glass fibre and epoxy resin layer are designed to act as an insulator to prevent corrosion currents from flowing through the conductive carbon fibre. The reinforcing fibre sheets are available in several different widths to accommodate different pipe diameters, with wider sheets being particularly useful for special geometries such as bends, tees, flanges, reducers, as well as the walls and roofs of large storage tanks.

After the resin-impregnated reinforcing fibres have been wrapped around the pipe, a special consolidating film called Belzona 9382 is used to hold the repair in place until the resin has cured. Once the resin has cured, the film can be easily removed.

Compliance with standards

The composite repair of pipework requires a high degree of reliability, especially in the case of high pressure piping systems or for pipes carrying hazardous media. For this reason, rigorous third-party and in-house testing is carried out to demonstrate compliance with a series of requirements set out in ISO 24817 and ASME PCC-2. For



Image 2: Damaged pipeline after suffering from Corrosion Under Insulation (CUI).



Image 3: After rebuilding the pipe to original profile using Belzona 1111, several wraps of Belzona 9381 were applied.



Image 4: The pipe repair before the removal of the release film.

the tests aimed at assessing the mechanical properties of the materials, plate specimens made of reinforcing fibre and each resin were used. On the other hand, in the pressure resistance test

aimed at evaluating durability of the system, a short pipe spool with pseudo-defects of the specified dimensions was repaired with the system, followed by a pressure resistance test for confirmation.

Test items	Details	Test methods
Tensile properties	Tensile strength, tensile modulus, Poisson's ratio, strain to failure	ISO 24817 – Annex B ASTM D3039
Structural integrity	Wrapped pipe with defect to survive short term pressure test	ISO 24817 – Annex C
Energy release rate	Toughness parameter for the repair/substrate interface	ISO 24817 – Annex D
Long-term strength	Long-term (creep rupture) strength of the repair	ISO 24817 – Annex E
Impact performance	Low velocity 5 J impact performance	ISO 24817 – Annex F
Thermal properties	Coefficient of thermal expansion	ISO 11359
	Glass transition temperature	ISO 11357-2
In-plane shear modulus	Shear modulus by V-Notched beam method	ASTM D5379
Lap shear adhesion strength	< Short-term condition > Shear adhesion strength of resin bonded to substrate	EN 1465
	< Long-term condition > Measurement of lap shear adhesion strength after 1,000 hours of exposure to immersion	EN 1465

Table 2: Test items and test methods.

Piping systems under pressure are subject to the Poisson effect. Due to the circumferential stresses occurring inside the pipe, the diameter of the pipe increases slightly, but at the same time there is a contraction in the axial direction and the pipe becomes shorter. Therefore, a Poisson's ratio close to the value of the pipe is required for the composites to be a suitable material to restore the mechanical strength of the pipelines. The Poisson's ratio of the Belzona SuperWrap II material is close enough to that of steel. This means that when a typical steel pipe is subjected to compressive or tensile loads, the accompany-

A summary of each test is given in Table 2.

Test results and verification

Table 3 shows some results of the physical property tests. In parentheses are the curing temperatures of the specimens.

Test items	Belzona 1981 resin	Belzona 1982 resin	Belzona 1983 resin
Short-term lap shear strength	15.5 MPa (20°C)	15.0 MPa (80°C)	11.2 MPa (150°C)
Long-term lap shear strength	15.5 MPa (40°C)	19.0 MPa (40°C)	10.3 MPa (150°C)
Glass transition temperature	90°C (60°C)	115°C (80°C)	188°C (150°C)
Young's modulus	38.8 GPa (20°C)	38.6 GPa (20°C)	36.9 GPa (150°C)
Thermal expansion coefficient	9.44 x 10 ⁻⁶ /K	11.26 x 10 ⁻⁶ /K	9.40 x 10 ⁻⁶ /K (20°C) 5.19 x 10 ⁻⁶ /K (150°C)

Table 3: Composite properties assessment results

In the tensile shear bond strength test, the bond strength of the resins is measured in two ways as: 1) cured for 7 days at specified temperature conditions (short-term condition), and 2) immersion in water for 1,000 hours at specified temperature conditions (long-term condition), both using carbon steel as the adherend. The comparison of the results of the low and high temperature tests is intended to see the effect of temperature changes on the adhesive strength of the resins. All the results comply with the requirements of ISO 24817 in two respects:

(a) The tensile shear bond strength of each resin is >5

MPa for short- and long-term conditions

(b) For each resin, the long-term values are at least 30% of the short-term values

The glass transition temperature (T_g) is the temperature at which a polymer material begins to soften as it is heated. It is a common phenomenon for thermoplastics and its value is often referred to in assessing the thermal properties and thermal resistance of resin-based repair techniques. When the resin is heated while it is curing, the density of the cross-linking increases and the glass transition temperature rises. When Belzona 1981 resin is cured at

60°C, Belzona 1982 resin at 80°C and Belzona 1983 resin at 150°C, the glass transition temperatures are 90°C, 115°C and 188°C respectively (see Table 3).

ing SuperWrap II repair reacts similarly to the base metal.

Young's modulus (tensile modulus) is a measure of the stiffness of a material, and the SuperWrap II materials have high Young's modulus of 37-



Image 5: Belzona SuperWrap II being applied.

Test items	Belzona 1981 resin	Belzona 1982 resin	Belzona 1983 resin
Short-term survival	39.2 MPa	39.2 MPa	28.4 MPa
Long-term survival	60.0 MPa	60.0 MPa	36.0 MPa
Impact	5 J	5 J	5 J

Table 4: Testing conditions for composite performance.

39 GPa, meaning that the repair will have good stiffness and bending moment. From a practical point of view, when assessing the performance of a composite pipe repair, it is reported that a standard modulus of elasticity of 6,895 MPa or higher is desirable,³ and the values of SuperWrap II materials are well above this. On the other hand, considering that the Young's modulus of ordinary steel is about 200 GPa, SuperWrap II materials, which have about one-fifth, are far more elastic than steel, and in this sense, it can be said that SuperWrap II repair has excellent elasticity and can easily follow the movement of the base metal.

The thermal expansion coefficient of a solid material indicates the extent to which its length and volume change when subjected to a change in temperature under constant pressure conditions. Piping, which is subjected to a variety of operating conditions, generally undergoes repeated expansion and contraction as a result of temperature changes. Therefore, composite materials used to restore the mechanical strength of pipe materials must also be able to cope with thermal strain. The linear expansion coefficient of Belzona SuperWrap II materials cured at ambient temperature are between 9.40 and 11.26×10^{-6} /K, which is close to that of ordinary steel ($11-12.5 \times 10^{-6}$ /K).⁴ This means that the stress effect (thermal strain)

on the adhered surface caused by the difference in thermal expansion between the composite materials and the base metal is minimal.

Table 4 shows the conditions for durability testing of the SuperWrap II composite materials.

The short-term pressure test evaluates the performance of Belzona SuperWrap II against wall thinning defects (no penetration). The objective is to determine the maximum level of wall thinning that can be repaired. The test is carried out on a short carbon steel spool with a pseudo-defect (wall loss) of a specified size. The repair is designed to restore the yield strength of the original pipe wall. The test pressure was calculated as the yield pressure of the test spool in its original sound condition (test pressures indicated in Table 4). The difference in test pressure between the Belzona 1981/1982 resins and Belzona 1983 resin is due to the different test spools used. All the resins passed the test and the results demonstrate that the repair conforms to the design specification and is able to restore the durability of the pipe material.

The long-term pressure test also evaluates the performance of Belzona SuperWrap II against thin-wall defects. Here, the durability of the repair is assessed after 1,000 hours of sustained loading by

maintaining the pipe internal pressure at a constant level (test pressures indicated in Table 4). As a

Requirements for Belzona SuperWrap II application

The repair design of Belzona SuperWrap II is determined by strength calculations based on actual defective



Image 6: A Belzona SuperWrap II application before being overcoated with Belzona 5811 (Immersion Grade) for extra protection.

result, no cracks, delamination or any other degradation was observed and the test was therefore deemed a pass.

The impact endurance test examines the effect on the repair of a low velocity 5 J impact, simulating a tool drop such as a spanner being dropped on the repair. The objective of this test is to determine the minimum thickness of the repair layer where external impact is concerned. In accordance with ISO 24817 Annex F, an impact of 5 J was applied to the pipe repair by dropping a weight from a height of 1 m, followed by a pressure test. The results showed that there was no difference between the measured and calculated energy release rates, and it was concluded that this level of impact did not affect the integrity of the SuperWrap II repair system.

conditions of pipes in accordance with the ISO/ASME standards, which also take into account factors such as surface preparation method, pipe geometry, environmental conditions, operational/design pressures, etc. The repair is then carried out following the design, but there are certain conditions that must be adhered to during the application.

Firstly, to ensure the quality of the work, all Belzona SuperWrap II installers are required to attend and pass a validated training course. The course includes a practical test (as well as a theory exam), in which participants are asked to repair a pipe spool with a simulated defect, which must then pass a certain pressure test.

As a strict rule, a compliant repair must always be conducted by trained installers. The ISO/ASME

standards defines repair classes from class 1 to class 3. Class 1 is for low specification duties with least critical conditions such as pressure of <2 MPa and temperature of <40°C and since this is for systems that do not relate directly to personnel safety the repair jobs can be handled by installers alone. Class 2 and 3 however involve more critical scenarios, for example higher pressure and temperature conditions as well as systems transporting hazardous fluids; in those cases therefore the work must be supervised by a certified supervisor who has completed a higher level of training. Periodic annual renewal of qualifications is also compulsory for the installers and supervisors to ensure that they maintain and improve their skills after certification.

All the inspection results, including environmental measurements, surface roughness achieved by surface preparation conducted, batch numbers of products used, and resulting repair thickness, are recorded in QA/QC documents of each project. And this will be collected on all projects, including information on who was the installer/supervisor involved.

After use in service, Belzona SuperWrap II repairs can be revalidated or decommissioned upon reaching its design lifetime, depending on the decision made by the asset owner.

Belzona SuperWrap II repair solution is available worldwide through the network of

Belzona International Distributors, and the applications can be carried out by trained and validated personnel from third parties as long as they fulfil the prerequisites. By allowing the asset owner to choose who would carry out the design and also who would apply the wraps on-site (as long as those parties are qualified as per the standard), the operator has the flexibility to appoint the contractors best suited, depending on the specific requirements of a project.

Conclusions

□ Belzona SuperWrap II is a pipe repair technology based on a composite material consisting of a two-component epoxy resin and a hybrid reinforcing fibre (carbon fibre/glass fibre).

□ Prequalification tests in accordance with both ISO

and ASME standards have shown that Belzona SuperWrap II materials have a high level of mechanical properties and are suitable for the compliant pipe repair.

□ The composite repair is designed on the basis of engineering strength calculations and is capable of restoring the integrity of damaged pipe materials.

□ A system of accreditation and registration of installers/supervisors ensures uniform quality of workmanship and high reliability.

□ Belzona SuperWrap II repair, which complies with the ISO/ASME standards, is a reliable long-term repair solution that contributes to the maintenance management of pipework.

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Over the last 30 years, extensive restoration work has been undertaken on the famous Zagreb Cathedral in Croatia, with ongoing repairs to this day

The famous Zagreb Cathedral is the tallest and one of the most beautiful buildings in Croatia that attracts thousands of tourists worldwide. As the most impressive gothic-style sacral building southeast of the Alps, it is characterized by great architectural and historical value. Its construction dates back to 1093 with continued enrichment of the cathedral by famous architects during the following centuries.

Reconstruction of the cathedral in the late 1800s was led by Hermann Bollé, who brought the cathedral to its most recent architectural form in which it stood until the

earthquake of March 22nd, 2020, damaged the cathedral's southern spire. Over the last 30 years, extensive restoration work has been undertaken on the cathedral, with ongoing repairs to this day. During reconstruction work on the south tower of the cathedral in 2012, damaged steel joints were found surrounding the tower 10 cm (4 in) below the surface at approximately every 3 m (1.1 yd) between the first and 25th rows. Most of the joints were only partially exposed in order to replace the surface layer of stone on the bell-tower, while the back of the joints remained embedded in stone and lime mortar. The

joints were covered with a layer of rust and in drainage areas corroded all the way through the cross-section. In order to define the optimal solution for maintaining or improving the mechanical resistance and structural stability of the tower, the Faculty of Mechanical Engineering and Naval Architecture of Zagreb was called in to examine the joints. At their laboratory, they



PHOTOS: CORTEC

The walls are exposed to damaging atmospheric influences, and the binding material between the bricks has washed away, leading to brick deterioration.

performed experiments on steel joints removed from the cathedral. They recommended doing the following:

- Remove corrosion from accessible joint connections
- Apply corrosion protection to accessible joint connections
- Strengthen the joint connections where damage had occurred

It was suggested that a minimal range of intrusion be used to keep the mechanical resistance and stability of the tower structure at their existing level while keeping costs at a minimum. Cortec's (cortecmci.com) CorrVerter® MCI® Rust Primer was recommended for corrosion protection. CorrVerter® is a water-based product that quickly converts rust into a protective layer and is capable of penetrating into



CorrVerter® is a water-based product that quickly converts rust into a protective layer and is capable of penetrating into corroded surfaces.

corroded surfaces. It contains a novel chemical chelating agent that modifies surface rust into a hydrophobic passive layer. A metal brush was used to remove loose rust from the joints. Then, two layers of CorrVerter® MCI® Rust Primer coating were applied directly onto the metal. A brush was used for CorrVerter® MCI® application on smaller metal joint surfaces, while spray



Over the last 30 years, extensive restoration work has been undertaken on the cathedral, with ongoing repairs to this day.



The joints were reinforced with steel fishplates that were welded onto the joints and also protected with CorrVerter® MCI® Rust Primer.

application was used for larger areas. The first coat was applied at a thickness of 100 microns (4 mils). A second coat was applied at a thickness of 75 microns (3 mils). During application, the coating temperature was 13 °C (55 °F). The joints were then reinforced with steel fishplates that were welded onto the joints and also protected with CorrVerter® MCI® Rust Primer. The final step was to replace the stones around the joints. With the help of a skilled team and

good project management, the entire project was completed successfully with minimal cost and intrusion as specified. The coating penetrated into the metal and stopped further advancement of the corrosion process.

Renovation of medieval city walls

The town of Ilok, Croatia, is a place of rich history and cultural heritage. The medieval long fortress and royal castle of Ilok are protected historical and

cultural treasures of the highest degree, enabling visitors to step into ages long past. The tower walls have a square floor plan and rest on foundations made of broken stone. These walls are exposed to damaging atmospheric influences, and the binding material between the bricks has washed away, leading to brick deterioration. Renovation work on 'tower three' includes strengthening of the foundations, restoration of collapsed parts, and injection of cracks. The

project involves the use of corrosion inhibitors to prolong the life of the structure. Cortec's corrosion inhibitor, MCI®-2005 is added into concrete being used to reinforce the foundation. This amine-carboxylate based corrosion inhibitor additive will be used to protect embedded metallic reinforcement from corrosion in order to extend the lifetime of the walls. MCI®-2005 is a water-based, organic corrosion inhibiting admixture with set-retarding effects. When incorporated into concrete, it migrates towards reinforcement to form a molecular layer that inhibits the corrosion reaction on both anodic and cathodic components of the corrosion cell. In new construction, this protection is quantified by subsequent reduction in corrosion rates when corrosion does initiate. When used with repair mortars and grouts, MCI®-2005 not only protects rebar within the patch, but can also help protect embedded reinforcement already in place in undisturbed concrete adjacent to the repair. MCI®-2005 is a USDA Certified Biobased Product.



Renovation work includes strengthening of the foundations, restoration of collapsed parts, and injection of cracks.

Feature courtesy: Cortec® Corporation

Bishops Scientific partners with Khushboo Scientific for Anton Paar range of ViscoQC Rotational Viscometers

Bishops Scientific Pvt Ltd has entered into a new business partnership with Khushboo Scientific Pvt Ltd for the Anton Paar range of ViscoQC Rotational Viscometers.

Bishops Scientific have appointed Khushboo Scientific as all-India partner for the paints, coatings, adhesives, polymers, printing inks, and automotive industry and has also entrusted them with growing business in the key states of Tamil Nadu and Karnataka.

Khushbhoo Scientific with

their vast experience will strengthen Anton Paar and Bishops Scientific's reach in the rapidly growing paint market in India including paint shops and laboratories of different industries like automotive, white goods manufacturers and research institutes for paints and coatings.

The Visco QC 100/300 Rotational Viscometer digital rotational viscometers that determines the dynamic viscosity at multiple points for analyzing the flow behavior

and comes with a unique magnetic spindle coupling; temperature probe; data transfer software; automatic spindle detection, and automatic speed detection. Model ViscoQC100 features a wide 3.5-inch color LCD display, while the ViscoQC 300



The Anton Paar and Khushboo Scientific team at the tie-up announcement.

features a 7-inch color touchscreen.

More details: khushbooscientific.com

Nouryon launches Global Service Center in Mumbai, reinforcing its long-term commitment to India

Nouryon (nouryon.com), a global specialty chemicals leader, has announced the expansion of its office footprint and workforce in Mumbai, India, with the launch of a new Global Service Center, notes a press communicate from the company. The Global Service Center includes commercial teams focused on business

development in India as well as functional hubs that will support the Company's global growth plans. The newly expanded office and innovation center in Mumbai will employ a growing workforce of nearly 350 employees that will occupy approximately 50,000 square feet.

"Our expanded presence in

India reinforces Nouryon's long-term commitment to this strategically important talent and growth market," said Charlie Shaver, Nouryon Chairman and CEO. "Nouryon will continue to make sustained investments in talent development and capability enhancement to ensure Nouryon is well positioned to maximize growth in India and around the world."

The Global Service Center also hosts commercial teams, the innovation and application development center, as well as other supporting functional teams including Customer Service, Finance Operations, Logistics, Trade Compliance, Product Safety & Regulatory Affairs, Information Management, and Human Resources.

"The most recent expansion of global service capabilities in our Mumbai office complements our innovation and

application development center in the same location that provides product testing and application support tailored to local needs," said Sobers Sethi, Senior Vice President Emerging Markets and China at Nouryon. "India offers a large talent pool of professionals who are passionate and interested in growing with a multinational company like Nouryon."

Nouryon has operated in India since 1991. The Mumbai-based commercial team is focused on key end-markets including personal care, cleaning, crop nutrition, paints, coatings, and packaging. In addition to the office and innovation center in Mumbai, Nouryon operates an organic peroxide and metal alkyls production site in Mahad and has a joint venture with Atul that includes India's largest monochloroacetic acid (MCA) plant in Gujarat.



Nouryon's Global Service Center includes commercial teams focused on business development in India as well as hubs to support the Company's global growth plans.

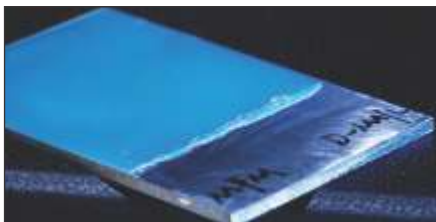
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JUN 12 – 16, 2023	Certified Coating Inspector / CIP Level 2 Course	Vadodara	Corcon Institute of Corrosion	T: (022) 24106494 E: info@corrosionindia.org W: corrosionindia.org
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New corrosion protection that repairs itself

Skyscrapers, bridges, ships, aeroplanes, cars – everything humans make or build sooner or later decays. The ravages of time are known as corrosion; nothing is safe from it.

This makes the fight against corrosion expensive. All countries together invest around 3.5 percent of annual global gross domestic product in corrosion protection, which amounts to some 4,000 billion dollars: a huge market – and a gigantic problem.

Researchers at ETH Zurich led by Markus Niederberger and Walter Caseri from the Laboratory for Multifunctional Materials have now presented a new solution. Over the past years, they have developed a plastic that could greatly improve and simplify corrosion protection. Poly (phenylene methylene) is the miracle material's name, or PPM for short.



Fluorescent corrosion protection on a metal plate.

This new corrosion protection material kills several birds with one stone. When mixed as paint and heated, PPM can be sprayed onto a surface and becomes solid. The polymer indicates holes and cracks in the protective layer by failing to fluoresce.

What's more, it repairs any damage itself without further external intervention. And at the end of a product's life, the polymer can be completely removed and recycled with only minimal material loss. The recycled polymer can then be applied to another surface with no loss in its special properties and functions.

It was pure chance that kicked off this development. About ten years ago, researchers in Niederberger's lab were working on the production of nanoparticles in a special organic solvent. Under certain conditions, the solvent became solid: it

polymerized. "That was unintentional and unwanted," Niederberger recalls. "We didn't know what to do with it at first either."

But then they discovered that the

polymer they had created by accident – known as PPM – had another interesting property in addition to its high thermal stability: it fluoresced even though conventional knowledge suggested it should not be fluorescent at all. And so the researchers specifically refined the material. First, a doctoral student improved the polymer's synthesis. After that, his successor, the doctoral student Marco D'Elia, was given the task of finding a useful application for PPM.

"And he did this job with flying colors," says a delighted Walter Caseri, who supervised D'Elia. His contacts with corrosion experts at the Università degli Studi di Milano also proved fruitful, Caseri says.

Laboratory tests revealed that a PPM-based coating protects metals, especially aluminum, well against corrosion. Even though this protective coating can be applied in layers that are up to ten times thinner than conventional protective agents – such as those based on epoxy resins – it is durable.

Last but not least, the polymer seals any damage to the coating by itself. "Self-repair mechanisms are in great demand, but they're very difficult to attain, and good solutions are still rare," Caseri says. To achieve self-repair usually requires chemical additives, which migrate in the polymer over time and are released into the environment. Not so with PPM: "This material doesn't require any additives," Caseri says.

PPM is also more sustainable

than previous corrosion protection materials because it can be completely removed and recycled at the end of the product's life. While some polymer material is lost in the process, the recycling rate is very high at 95 percent. In their tests, the researchers were able to reuse the material five times.

Studies on the sustainability of PPM-based corrosion protection also show that the polymer performs better than epoxy-based corrosion protection materials when it comes to both environmental impact and human health. "There are really only two disposal solutions for epoxy resins: incineration or landfill," D'Elia says. "Our product allows for a third solution: recycling."

Nevertheless, PPM corrosion protection is not completely harmless to the environment. "Synthetic products always have an impact," D'Elia says. "But if you choose the right approach, you can limit that impact to a great extent." The former doctoral student hopes to see PPM corrosion protection commercialized.

The researchers have applied for a patent for their invention. It is still pending. They are also currently looking for an industry partner to further develop the product and to manufacture and distribute it on a large scale. Given the size of the global market, D'Elia sees huge potential for PPM. "Our technology is pretty advanced, but before we can sell it as a product, there are still some improvements for us to make," he says.



Walter Caseri, Marco D'Elia, and Markus Niederberger worked on the development of the new corrosion protection material PPM.



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Center for advanced materials at QU sheds light on smart self-healing composite coatings for corrosion protection in the oil and gas industry

A study on polymeric smart self-healing composite coatings modified by numerous additives reveals promising corrosion protection of steel parts.

Researchers at the Center for Advanced Materials (CAM) in Qatar University (QU) have confirmed the improved corrosion inhibition and self-healing properties of the polymeric composite coatings modified by various anti-corrosive pigments, in collaboration with their

lifetime and durability of painted materials.

Globally, steel-made infrastructures have been expanding at an incredible rate worldwide. They are critical for the expansion and operation of countless industries. Steel is susceptible to corrosion failures, particularly in aggressive environments, and requires surface protection and effective corrosion management to avoid failures. This scenario poses an enormous challenge

composite coatings aiming to address the corrosion challenges, mainly in the oil and gas industry, which is the backbone of the economy in the State of Qatar and the Middle East.

QSRTC always encourages active collaborative research with academic institutions. We believe sustainable development strongly depends upon the strong relationships between academia and industrial partners. QSRTC and QU's work in designing, developing, and characterizing polymeric-based smart self-healing composite coatings for corrosion protection in the oil and gas industry is a noteworthy example of this collaboration. Developing this type of novel coating formulation with improved performance and testing the prototypes was a wonderful experience. We look forward to more fruitful and applied collaborative research on corrosion protection in the future.

At Instituto Superior Técnico (IST), Lisbon, Portugal, around 60% of the scientific publications involve international collaborations with researchers from highly reputed research organizations. The research strategy of IST spans from creative fundamental research to innovative applied solutions carrying the potential to be transferred to the industry. IST mission is to contribute to socio-economic development by delivering cutting-edge research outcomes,

innovative products and solutions, and hands-on hands with the industry. Advancing surface protection solutions by developing novel and smarter coatings for metal protection in industrial applications are at the core of its research streams. These activities strongly contribute to raising our cooperation with different partners from the research and industry sectors. A series of collaborative projects of IST on smart self-healing composite coatings with Qatar University has proven the implementation of international collaboration between both institutions.

Q-COAT have a long-standing and active research collaboration with QU/CAM. The lab scale validation of high performance of epoxy coated rebars reinforced in concrete as (see photo) is an outstanding example of academia-industrial relationship. Among other ongoing collaborative research projects, smart self-healing composite coatings for corrosion protection are remarkable. Addressing corrosion challenges by developing novel coating formulations and aiming for their commercialization is the ultimate objectives of the academia industrial partnership. We believe, this collaborative research work is bridging the gap between industry and academia, which is essential for the economy of the State of Qatar in accordance with Qatar National Vision 2030.



industrial collaborators, Qatar Shell Research and Technology Center (QSRTC) and Qatar Metal Coating Company (QCOAT).

The study on the smart self-healing concept addresses this critical challenge by delivering an innovative and sound concept: autonomous corrosion protection solutions based on multilevel healing strategies for primers applied on piping steel networks exposed to marine environments. Polymeric coatings, which are modified with smart nano additives tailored to prevent and combat corrosion by autonomous healing with minimal human intervention, are considered a revolutionary solution to extend the

to the industry: How to comply with these requirements while keeping competitive solutions, sustainable operations, and maintenance costs.

Dr Abdul Shakoor, Research Assistant Professor at the Center for Advanced Materials (CAM), is leading the active research on the design, synthesis, and characterization of polymeric smart self-healing composite coatings. The novel formulations of developed coatings can be used extensively in seawater desalination systems, the oil and gas industry, and the automobile industry.

The team is working smartly to develop some novel chemistries of the polymeric



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AMPP Annual Conference + Expo climbs to new heights in 2023

The 2023 AMPP Annual Conference + Expo in Denver, Colorado, drew more than 5,700 attendees from the corrosion and coatings industries worldwide. Held by the Association for Materials Protection and Performance (AMPP), each year's conference represents the industry's largest and most comprehensive event, all while offering an ideal occasion to reconnect with old friends and network with industry peers.

From informative programs and workshops to widespread exhibits and networking, this year's show featured the very latest information and research on materials, corrosion and coating trends, best practices, and products. Whether attendees are focused on corrosion, coatings, materials, or seeing new technologies from around the world, they are able to find everything they need in one place.

This year's conference was the second held by AMPP following the 2021 merger between legacy organizations

NACE International and SSPC: The Society for Protective Coatings. As such, the show aims to provide everything attendees valued from the legacy CORROSION and Coatings+ events of those past organizations.

Relative to 2022, AMPP's 2023 show nearly doubled its number of forums, workshops, and information exchanges. It also featured a new student and young professionals (SYP) track, along with the launch of AMPP Connect — a hosted buyer program that fosters business relationships and partnerships. In all, the 2023 conference hosted 51 symposia and 41 informative sessions, ranging from forums and workshops to theater presentations.

AMPP's 2023 technical program featured paper presentations covering a wide range of corrosion and coatings topics such as coatings science, corrosion management, coatings failure, cathodic protection, and much more. Forums included

PHMSA's annual pipeline safety forum, an extensive look at corrosion under insulation (CUI), and a contractor forum exploring

pending changes to OSHA's lead rule. A protective coatings workshop was one of several workshops focused on specialized topics throughout the week.

Awards programs included AMPP's annual Honoree Night and its Scholarship Awards and EMERGING Leaders Bash, along with the new AMPP Project Awards. Meanwhile, AMPP's Publications team added to the list with the annual CoatingsPro Contractor Awards and Student Poster Awards, sponsored by CORROSION journal. AMPP 2023 had the biennial Materials Performance (MP) Corrosion Innovation of the Year Awards, as well.

With longer hours each day, the Expo featured 381 companies displaying the latest in corrosion control and protective coatings technologies. For a hands-on interactive experience, a coatings experience and cathodic protection (CP) test field were available in the Exhibit Hall.



Mr. Manoj Mishra (center), AMPP India Chapter, Mumbai, India was conferred with the 'AMPP Elaine Bowman Distinguished Service Award 2023,' for excellence in reorganization & contribution for the promotion of corrosion awareness in India and worldwide.

Two AMPPiTheater areas featured topical presentations on subjects such as the increasing use of robotics for CUI inspections and the evolving needs of internal corrosion management programs. The EMERG Student Camp engaged the industry's next generation.

Finally, this year's show featured an unofficial passing of the torch, with outgoing CEO Bob Chalker regularly walking the halls with incoming CEO Alan Thomas, who takes the reins effective April 1, 2023. AMPP's leadership ranks were also represented with the regular presence of Amir Eliezer, Chair of the AMPP Board of Directors, and Cris Conner, Chair of the AMPP Global Center Board of Directors, along with many others from those respective boards.

The 2024 AMPP Conference + Expo will be held March 3-7, 2024, in New Orleans, Louisiana, and a call for presentation topics is already well underway.



PHOTOS: AMPP



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JUN 21 – 24, 2023	SURFACE & COATINGS 2023	BITEC Bangkok, Thailand	Reed Exhibitions	T: +66 2286 7222 E: surfaceandcoatings@reedtradex.co.th W: reedtradex.com
JUN 26 – 28, 2023	COATINGSTECH CONFERENCE 2023	Hyatt Regency Cleveland at the Arcade, Ohio, USA	American Coatings Association	W: paint.org
JUN 28 – 30, 2023	CII SURFACE & COATING EXPO 2023	Chennai Trade Centre Chennai, India	Confederation of Indian Industries	T: (044) 42444555 E: surface.coating@cii.in W: ciisce.in
JUL 13 – 15, 2023	EXPO PAINT AND COATINGS 2023	Pragati Maidan New Delhi, India	Toredo Fairs India Pvt Ltd	T: (91) 98453 63225 E: info@expopaintcoating.in W: expopaintcoating.in
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AUG 27 – 31, 2023	EUROCORR 2023	Square – Business Meeting Centre, Brussels, Belgium	DECHEMA	E: eurocorr@dechema.de W: eurocorr.org
SEP 12 – 13, 2023	INTERNATIONAL ANTIFOULING CONFERENCE	Eriksberg Shipyard Area Gothenburg, Sweden	RISE/I-Tech	W: antifouling-conference-2023.confetti.events
SEP 15 – 16, 2023	15th INT CONF ON SURFACE PROTECTIVE COATINGS AND PAINT COATINGS	Hotel Lalit	Mumbai, India	T: (91-22) 35113458 E: sspcindia1@gmail.com W: sspcindia.org
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I, Franco Lonappan, hereby declare that the particulars given above are true to the best of my knowledge and belief.

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