CHRONICLING PROCESS INDUSTRY INNOVATIONS SINCE 1966

VOL.58 | ISSUE 2 | FEBRUARY 2023

CHEMICAL ENGINEERING WORLD

www.jasubhaimedia.com

Chemtech FOUNDATION
Inspiring Intelligence › Igniting Innovation

Supported by

सत्यमेव जयते
Ministry of Chemicals & Fertilizers
Department of Chemicals and Petrochemicals, Government of India

DECHEMA Society for Chemical Engineering and Biotechnology e. V.

VDMA Process Plant and Equipment

World Meet of the CHEMICALS, PETROCHEMICALS, BIOPHARMA & PROCESS Industry in India

ChemTECH WORLD EXPO 2024

31st International Exhibition & Conferences

4-7 March 2024

Venue: Bombay Exhibition Center, Goregaon (East), Mumbai, India

50 CHEMTECH FOUNDATION 1974-2024
Inspiring Intelligence... ..Igniting Innovation

Join us for 50th Years Celebration

LEADERSHIP FOR CHEMTECH 2024

Patron & Brand Ambassador
ChemTECH World Expo 2024
Shri Suresh Prabhu
Former Member of Parliament
Government of India

Jury ChairmanChemtech Leadership & Excellence Awards 2024
Dr. R A Mashelkar
Scientist, Former Director General, Council of Scientific and Industrial Research (CSIR)

Chairman
Specialty Chemicals World Expo 2024
Mr. Nadir Godrej
Managing Director, Godrej Industries Ltd

Chairman, EPC World Expo 2024
Mr. B Narayan
Group President Projects & Procurement,
Reliance Industries Ltd

Co-Chairman, EPC World Expo 2024
Mr. Subramanian Sarma
Whole time Director & Sr. EVP Energy
Larsen & Toubro Limited

Chairperson, Refining & Petrochemicals World Expo 2024
Ms. Sukla Mistry
Director (Refineries), Indian Oil Corporation Ltd

Co-Chairman
Refining & Petrochemicals World Expo 2024
Mr. Sanjay Khanna
Director (Refineries)
Bharat Petroleum Corporation Ltd

Chairman, WaterEX World Expo 2024
Mr. P Raghavendra Rao, IAS
Chairman, Haryana State Pollution Control Board, Ex Secretary (Chemicals & Petrochemicals)

Convener, Specialty Chemicals World Expo 2024
Dr. Raman Ramachandran
Head of Management Development Programmes K J Somaiya Institute of Management

Key Board Member
Specialty Chemicals World Expo 2024
Mr. Rajendra Gogri
Chairman & Managing Director
Aarti Industries Ltd

EXHIBITOR GROUPS

- Chemical & Pharma Processing
- Process Plants & Equipment
- Thermal & Mechanical Processing
- Engineering Procurement & Construction
- Technology Licensors
- Project Management Consultants
- Refining
- Chemicals & Petrochemicals
- Specialty Chemicals
- Chloroalkali
- Fertilizers
- Water & Waste Management
- Environment Technologies & Services
- Digital Services
- Industrial Automation
- Instrumentation & Process Automation
- Electrical Equipment
- Research & Development
- Biotechnology
- Green Chemistry
- Banking Finance & Insurance
- Lab & Analytical Instruments

PHARMA & BIOPHARMA

- Ingredients
- Bulk drugs
- R&D
- Warehousing
- Cold chain
- Packaging
- Contract Research & Manufacturing

CLEAN ENERGY

- Hydrogen
- Biofuels
- Methanol
- Carbon Capture Utilization & Storage
- Renewables – Solar Wind & Hydro

LOGISTICS

- Logistics Services
- Containers
- Supply Chain Management
- Packaging
- Material Handling
- Storage & Warehousing
- Cold Chain Management

CORROSION CONTROL

- Industrial Coatings
- Corrosion Control Technologies & Services
- Surface Engineering Solutions
- New metallurgies
- Inspection & Monitoring Technologies

Concurrent Events

EPC 2024 Engineering Procurement Construction
Specialty ChemICAL World Expo 2024
Refining & Petro CHEMICALS 2024
Bio Pharma World Expo 2024
Industry AUTOMATION & Control 2024
PVF Pumps, Valves & Fittings WORLD EXPO 2024
WaterEX WORLD EXPO 2024
BOILER World Expo 2024
SURFACE ENGINEERING & Corrosion Control World Expo 2024
Student Outreach Program 2024 — Develop Future Leaders

ChemTECH World Expo 2022

300+	19350	6	150	650+	200	27
EXHIBITORS & PARTNERS	VISITORS	CONFERENCES	SPEAKERS	DELEGATES	STUDENTS	COUNTRIES

Organised by:

Jasubhai MEDIA

Jasubhai Media Pvt Ltd

Taj Building, 3rd Floor, 210, Dr. D N Road, Fort, Mumbai – 400 001, INDIA.
Tel: +91-22-4037 3636, **Email:** sales@jasubhai.com

Ahmedabad - 09833104834 | Bangalore - 09892644177 | Chennai - 09176963737 | Delhi - 09818148551
Hyderabad / Pune - 09822209183 | Vadodara - 09820544904

sales@jasubhai.com

www.chemtechie.com

CHRONICLING PROCESS INDUSTRY INNOVATIONS SINCE 1966

VOL.58 | ISSUE 2 | FEBRUARY 2023

CHEMICAL ENGINEERING WORLD

www.jasubhaimedia.com

CORROSION MITIGATION

Sanicro® 35 Bridging the gaps

Good news! We've developed an all-new austenitic tube grade called Sanicro® 35 (Alloy 35Mo) that's easy to fabricate and bridges many of the materials properties gaps between stainless steels and costly nickel alloys. This structurally stable PRE 52 super-austenitic alloy offers comparatively higher pitting resistance and outperforms conventional 6Mo grades, with only moderate nickel content. An ideal choice for superior corrosion resistance and high strength in heat exchangers and hydraulic & instrumentation tubing. Find out more on our web landing page alleima.com/sanicro-35 and watch the film.

For further enquiries, please email our APAC Business Development Manager Sudhindra Hathwar, sudhindra.hathwar@alleima.com

Alleima

alleima.com

HORIZON POLYMER

www.horizonpolymer.com

India's Largest Processor of **FLUOROPOLYMERS**

Valves qualified ISO 15848-Part 1.

Pipework qualified ASTM F 1545

Chemours Co FC LLC - Delaware appoints Horizon Polymer as TEFLON® Licensing Partner for India Under Trademark license agreement to promote and sell PTFE/PFA/FEP Lined Piping products using TEFLON® PTFE/PFA/FEP Fluoropolymer.

TEFLON and Teflon diamond brand logo are registered trademarks of The Chemours Company FC, LLC used under license by Horizon Polymer Engineering Pvt. Ltd.

Horizon Polymer Eng Pvt. Ltd.:
204, Sumer Kendra, Pandurang Bhudhkar Marg, Worli, Mumbai - 400018. India
Contact: +91 22 24965031-36 I **Fax:** +91 22 24961073
Email: **vp@horizonpolymers.com**

CHEMICAL ENGINEERING WORLD
RNI REGISTRATION NO. 11403/66

CHAIRMAN
Maulik Jasubhai Shah

PUBLISHER & CEO
Hemant K. Shetty

EDITOR
Mittravinda Ranjan

CREATIVES
Arun Parab

GENERAL MANAGER SALES
Prashant Koshti
Amit Bhalerao

BRAND MANAGER
Sudhanshu Nagar

SALES
Godfrey Lobo
Priyaranjan Singh
Chandrahas M Amin
Yonack Pradeep

JASUBHAI MEDIA PVT. LTD.
Registered Office: 26, Maker Chambers VI, 2nd Floor, Nariman Point, Mumbai 400 021, INDIA.
Tel.: 022-4037 3737 Fax: 022-2287 0502
E-mail: sales@jasubhai.com

PUBLISHED BY:

Jasubhai MEDIA

When you've got power, performance comes naturally.

Like our wide range of customizable products.

Series M
Helical Inline
Geared Motor

Series C
Heliworm
Geared Motor

Series F
Parallel Shaft
Geared Motor

Series K
Helibevel
Geared Motor

Series PL
Planetary
Geared Motor

Series J
Shaft Mounted
Speed Reducer

Loose Gears
Customized
Gears

GEARED MOTORS | GEAR BOXES | CUSTOMIZED GEARS | DRIVE SOLUTIONS

- Robust design • Modular construction • User-friendly interface • Quick installation
- Economical operation • Easy maintenance

radicon POWERBUILD

Phone: +91-2692-231070, 231120, +91-75675 67567 | **Website:** www.powerbuild.in | **E-mail:** infopbl@powerbuild.in |

CONTENTS

FEATURES

Corrosion Control with Electrochemical Impedance Spectroscopy Measuring Technique 19

Maheshkumar Aradhye
Associate Vice President - R & D
NACE International: CIP & PCS - Instructor
NACE Certified Coating Inspector Level -3 # 15945
NACE Certified Protective Coating Specialist # 21914
SSPC PA- Protective Coating Specialist # 2011-049-332

Life Cycle Analysis of Assets in Chemical Industry 27

Anand Umakanthan
Head - Reliability Fixed Equipment & Piping, Reliance Industries

Avoiding Downtime with Proactive Maintenance 33

Clive Jone
Managing Director
Global Heat Transfer

Unlocking the Full Benefits of IoT Technology 38

Chris Riché
Product manager
Flowserve Corporation

AD INDEX 8

NEWS 10

CHEMICAL ENGINEERING WORLD

AD INDEX

Alleima India Private Limited 4

Hi-Tech Applicator 1

Horizon Polymer Engineering Pvt Ltd 5

Power Build Private Limited 7

Chemtech FOUNDATION
Inspiring Intelligence • Igniting Innovation

International Integrated **ENERGY** Exhibition & Conferences

ANNOUNCING 2025

Oil Gas & Power

World Expo 2025

February 2025

Venue: Bombay Exhibition Center, Goregaon (East), Mumbai, India

Oil&GAS World Expo 2025 | POWER + COAL World Expo 2025 | Refining & Petro CHEMICALS 2025 | GAS WORLDTECH Expo 2025

INLAND WATERWAYS & PORTS World Expo 2025 | MARITIME & LOGISTICS World Expo 2025 | SURFACE ENGINEERING & Corrosion Control World Expo 2025







Supported by:
CHEMTECH FOUNDATION 1974-2024
Inspiring Intelligence...
..Igniting Innovation

Organised by: **Jasubhai Media Pvt Ltd**

Taj Building, 3rd Floor, 210, Dr. D N Road, Fort, Mumbai – 400 001, INDIA.
Tel: +91-22-4037 3636, **Email:** sales@jasubhai.com

Ahmedabad - 09833104834 | Bangalore - 09892644177 | Chennai - 09176963737
Delhi - 09818148551 | Hyderabad / Pune - 09822209183 | Vadodara - 09820544904

Jasubhai MEDIA

sales@jasubhai.com **www.chemtech-online.com**

Union Home Minister and Minister of Cooperation, Shri Amit Shah performed Bhumi Pujan and laid the foundation stone of the fifth unit of IFFCO Nano Urea Plant at Deoghar

Jharkhand, India: On the occasion of IFFCO Nano Urea Plant's foundation stone laying ceremony, Member of Parliament from Godda Shri Nishikant Dubey, IFFCO Chairman, Shri Dilip Sanghani and many other dignitaries were also present. In his address, Shri Amit Shah said that today the foundation stone of the production unit of Nano Urea Plant of IFFCO has been laid here. Liquid urea is very important for the conservation of soil of our country. He said that Prime Minister Shri Narendra Modi made land conservation a major concern and gave priority to all land conservation works, be it natural farming, organic farming or speeding up the process from research to production of Nano Urea. Shri Shah said that with the construction of the Deoghar unit, about 6 crore liquid urea bottles will be manufactured here every year, which will reduce our dependence on the import of Urea and India will become self-reliant.

The Union Home Minister and Minister of Cooperation said that this small bottle of 500 ml would become a substitute for a full bag of urea. In many places in the country, farmers spray urea as well as liquid urea, which damages not only the crops but also the land. He said that the production may probably increase after spraying of liquid urea. Shri Shah said that the research works to develop nano liquid urea has been done for the conservation of Mother Earth. Chemical fertilizer kills the earthworms present in the soil which produce manure naturally, while the spraying of liquid urea will not make the soil toxic.

National Green Hydrogen Mission targets a production capacity of 5 Million Metric Tonnes (MMT) per annum by 2030

New Delhi, India: On 4th January 2023, the Union Cabinet approved the National Green Hydrogen Mission with an outlay of ₹ 19,744 crore. The Mission targets a production capacity of 5 Million Metric Tonnes (MMT) per annum by 2030

To achieve these targets, the following components have been announced as part of the Mission: Facilitating demand creation through exports and domestic utilization; Strategic Interventions for Green Hydrogen Transition (SIGHT) programme, which includes incentives for manufacturing of electrolysers and production of green hydrogen; Pilot Projects for steel, mobility, shipping, decentralized energy applications, hydrogen production from biomass, hydrogen storage, etc.; Development of Green Hydrogen Hubs; Support for infrastructure development; Establishing a robust framework of regulations and standards; Research & Development programme; Skill development programme; and Public awareness and outreach programme

This information was given by Shri R.K Singh, Union Minister for Power and New and Renewable Energy in a written reply in Rajya Sabha.

Union Minister Dr Jitendra Singh says, Government will promote Industry-driven Start-Ups to create wealth and jobs

New Delhi, India: Union Minister of State (Independent Charge) Science & Technology; Minister of State (Independent Charge) Earth Sciences; MoS PMO, Personnel, Public Grievances, Pensions, Atomic Energy and Space, Dr Jitendra Singh today said, Government will promote Industry-driven Start-Ups to create wealth and jobs.

Addressing the 37th Foundation day of Department of Biotechnology (DBT) as Chief Guest at National Institute of Immunology, NII, Delhi, Dr Jitendra Singh called for equal stake with equal partnership and responsibility by Industry to sustain the Start-Ups boom. The Minister said, Start-Ups will become sustainable, if Industry from the very beginning will identify the theme/subject/product and invest matching equity with the Government. The Minister assured that funds will not be a constraint under Prime Minister Narendra Modi's Government to promote the "Innovation Eco-System" in the country.

Giving the example of Prime Minister Narendra Modi's idea of an Atma Nirbhar Bharat, where India's vaccine strategy brought together pharma, industry and academia in a partnership with an eye on meeting the current as well as possible future challenges, Dr Jitendra Singh said, the idea behind initiatives like this is to have a sustainable partnership in the long run and provide a sustainable source of livelihood to India's youth. He added that the Government of India, led by Prime Minister Modi, is encouraging industrial outreach by extending all possible support.

SAIL records best ever monthly production in January 2023

New Delhi, India: Steel Authority of India Limited (SAIL), a Maharatna PSU under the Ministry of Steel, has recorded the best ever monthly production in January 2023. Crude Steel production of 1.72 Million Tonne (MT) during January 2023 is the best ever monthly performance registering an impressive growth over the previous best achieved in March 2022. SAIL also achieved the best ever monthly production of hot metal and saleable steel at 1.8 MT and 1.61 MT during this month, registering growth over the previous best recorded in March 2022.

Promotion of Green Steel

New Delhi, India: The emissions from iron and steel sector as reported by Ministry of Environment, Forest and Climate Change (MoEFCC) in India's first, second and third Biennial Update Reports (BURs) to the United Nations Framework Convention on Climate Change (UNFCCC) for the years 2010, 2014 and 2016 were 95.998 million tonnes CO2, 154.678 million tonnes CO2 and 135.420 million tonnes CO2, respectively.

The Ministry of Steel is committed to Net-Zero target by 2070. Towards this, in short term (FY 2030), reduction of carbon emissions in steel industry through promotion of energy and resource efficiency as well as renewable energy is being focused. For the medium term (2030-2047), utilisation of Green Hydrogen and Carbon Capture, Utilisation and Storage are the focus areas. For long term (2047-2070), disruptive alternative technological innovations can help achieve the transition to net-zero. For this purpose, Ministry of Steel is continuously engaging with various stakeholders.

Steps taken for promoting decarbonization in steel industry include Steel Scrap Recycling Policy, 2019 enhances the availability of domestically generated scrap to reduce the consumption of coal in steel making; Ministry of New and Renewable Energy (MNRE) has announced National Green Hydrogen Mission for green hydrogen production and usage. The steel sector has also been made a stakeholder in the Mission; Motor Vehicles (Registration and Functions of Vehicles Scrapping Facility) Rules September 2021, shall increase availability of scrap in the steel sector; National Solar Mission launched by MNRE in January 2010 promotes the use of solar energy and also helps reduce the emission of steel industry; Perform, Achieve and Trade (PAT) scheme, under National Mission for Enhanced Energy Efficiency, incentivizes steel industry to reduce energy consumption; The steel sector has adopted the Best Available Technologies (BAT) available globally, in the modernization & expansions projects; Japan's New Energy and Industrial Technology Development Organization (NEDO) Model Projects for Energy Efficiency Improvement have been implemented in steel plants.

The Ministry is focusing on raising awareness on the emerging market for green steel among the manufactures.

LoI signed between DST & Fraunhofer ISE on hydrogen & clean energy technologies can accelerate energy transition in India

New Delhi, India: A Letter of Intent (LoI) was signed between the Department of Science and Technology (DST) and Fraunhofer Institute for Solar Energy Systems (Fraunhofer ISE) for a long-term collaboration focusing on hydrogen technologies.

The LoI was signed on 25th February 2023, by Dr. Anita Gupta, Scientist G and Head, Energy Technologies Cell, DST and Prof. Dr. Christopher Hebling, Director, Division Hydrogen Technologies, Fraunhofer ISE in the presence of Secretary, DST, Dr. S. Chandrasekhar. The event was also attended by Mr. R. Madhan, Director, Indo-German

Science & Technology Centre (IGSTC), Ms Anandi Iyer, Director Fraunhofer India and officials representing both the sides.

India and Germany share the goal of decarbonizing their economies and are committed to collaborating jointly in the pursuit of energy security and climate protection. Both countries have committed to develop a national green hydrogen economy to facilitate achievement of the Paris Agreement targets.

The LoI will trigger development of higher Technology Readiness Level (TRL) for hydrogen energy clusters being set up by DST and identify existing technologies and potential interventions from Fraunhofer in green hydrogen, integrate them with indigenous technologies, and deploy / calibrate them for Indian conditions.

DST will provide the enabling framework for cooperation in the hydrogen valley cluster projects, support activities, and facilitate the resources needed wherever applicable and possible. Meanwhile Fraunhofer acts as a technology partner for the hydrogen valley /cluster, provides information and access to technologies of TRL 5 – 8, scientific and technical experts, collaboration in preparing technology roadmaps and guidelines for innovation ecosystem/cluster.

Dr Mansukh Mandaviya inaugurates IFFCO Nano Urea Liquid Plants at Aonla and Phulpur in UP

Phulpur, Uttar Pradesh: Union Minister of Chemicals and Fertilizers, Dr Mansukh Mandaviya inaugurated the IFFCO Nano Urea Liquid Plants at Aonla and Phulpur in Uttar Pradesh today.

Addressing the event, Dr Mandaviya stated that today is an important day because Nano urea plants have been dedicated to the nation. He said that Nano Urea, in the coming times will ensure the progress of the farmers, increase their income. In this way it will change the future of our farmer. Union Minister highlighted the benefits of Nano urea stating that it is the best green technology and provides solution of pollution. It saves the soil and also increases the production and hence is the best for the farmers. He further said that Government's Expert Committee has given approval to Nano DAP, and it will also come to replace DAP shortly. He added that Nano-DAP will immensely benefit our farmers and it will be available at half the cost of DAP.

Dr Mandaviya also underlined the efforts of the government in making Nano urea available to the farmers. He also pointed out the challenges in bringing Nano urea ranging from getting approvals from various departments, convincing the farmers to tackling conventional urea lobby.

Covestro successfully starts up a new world-scale chlorine plant in Tarragona

Tarragona, Spain: Covestro has successfully started up a new world-scale facility for the production of chlorine in Tarragona, Spain. It is the first world-scale production plant for chlorine based upon the highly innovative and energy efficient ODC (oxygen depolarized cathode) technology invented by Covestro and its partners. The new plant ensures an efficient, sustainable and independent supply of chlorine and caustic soda to MDI production in Tarragona. This will strengthen the European production network for MDI – a precursor for the manufacture of rigid polyurethane foam used to insulate refrigeration appliances and buildings. The 200-million-euro investment has created 50 new jobs on site.

"The successful start-up of the new plant is good news, both economically and ecologically, for Covestro as well as for our site in Tarragona", said CEO Dr. Markus Steilemann. "The plant demonstrates how new technologies enable us to advance our vision of the circular economy and further reduce resource consumption while increasing the robustness and efficiency of our production network."

The new chlorine facility is the first industrial-scale plant in the world to use the innovative oxygen depolarized cathode technology (ODC). The technology has been developed by Covestro in collaboration with thyssenkrupp nucera. Compared to the currently predominant conventional chlor-alkali electrolysis, the new process requires a lower voltage, which results in energy savings of up to 25 percent. At the new plant in Tarragona, this can avoid up to 22,000 metric tons of CO_2 emissions per year compared with existing processes – based on the energy mix at the start of construction planning in 2018. The new plant will thus make an important contribution to Covestro's goal of being operationally climate-neutral by 2035.

VDMA Valves: Dr. Laura Dorfer to become new Managing Director

L-R: Dr. Laura Dorfer, Wolfgang Burchard

Frankfurt, Germany: Dr. Laura Dorfer will take over as Managing Director of the VDMA Valves Association at the beginning of April 2023. She will succeed Wolfgang Burchard, who is retiring. "Whether in the networked factory or in smart, energy-efficient building technology - the valve industry will continue to play an important role as an equipment supplier and technology provider in the future," Dorfer emphasized on the occasion of her appointment. "I look forward to accompanying the valve companies in the coming years as they master the market challenges and continue to position themselves for the future."

After completing her doctorate in business administration at the University of Siegen, Dr. Laura Dorfer has been responsible for the strategic establishment and successful further development of the VDMA Startup-Machine as project manager since February 2018. Together with her team, she has developed and marketed products and services for the targeted networking and initiation of cooperation between companies and solution providers from the startup scene for member companies of the VDMA. In the future, she will contribute her networking strength, her market strategy orientation, and her intuition for customer-centric products of tomorrow's association world to the further development of the Valves association.

European Investment Bank backs green hydrogen deployment in India and joins India Hydrogen Alliance

Mumbai, India: Kris Peeters, Vice President of the European Investment Bank (EIB), the bank of the European Union, formally agreed today to join the India Hydrogen Alliance (IH2A) and increase support for large-scale green hydrogen hubs and projects across India with an indicative funding of EUR 1 billion, subject to Indian Government and EIB approvals.

Kris Peeters, Vice President of the European Investment Bank, said, "The European Investment Bank recognises the huge potential of developing and reducing the cost of green hydrogen in India. Together with industry, national government and state

authorities we are exploring how the EU Bank might play a role in supporting India's National Hydrogen mission, in order to enable the use of green hydrogen to decarbonise energy, industry and transport. The strengthened cooperation through the India Hydrogen Alliance will contribute to implement a national green hydrogen roadmap that delivers India's energy transition and net-zero carbon plans alongside strengthening energy security in the years ahead. Joining IH2A builds on the EIB's global climate engagement and our support for climate action in India over the last three decades."

Jillian Evanko, President and CEO, Chart Industries and Founding Member, IH2A, said, "We are delighted to partner with EIB to bring much needed funding to help develop the green hydrogen economy in India. Funding for large-scale green hydrogen projects is nascent and EIB's participation will help solve a key eco-system problem. We look forward to work closely with EIB, investors, industry and the government to help realize hydrogen commercialisation at scale, in the next half decade. This is an essential part of getting the first few steps of the hydrogen transition right, before we look at 2030 scenarios."

H.E. Ugo Astuto, EU Ambassador to India said: "In September the First EU-India Green Hydrogen Forum was held in Delhi during the visit of Commissioner for Energy Kadri Simson, strengthening EU-India clean energy cooperation. The European Investment Bank joining the India Hydrogen Alliance today further highlights a Team Europe approach for a green and resilient future, underpinning the EU Global Gateway strategy."

Perstorp sets reduction targets for water and waste

Stockholm, Sweden: Sustainable solutions provider Perstorp has added new corporate sustainability targets, for water and waste, to its sustainability strategy. Its long-term sustainability ambition is to become Finite Material Neutral, which involves water and waste, along with raw materials, energy and catalysts. In 2021 the company set its first 2030 targets, for greenhouse gas emissions (using approved science-based targets) and (eco) toxic impact. Now Perstorp has added new sustainability targets that will address its long-term ambition.

These new 2030 corporate targets (all measured using 2019 as the base year) are: 30% absolute reduction of freshwater consumption; 30% absolute reduction of hazardous waste directed to disposal; 30% absolute reduction of non-hazardous waste directed to disposal

"Fresh water consumption and waste are two areas of big importance in reducing our environmental impact and working toward increased circularity," says Anna Berggren, Vice President Sustainability at Perstorp Group. "Fresh water scarcity is already a fact around the world, and we have a responsibility to reduce our consumption and utilize alternative water sources. We must also minimize waste generation and find new circular solutions of reusing and recycling the waste streams into new products, either ourselves or so that a third party can use them as raw material. We have set ambitious and absolute sustainability targets, that are to be achieved regardless of production growth. To

be able to reach these targets we have several large projects planned that will contribute significantly."

All Perstorp production plants use water for multiple purposes, including, for example: for cooling, as a solvent for chemical reactions, as a carrier for products, and as a heat-transfer medium. One way to reduce freshwater consumption is to purify and recycle wastewater. Perstorp sees this as an important core technology and is planning to invest in wastewater recycling projects at several of its production sites.

Global Clean-tech majors Bioweg and Ginkgo Bioworks to combat Microplastic Pollution with Bio-based Materials

Mumbai, India: Bioweg, an innovative 'Bio-innovation to Business' German producer of highly functional and customizable bio-based materials, has partnered with Ginkgo Bioworks, global leaders in building platforms for cell programming and biosecurity, to announce a collaboration to optimize the production of bacterial cellulose and produce novel variants with improved performance to serve a variety of end markets. Biomaterials could prove to the most biodegradable, carbon-negative plastic alternative that could put the world on a more sustainable track. Bioweg was founded in Germany in 2019 by Dr Prateek Mahalwar and Srinivas Karuturi, two Indian-origin founders from Delhi and Bengaluru. Both share a common passion for combining bio-innovation and business problems.

The problem of microplastics is prevalent all over the world and also India is not unaffected. A recent study by the National Centre for Coastal Research (NCCR) has found that microplastic pollution is very high on the east coast about 10 km into the open sea, with up to 308 particles per kg of sediment. It is therefore not surprising that an average person could be ingesting about 5 grams of plastic each week through the consumption of common foods and beverages, according to a study by the University of Newcastle. These microplastics are non-biodegradable and sometimes carry toxic chemicals on top of them. Regulatory agencies and communities around the world have addressed microplastics contamination through significant regulations. Bioweg's current products based on biodegradable bacterial cellulose have already been tested and implemented by companies as an effective substitute for widely used synthetic polymers such as acrylates, polyethylene, and polystyrene. Synthetic polymers often appear

as microbeads (micro powders) and texturants (rheology modifiers) in products throughout the cosmetics, homecare, personal care, agricultural coatings, and other industries, which contribute to microplastic pollution in surface waters worldwide.

"Consumers and companies are united in their commitment to finding better performing and more sustainable alternatives for everyday products to break the chain of microplastic pollution. Our solutions are not just tackling a major environmental, sustainability and health problem, but also present a robust market opportunity to replace plastic polymers in care, coatings, chemicals, and other industries," said Prateek Mahalwar, CEO at Bioweg. "We believe that this partnership will be a win-win situation for us and will give us access to strain engineering and screening capabilities that can enable us to deliver our biobased solutions at scale and competitive pricing."

Corrosion Control with Electrochemical Impedance Spectroscopy Measuring Technique

Performance testing with regards to corrosion protection is very important for both coating developers and coating customers. How else can we judge if a coating system is delivering the properties that we require. In this paper a short overview will be given of the possibilities that we have and the problems that we face with the performance testing.

One of the less well-known techniques for looking at anti-corrosive coating systems is Electrochemical Impedance spectroscopy. Although EIS is around for quite a long time, little is published on EIS testing on coating systems. In the past, EIS was mostly used to describe corrosion processes and not in a way to try to prevent corrosion in an early stage or even to help in the development of better anti-corrosive coatings. Prevention of corrosion can be done by proper maintenance. So to know in an early stage when to do maintenance would be very useful. Here we will discuss one such technique.

Electrochemical Impedance spectroscopy is an official ISO test (ISO 16773). The ISO 16773 describes how the test should be carried out and what kind of equipment is necessary. What ISO 16773 does not tell you is how to evaluate the measurements. Here experience and sometimes even companies' intellectual properties come into place. This of course hinders an industry-wide acceptance of this technique.

How to do performance testing of anti-corrosive coatings?

Performance Testing can be divided into two main groups.

Outdoor Exposure Testing

Outdoor exposure testing is of course what everybody would prefer. However, this kind of testing in general will take 10 to 20 years. In coating developments

this is of course not feasible. It is not even sure if the materials that were used are still available in 10 to 20 years' time. Legislation might very well change as well. Furthermore, outdoors is not well defined making it impossible to use a test result achieved in one place, for example the north of India, for a different location, for example the south of India. So what can we test for?

During and just after application we can do a visual inspection, measure Wet Film Thickness (WFT), Dry Film Thickness (DFT), holiday testing and finally adhesion testing, which will damage the coating system. None of these test will be a good predictor for coating performance. Only in the case that the specifications for the coating system are not met, a negative prediction can be made.

During service life of a coating system we can do a visual inspection, measure DFT and do an adhesion test. These tests will not give an indication if there is already the beginning of corrosion underneath the coating system and that maintenance should be scheduled, making them not very suited for corrosion control.

Accelerated Testing

This is what everybody in the coating industry is doing and what most customers are requesting. The advantage of the accelerated tests is of course that they are quick, typically they will take six months or less. The results are in general reproducible which makes them suitable for comparison (between similar systems) and you will find them in specifications for big projects. The big question of course remains how good the relation between the accelerated tests and real life weathering is. This question is unfortunately not often asked and accelerated test results are taken as true predictors for real life exposure. This can lead to strange project specifications, for example salt spray results for a dessert project. It is not possible to relate an accelerated test results to an in service life coating condition. In short an accelerated test result does not give an indication of the performance of an anti-corrosive coating system during it service life thus making it not suited for corrosion control either.

What would we like to have?

We would like to have a test that will deliver quick results that are the same for outdoor tests as well as for laboratory tests. The test should be reproducible, non-destructive and should give a good indication for anti-corrosive behavior. It would also be important if the test could be used to follow the anti-corrosive behavior of a coating system in time.

In the laboratory, an EIS test is performed direct, after 24 hours, after a week and finally after three weeks. Thus making it a very fast test. Especially if you compare

this with salt spray or immersion test that can take up to half a year or less.

EIS testing can also be done outside the laboratory thus making it possible to compare laboratory results with real-life results. Every EIS result is a good indication of the current condition of the coatings system. So for example a decrease of the EIS results is an indication of the necessity of system maintenance in a very early stage.

Explanation Impedance measurements

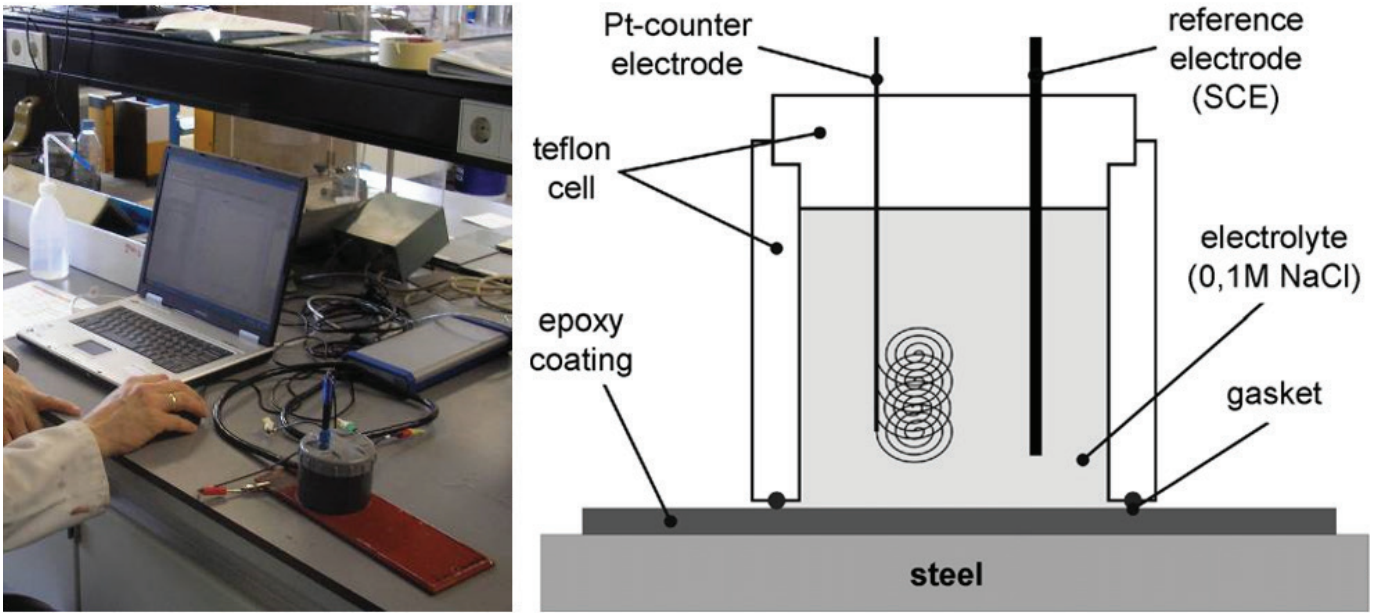
EIS is an electrochemical measuring method that quantifies the protective behavior of coatings. Besides the general performance of coatings also protective mechanisms can be identified.

The advantage of the method is a rapid evaluation of the coating performance as well as a better correlation with the expected performance in the field.

Electrochemical Impedance Spectroscopy (EIS)

Impedance measurements on organic coatings, involve an application of an alternating voltage over a counter electrode and a coated (metal) substrate, while the response of the system is measured. Since the Impedance is frequency-dependent, the measurements are executed over a range of frequencies.

The data measured need to be processed in order to provide some meaning. In general the data are fitted assuming that process changes within a coating follow



Set-up of the measurement and a graphical representation of the cell itself

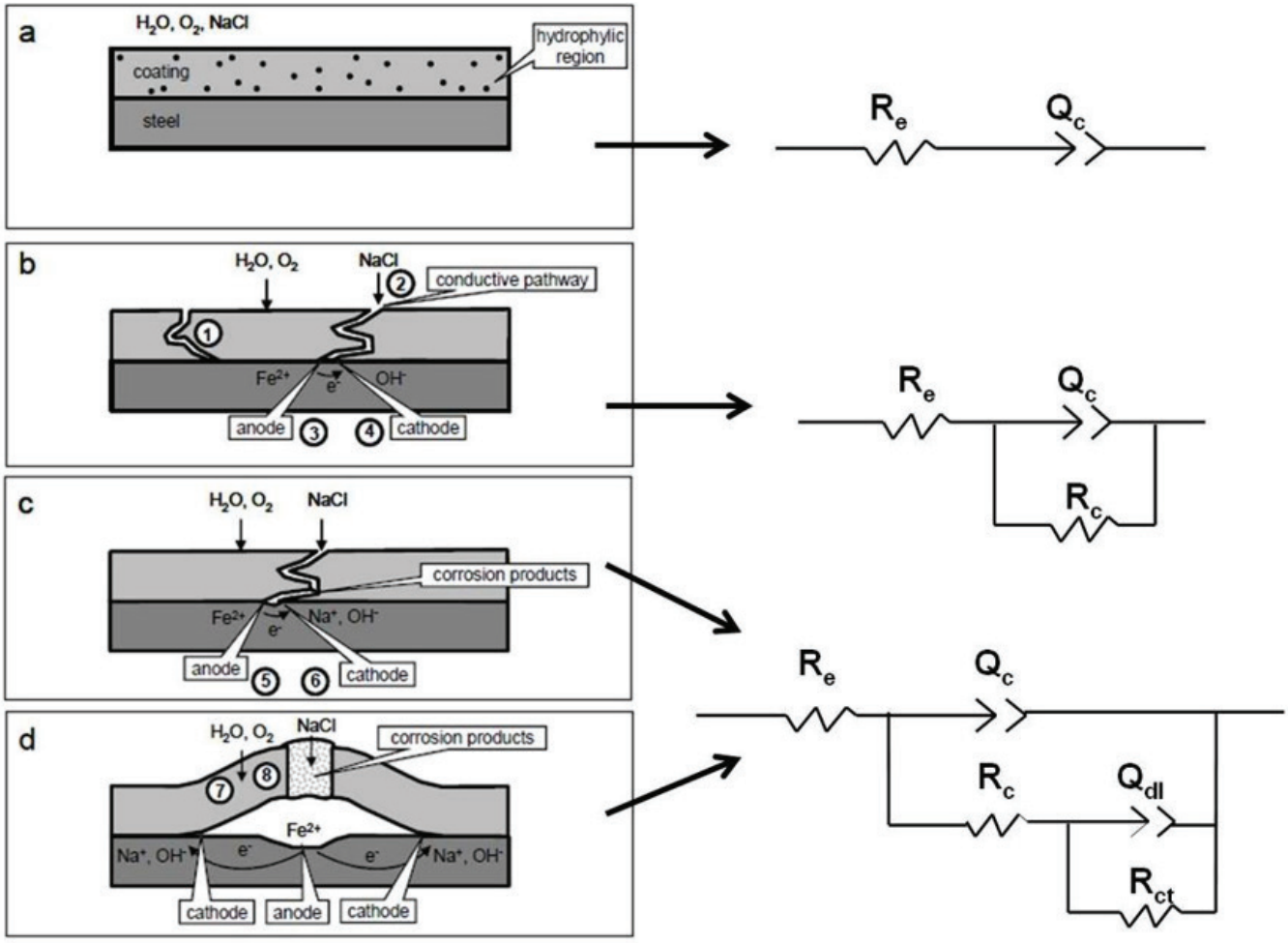
a unified degradation mechanism model, which is founded on the formation of conductive pathways (see figure 1 on next page).

This figure shows the degradation from an ideal coating a, to what mostly is measured for a new or properly protecting coating b, an intact but degraded coating c and in the last time of service before failing d. A number of equivalent circuits were used to fit the data in our tests. The parameters that can be derived from these fits are: electrolyte resistance (R_e), constant phase element (CPE, Q_c), coating resistance (R_c), metal double layer capacitance (C_{dl}), charge transfer resistance (R_{ct}).

The constant phase element (CPE) allows for small deviations from ideal capacitance behavior and is characterized by two parameters, Y_0 and n. Y_0 can be related to coating capacitance if n=1, while n itself represents deviation from ideal coating behavior. For ideal coatings, n =1, while practical systems show a deviation with results below 1

Most Probable Equivalent Circuit (MPEC) fitting model based on a uniform degradation mechanism

The coating resistance R_c expressed in Ω/cm^2 is a measure for the resistance to ion transport through the coating. The



most important factor of protection against corrosion by barrier coatings is through their resistance to ion transport.

The results provide the data on the following parameters:

n value: The n-value shows the deviation of ideal coating behavior. An ideal coating has an n- value of 1. In practice, the n-value will be a few hundredths lower. The n-value decreases with time.

Y_0 value : The Y_0 value of a coating can be related to the number of polarisable groups in the coating. The value increases with time. From Y_0, the relative water uptake can be calculated.

R_c: R_c equals the resistance that charge carriers (ions) encounter as they migrate through the coating. A good coating has a high Rc value. Rc decreases with time.

These values are useful when the coating is still intact, see figure b.

However, when corrosion products have been formed beneath the coating, figure c and d come into play and a different equivalent circuit has to be considered. Then two new parameters can be calculated.

The Q_{dl} provides an indication of the development of the electrochemical double layer underneath the coating, which can be related to the progress of delamination.

The R_{ct} is the charge transfer resistance and can be related to the corrosion rate of the process.

Concluding, for an intact coating, no values for Q_{dl} and R_{ct} should be found.

Interpretation of coating performance

Data from literature has led to the following qualification range, which was used in a project report for the Corus group. (A copy can be obtained from central office).

$R_c > 10^{10}$ Ohm/sq.cm - Best corrosion protection.

$R_c > 10^8$ Ohm/sq.cm - Better corrosion protection.

R_c107 - 10^8 Ohm/sq.cm - Standard corrosion protection

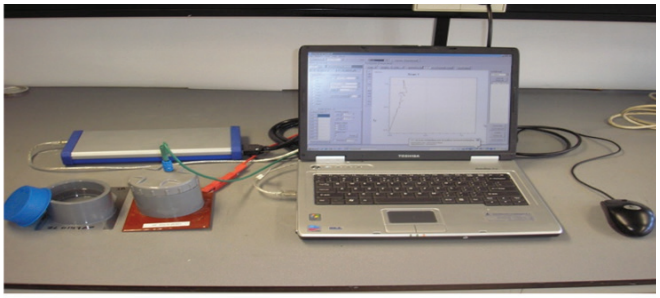
R_c 10^6 - 107 Ohm/sq.cm - Doubtful corrosion protection.

$R_c < 10^6$ Ohm/sq.sm - Poor corrosion protection.

These values should be used with caution, judgment of coating systems must be done by their total performance and not by only one parameter. Measurements at TNO has led to the conclusion that the relative water absorption calculated from Y0 after 1-day immersion should be less than 0,1 for a heavy duty coating. Finally, the following data was taken from the Corus report and

gives average values for a generic class of coating.

Experimental: Laboratory setup



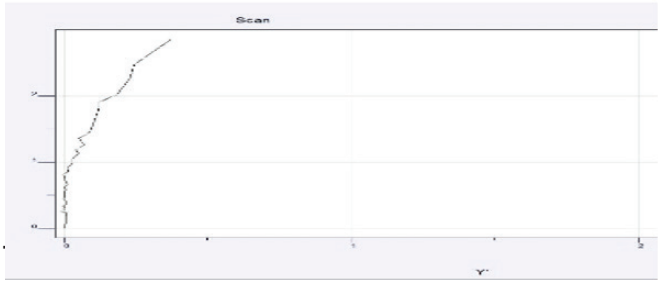
Example of the setup as it was used in the laboratory for EIS measurements

Steel Q-panel QD-46 (102cm x 152cm) were solvent washed and then air spray coated with different 1k and 2k ant-corrosive coatings. A PVC ring was glued upon the surface and then an electrolyte solution was poured into the ring. A graphite electrode was used for the measurements, an potentiostat and a laptop / PC. The frequency range ran from 10^6 Hz to 0.01 Hz. Measuring to even lower frequencies simply would take too long making this setup less usable.

Example of the setup as it was used in the field

Field setup

In the field we need two electrodes in order not to damage the coating.



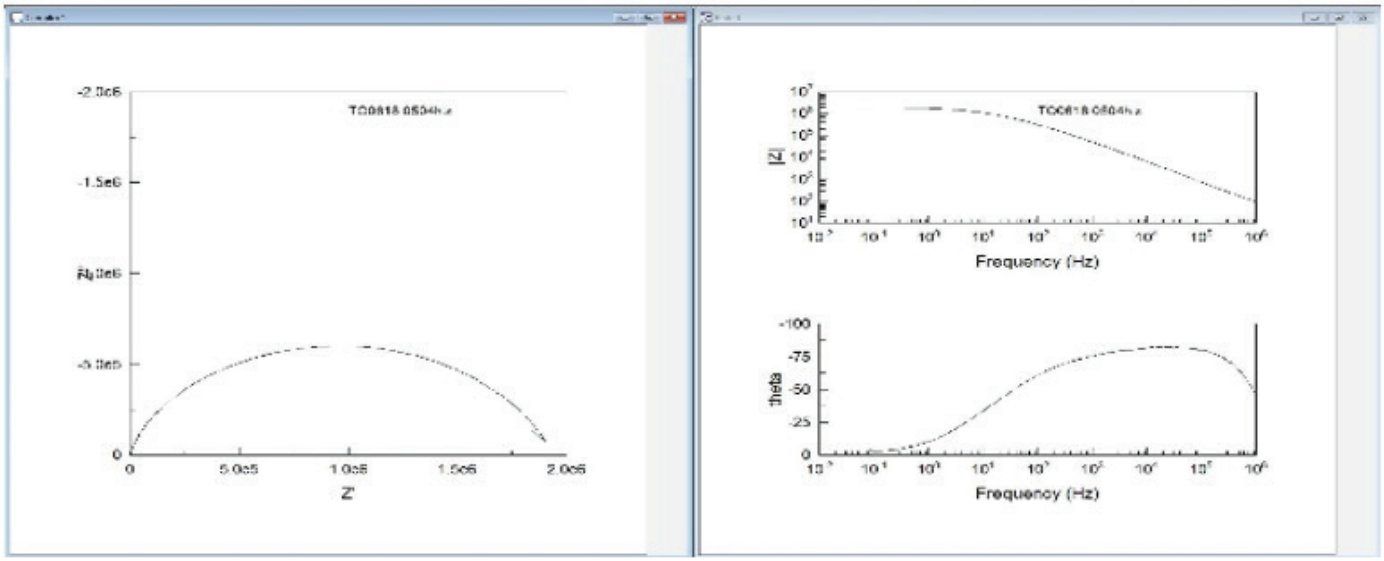
EIS data graph example

This kind of data presentation is not easy to interpret, for that reason a more common presentation is the Nyguist and Bode plots:

For more experienced EIS users these plots give already a lot more information. However, we would like to have simple numbers to compare coatings systems. To be able to get these we need an (electrical) model that imitates these measurements. There are numerous models that can we used, but the most popular uses a Constant Phase Element. Together with a Resistor for the electrolyte (Re) and a Resistor for the coating (Rc) the behavior of a good ant-corrosive coating can be modeled.

From the CPE we can calculate an Y0 admittance constant and a n-value that is the power of the CPE.

For coatings the Y_0 is an indication for number of polarizable groups in the



Nyguist and Bode plot example

coating. The value increases with time. Can be related to relative water absorption by using Brasher-Kinksbury equation.

For coatings the n-value shows the deviation of ideal coating behavior. An ideal anti-corrosive coating has an n-value of 1.

Results

In our laboratories, we successfully use EIS to evaluate our research and development tests.

With use of the Re, Rc, Y_0, n-value and the relative water take-up that can be calculated from two Y_0 numbers we were able to build up an extensive database of anti-corrosive coatings. We were able to make a ranking on anti-corrosive properties of our coating range. We were able to relate the real life measurement in the field on aged coating systems to those measurements that were done in the laboratory on the same or similar systems. In this way we were able to give advice on maintenance strategies on big projects. Examples of these measurements will be given in the presentation.

EIS is extremely powerful to pick-up any modifications that influence the anti-corrosive properties of a coating and that can be very useful when developing anti-corrosive coatings as well as detecting application errors in real life.

Generic Coatings Impedance results after 21 days.

Conclusions

Electrochemical Impedance spectroscopy (EIS) can be used both in the laboratory as well as in the field on real life objects to predict anti-corrosive protection.

Group	Rc (Ohm/ cm2)	Yo (sn/Ohm)	n	Rel. water uptake after 24 hr
Splash zone Epoxy Coatings	$8.0 * 10^{8}$	$5.5 * 10^{-11}$	0.96	0.01
Aluminium flake coating	$2.6 * 10^{8}$	$2.1 * 10^{-10}$	0.94	0,02
IOZ + HS Epoxy	$2.6 * 10^{8}$	$1.2 * 10^{-10}$	0.92	0,08
Heavy Duty Epoxy	$2.1 * 10^{8}$	$4.8 * 10^{-11}$	0.96	0,04
Novolac Epoxy Linings	$1.1 * 10^{8}$	$9.4 * 10^{-11}$	0.93	0,06
Surface Tolerant Epoxy, underwater curable	$1.1 * 10^{8}$	$4.2 * 10^{-10}$	0.85	0,28
Ceramic filled epoxy Lining	$9.4 * 10^{7}$	$1.0 * 10^{-10}$	0.93	0,10
High Solids Epoxy	$1.9 * 10^{7}$	$2.9 * 10^{-10}$	0.90	0,24
Amine Cured Phenolic Epoxy	$1.8 * 10^{7}$	$3.3 * 10^{-10}$	0.88	0,26

EIS is a fast and non-destructive test.

EIS is not yet industry wide accepted as good indicator for anti-corrosive performance of coating systems. ■

References:

- *F.M. Geenen, "Characterisation of Organic Coatings with Impedance Measurements, Ph.D Thesis, Delft University of Technology,1991.*
- *J. Andrews, F. Anwari, B.J. Carlozzo, M. DiLorenzo, R. Glover, S. Grossman, C.J. Knaus, J. McCarthy, B. Mysza, R. Patterson, R. Raymond, B. Skerry, P.M. Slifko, W. Stipkovich, J.C. Weaver, M. Wolfe., "Correlation of Accelerated Eposure Testing and Exterior Exposure Sites." JCT Journal of Coatings Technology, vol. 66 ,1994, pp. 49-67.*
- *W.M. Bos, "Prediction of coating durability, Early detection using electrochemical methods.", PhD Thesis TU Delft, The Netherlands, 2008.*
- *G.P. Bierwagen, L.He., J.Li, L. Ellingson, D.E. Tallman. Studies of new accelerated evaluation method for coating corrosion resistance – thermal cyclic testing." Progress in organic Coatings 39 (2000) 67-78.*
- *S. Nyborg Rasmussen, "Corrosion protection with coatings - will pre-qualification testing improveperformance?" SFL congress, Hempel (2006).*
- *O.O. Kundsen, U. Steinsmo, M. Bjordal, S. Nijjer, "Accelerated testing, correlation between four acceleratedtest and five years of offshore field testing." JPCL (2001).*
- *J.E.O. Mayne, "The mechanism of the inhibition of the corrosion of iron and steel by means of paint.", Official digest, 24 p.127-136, (1952).*
- *R.C. Bacon, J.J. Smith, F.M. Rugg, "Electrolytic resistance in evaluating protective merit of coatings on metals.", Industrial and engineering chemistry P 161-167, 1948.*
- *M. Kendig, F. Mansfeld and S. Tsai, "Determination of the long term corrosion behaviour of coated steel with AC impedance measurements.", Corrosion Science 23, 317, 1983.*
- *M. Kendig, J. Scully, "Basic Aspect of electrochemical impedance application for the life prediction of organic coatings on metals.", Corrosion, Nace, January 1990*
- *E.P.M. van Westing, "Determination of coating performance with impedance measurements." PhD Thesis TU Delft, The Netherlands, 1992.*
- *J.N,. Murray, H.P. Hack, "Testing organic architectural coatings in ASTM synthetic seawater immersion condition using EIS.", Corrosion Vol 48 No 8 P 671-685, 1992.*
- *A. Amirudin, D. Thierry, "Application of electrochemical impedance spectroscopy to study the degradation of polymer-coated metals.", Progress in organic coatings 26, 1-28 1995.*
- *J.H.W. de Wit, D.H. van der Weijde, G. Ferrari, Chpt. 19, "Organic coatings of Corrosion mechanisms in Theory and Practice.", second edition, Marcel Dekker 2002.*

Author

Maheshkumar Aradhye
Associate Vice President - R & D
NACE International: CIP & PCS - Instructor
NACE Certified Coating Inspector Level -3 # 15945
NACE Certified Protective Coating Specialist # 21914
SSPC PA- Protective Coating Specialist # 2011-049-332

Life Cycle Analysis of Assets in Chemical Industry

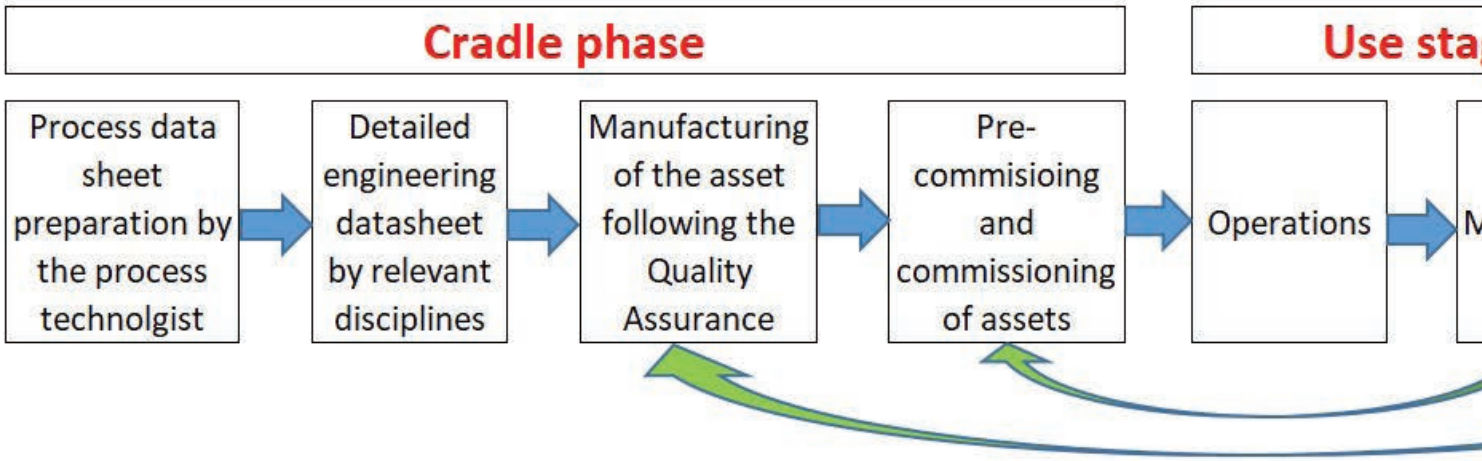
While developing any new chemical process unit, the unit is designed always with an intent that assets will serve and deliver performance with efficiency till the process unit is retired. The end of life of a process unit is usually linked to economics of operation when running the unit becomes unviable. Obsolescence and environmental reasons also do force some process units to permanently shut down.

It has always been an intent and practice to specify a design life for different categories of assets. For e.g a pressure vessel is designed for 30 years and in plant pipelines are designed for about 15 years.

It has been observed that in real life, the experience is different. Generally speaking about 80% of the assets, provides a life more than anticipated with minimum or NIL maintenance. The remaining about 20% of assets demand significant maintenance attention or replacement decisions to sustain the process unit operations during its life cycle.

This concept of life cycle analysis (LCA) is also sometime referred to as "Cradle to Grave". The various stages of assets in a typical chemical plant could be specified as follows.

Actions mentioned as below, when followed, can lead to more number of assets live upto full useful life of process



unit.

In a typical chemical plant, the cradle stage for assets starts when the process datasheet for the assets are conceived on a piece of paper. This stage can be even referred to as the pre-cradle stage. The process technologist involved in the design of the process unit has the primary responsibility of designing assets that are "Inherently safe". Critical assets shall be designed considering all the various operating conditions that can possibly happen during life cycle of the equipment. All the critical recommendations of the "Process hazard Analysis" shall be incorporated as a part of the design. The design shall eliminate catastrophic incidents. The process technologist shall specify the following as accurately as possible so that the assets are designed and manufactured to endure the life of the process unit itself.

a) Chemistry of the operating fluids. The chemical constituents that are present in "Parts per million" level shall also be indicated.

b) Fluid phases

c) Various operating conditions (pressure, temperature and flow) during various stages of operations that includes steady state, turn down operations, startups, planned shutdowns, emergency shutdowns, process trips of critical equipment, power outage, cooling water outage, prolonged shutdown (mothballing) etc.

d) A well-established chemical / metal interaction matrix.

Corrosion is one of the damages that is given significant importance while designing of process units. The material selection of critical assets shall be based on proven experience. The recent practice has been to complete the base line RBI (Risk Based Inspection) study during the cradle phase of the process unit. Even if RBI software is not available, the process plant can be analyzed for the concepts of RBI as per API 580/581. Carrying out RBI helps in identifying the damage mechanisms that is applicable to assets or set of assets for all the specified operating conditions. RBI study also involves the presence of material expert who could provide valuable inputs during material selection for various assets. This will also identify weak link in the plants that would require attention by maintenance and reliability teams after commissioning.

All assets shall be designed,

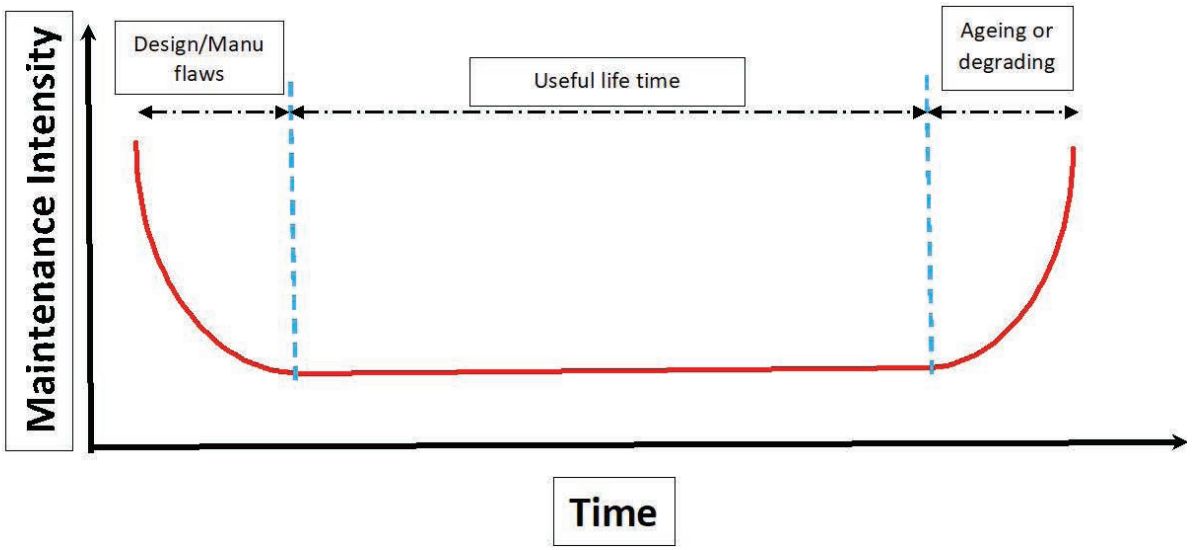
manufactured, constructed and tested in accordance with well-known, latest national and international codes and standards. Local statutory regulations, if any, needs to be adhered to. Adherence to codes and standards primarily insures safety of operations in the long run. It also assures delivery of efficient performance by the assets throughout the life cycle.

Assets shall be manufactured and procured from good reputed vendors and suppliers. Inspection during manufacturing of assets shall be done using a well-established "Quality Assurance Plan". Involvement of third party Inspection agencies as a part of manufacturing cycle of assets will further enhance quality of fabrication and remove surprises.

Assets shall be preserved adequately till they are commissioned. The operating crew shall prepare a testing plan for assets and implement the same as a part of pre-commissioning phase. The assets that need to be tested will include critical items like safety valves, isolation valves, NRV's etc. The testing shall ensure reliable operations on commissioning of the plant.

All the manufacturing records, O & M manuals shall be preserved safely so that they are available for reference when problems are encountered during normal operations of the plant. The above essential steps when adhered to shall ensure safe, efficient, reliable and predictable operations of the process units soon after commissioning. This is very essential to realize the business objectives of building the process unit.

Once the process units are commissioned, it is essential to sustain the safety and reliability of the process units. There has always been a question on how much maintenance is considered as optimum



maintenance because maintenance costs money. Most of the assets do follow the bath tub curve as shown below. There is phase of high intensity maintenance after initial commissioning that addresses the design and construction flaws. Thereafter there will be a long period of low intensity maintenance where the wear and tear is very slow, steady and predictable. Towards the end of the life cycle there will be an increase in the intensity of maintenance once again.

Operating and business managers always demand least outage of assets and least expense for asset maintenance. The learning that has happened over a period of time has been as follows. Planned, timely and condition based maintenance has always resulted in reduction in maintenance costs. Delayed maintenance, reduces reliability and increases maintenance costs over a period of time.

Different categories of assets require different type of monitoring and maintenance. The assets in a process units shall be analyzed and categorized as Vital / Essential / Desirable. The categorization shall be based on safety and production losses. Alternately some of the process unit follow the practice of identifying safety and production critical equipment. The intent of this categorization is to carry out adequate maintenance on each of the asset so that overall availability of process unit for production is high. The maintenance and reliability team shall have a written maintenance strategy document for various category of assets.

The assets shall have one or more of the following asset strategies.

Whereas maintenance strategies do get formulated based on experience, it is imperative to incorporate all the OEM recommendations as per the O & M manuals.

Predictive maintenance – These are activities that are carried out on the assets when the asset is in operations. Vibration monitoring of rotary equipment, Thermography of critical assets, pipeline thickness checks, operating parameters monitoring, Look/Listen/Feel (LLF) inspection, operator rounds etc are typical examples of predictive maintenance activities. With the advancement of IT tools, many of these inspections can be automated and made on line and further analytics can be added. The concept of "EED – Early Event Detection" is fast catching up in chemical plants to have a pre-warning of the failure rather than detection after the failure.

Preventive Maintenance – These are minimal maintenance activities that are carried out on the assets when they are not in operation. Preventive maintenance does not require assets to be dismantled or opened for inspection.

Overhauling maintenance – These are maintenance activities that are carried

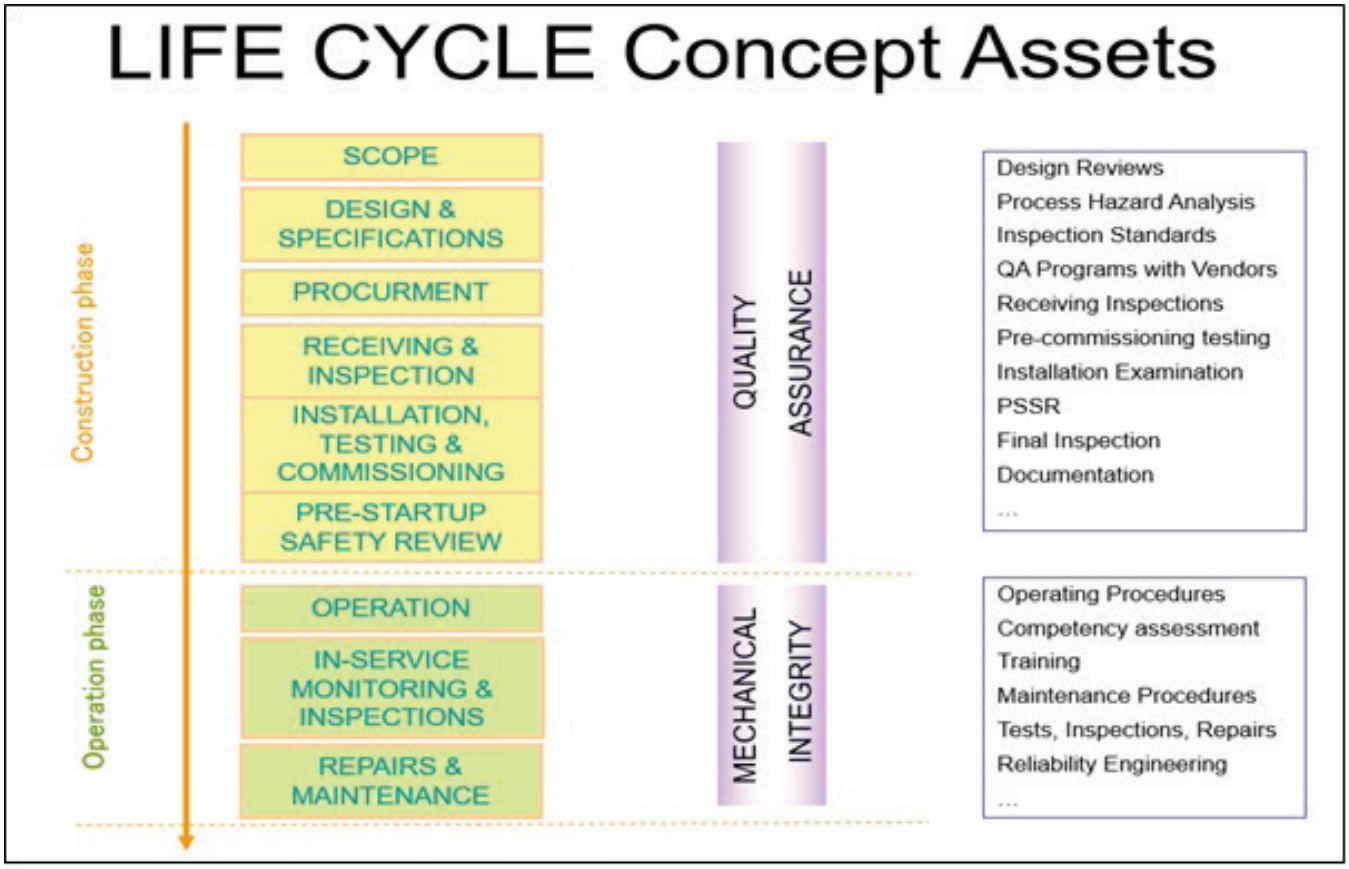
out on critical assets by dismantling, inspecting, cleaning and overhauling them. Maintenance of static equipment during a major shutdown, maintenance of rotary equipment like turbines and compressors, maintenance of transformers etc., will come under the category of overhauling maintenance.

All maintenance and testing shall be carried out based on a written down document and records shall be maintained for future reference. All repairs / refurbishments shall be based on written down procedures and will be in line with the codes, standards and proven good engineering practices.

Failures shall be analyzed to understand the root cause and corrective actions shall be implemented to avoid repetitive maintenance.

Monitoring the assets for process side corrosion is a very critical activity to increase the life of assets. Process plants shall be operated within a specific window referred to as "IOW - Integrity Operating windows". API 584 provides guidance and methodology on developing IOW for chemical process unit. Operating the unit within defined IOW's shall eliminate catastrophic and surprise failures.

Some of the following categories of assets and the damage mechanisms, if not taken care can lead to an increase



in maintenance intensity. These are also sometimes referred to as "pin prick failures". Sometimes failures under this category of assets and damage mechanisms can also lead to significant incidents resulting in safety and production loss incidents. The maintenance and reliability team shall develop a long term strategy for these type of degradation mechanisms and provide adequate care to assets.

- Atmospheric (External) corrosion
- Corrosion under Insulation
- Corrosion under fireproofing
- Corrosion under pipe supports
- Buried assets
- Critical process to utility interfaces and Non-return valves
- Critical Isolation valves
- Small-bore connection subjected to vibrations
- Dead legs (no flow piping and connections)
- Long term metallurgical degradations like fatigue and creep

Preservation of assets that are taken out of service for more than few months has to be done adequately. There has to be a marked-up document readily available with the operating crew indicating the assets that have been mothballed. There has to be a written down procedure and a testing protocol for re-commissioning of mothballed assets.

All changes to the plant shall be done based on a written down document. This is typically referred to as "MOC - Management of Change". The changes shall be engineered wherever required. Experienced personnel in the respective disciplines shall be provided an opportunity to review the changes proposed. OEM support can be considered if changes are considered critical. All changes to Trips and alarms limit or disabling the function of safety-critical assets shall follow the MOC process.

All the above interventions are summarized in the following pictorial.

Conclusion

Assets in a chemical plant can be built to endure the full life cycle of the process unit. At each stage different strategies have to be applied for exploiting the highest efficiency from the asset throughout its life cycle and also ensuring safe operations.

A high level of senior-level management commitment is essential to achieve the objective of assets available for operations till the process units are retired. ■

Author

Anand Umakanthan
Head - Reliability Fixed Equipment & Piping, Reliance Industries

Avoiding Downtime with Proactive Maintenance

According to leading AI-powered predictive maintenance provider, Senseye, large plants lose an average of 323 production hours a year, adding that one hour of downtime can cost up to $532,000. Manufacturers cannot afford extensive periods of downtime, so proactively maintaining equipment is key to continuous production. Here Clive Jones, managing director of global UK-based thermal fluid supplier Global Heat Transfer explores how businesses using thermal fluid can prevent equipment failures with proactive maintenance.

Heat transfer systems and fluids can be challenging to maintain because once introduced to the pipes, fluid is invisible and therefore difficult to visually monitor. As a result, issues with the fluid may go unnoticed until there is a chemical blending failure, temperature inconsistencies, or extensive pipe damage.

Fluid degradation

Chemical reactions occur at high temperatures that thermal fluids must maintain for prolonged periods. Over time, operating for long periods at these temperatures can cause the fluid to degrade, due to oxidation and thermal cracking. These processes produce contaminants, such as carbon, which will start to build up inside the pipes and negatively impact heat transfer efficiency.

Taking accurate measurements

Regular sampling enables businesses to proactively monitor fluid condition. Maintenance engineers can gain accurate representations of the fluid's condition by taking samples at regular intervals from a hot, closed and circulating system. After sending a sample to a thermal fluid expert for analysis, plant managers can use the data to find any changes in fluid, such as


Regular sampling

carbon level, and intervene if adaptations to the maintenance programme are needed.

Incorrect sampling may give inaccurate flash point results, which can have dangerous consequences. Unless the fluid samples are collected when the oil is hot and circulating, the results may reveal artificially high flash point values. Incorrect sampling can lead to the inaccurate conclusion that the fluid is safe and does not require attention, or that systems need to be wrongly shut down.

Businesses may not have the in-house expertise to fix and maintain the heat transfer system, so they can invest in a thermal fluid expert to carry out the relevant tests and service needed to help extend boiler lifespan. Most thermal fluid specialists offer companies a seven-point test to determine the overall condition of the fluid. This test is sufficient, but some companies also offer more extensive analysis with eleven-point tests. These look at the sample in greater detail to ensure the results completely reflect reality.

The curve

Engineers can also use sampling to predict the lifespan of fluid, using data to monitor condition over time and detect trends. For example, as a fluid reaches the end of its lifespan, there is a gradual curve that drops off sharply, referred to by specialists as 'the degradation curve.' This sudden change in the quality of thermal fluids is one of the reasons why regular and preventative maintenance is so important.

At the beginning of this curve, plant managers can dilute the degraded fluid, by topping up the system as a cost-effective and durable option to return to optimal productivity. This is no longer an option when the condition of the fluid has significantly deteriorated. Instead,

General maintenance

plant managers must flush and clean the system, prior to refilling it with fresh heat transfer fluid as a long-term solution.

Automating fluid sampling

Operating a system efficiently and continual monitoring are the best methods for extending thermal fluid maintenance. Embracing digital technologies is one way that businesses can improve proactive maintenance. For example, many industries have benefitted from installing Industry 4.0 technologies that monitor machine performance. Traditionally, engineers have only sampled fluid manually, but the rise of Industry 4.0 technologies could change how engineers carry out thermal fluid management.

Light ends removal

Carbon is not the only cause of fluid degradation, as hydrocarbon chains break under high temperatures light ends are produced, lowering the flash point of the fluid and making it more flammable at lower temperatures. If samples show that light ends are forming rapidly, it indicates that the heat transfer fluid is not venting properly, allowing temperatures to rise. The build-up of light ends can be prevented by using a light ends removal kit (LERK), which removes light ends as they form.

Light ends removal kit

Engineers temporarily install a LERK to eliminate volatile light ends in the fluid. Light ends are collected when the hot thermal fluid flows through the distillation vessel and the gaseous light ends are collected in the liquid phase of the condenser. The light ends are either drained automatically or manually from the system.

Light ends can be managed on a more regular and automated basis by permanently installing a LERK on a new or existing system. Businesses can choose to install LERKs that use gravity to return the oil to the circuit or opt for a new range of active, floor mounted, LERKs that employ a frequency-controlled pump. ■

Author

Clive Jone
Managing Director
Global Heat Transfer

CHEMICAL ENGINEERING WORLD

www.jasubhaimedia.com

Dynamic Platform
to
Connect with Chemical Industry Ecosystem
Direct Reach
to
>200,000 Readers
across
>25 countries

Embed Product Video

Choose the embedded features: insert all embedded features Contact: sales@jasubhai.com

Jasubhai MEDIA

Unlocking the Full Benefits of IoT Technology

Advances in asset health management, driven by breakthroughs in internet of things (IoT) technology, are creating tremendous excitement in the industry. This technology can deliver immediate benefits in industries ranging from water and desalination to thermal power generation, fertilizer, steel and cement, oil and gas, general chemical and petrochemical.

This revolutionary approach to equipment monitoring enables plant reliability engineers, operators and maintenance personnel to predict equipment and system behaviors and proactively prevent unplanned downtime. While many of these technologies have been discussed for years, they've only recently evolved to a level that makes IoT more viable for industrial users. Implemented correctly, they can deliver significant benefits such as:

- **Predict equipment behavior.** Reduce equipment lifecycle expenses by minimizing unscheduled downtime

and lowering maintenance costs, while preventing expensive repairs and maintenance delays.

- **Focus maintenance on assets that need attention.** Optimizing your maintenance efforts means you spend less time evaluating healthy equipment while avoiding unplanned downtime.
- **Detect and address unacceptable operating conditions.** IoT can improve reliability and availability by detecting and addressing unacceptable operating conditions before they evolve into significant issues.
- **Enhance equipment efficiency.** By knowing where all your assets are on their respective operating curve, you can optimize for maximum efficiency.
- **Reduce costs.** Reduce total cost of ownership (TCO) by easily recognizing when to schedule equipment maintenance and lowering spare part inventories.

Increase safety. By identifying exactly where the problem is and what it will take to fix it, IoT helps your team to respond to performance issues quickly, limiting the time they spend in hazardous environments. These benefits and more have been made possible by new synergies among three components of IoT technology: architecture, devices and monitoring.

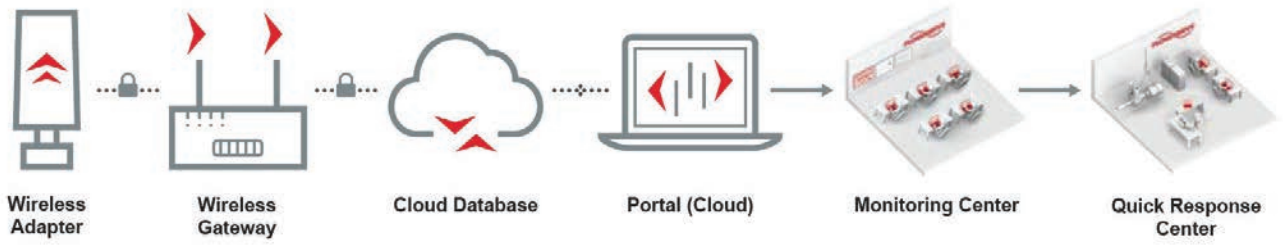
Architecture

An ideal IoT solution consists of five key components:

- **Equipment sensors** that collect data for analysis
- **A communications infrastructure** that transmits data from equipment sensors via a secure, encrypted network
- **Application-specific analysis** technology designed for pumps, valves and seals
- **A reporting platform** which provides insights into equipment performance over time, while sending emails and alerts so immediate action can be taken when an asset experiences a problem
- **A reporting center** staffed with experienced human professionals watching over alarms to provide help

The most basic use of this type of IoT system is condition monitoring, which sends periodic “snapshots” of equipment performance from the sensors to a central hub for analysis. In this way, you can proactively detect changes that could be early indicators of failure and uncover insights to improve your plant’s efficiency, productivity and profitability.

A more sophisticated approach made possible by the latest IoT systems is



predictive analytics, which captures a far more detailed stream of continuous, full-spectrum data that is transmitted close to real-time speed. This enables you to estimate when and why critical assets could fail earlier, and take preventive action before potential problems lead to downtime.

Devices

At the heart of any IoT system are instruments embedded with technology that enables them to connect with the architecture. These devices can capture and transmit a variety of equipment data. This includes, but is not limited to: temperature, pressure, flow, vibration, torque and other conditions.

This data can be transmitted to central gateways that communicate wirelessly with cloud infrastructure. Today's most reliable and user-friendly technologies use open and secure architectures and have seamless interfaces so you can easily scale your device infrastructure as your needs evolve.

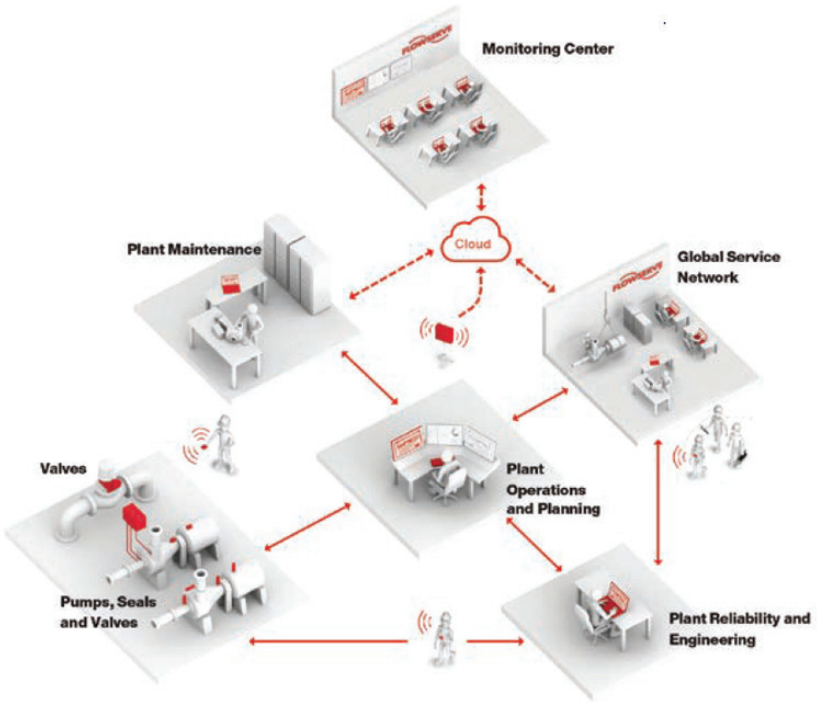
One of the most groundbreaking innovations has been the development of long-range wireless sensors that enable cost- effective monitoring of thousands of assets over sprawling facilities. Combined with gateway receivers capable of managing up to 2,000 wireless devices, data can now be securely transmitted 1.6 km (1 mi) or more, eliminating the limitations of short-range transmission technologies like Bluetooth.

Monitoring

Accurately capturing equipment performance is only one part of the IoT puzzle. Over time, instrumentation devices capture thousands of datasets. Effectively monitoring this information and analyzing it for trends are critical to unlocking IoT's full predictive analytics capabilities.

Data trends and algorithms analyze equipment performance data, detect fault conditions, predict imminent failures, and recommend corrective actions. By reviewing this information, reliability engineers can instantly see when vibration, temperature or other conditions begin to deviate from the norm in a pump, valve or seal. Observing these trends enables your team to assess and repair failures before they happen.

It's important to understand that



algorithms are based on proprietary models, methodologies and industry experience, so the company providing the algorithms has a significant impact on what an operation can achieve by using them.

Ideally, monitoring software should work with existing infrastructure built by any manufacturer and run on any platform, from the plant control room to a maintenance technician's handheld, an engineer's laptop or in a cloud-based portal. It should also be backed by an off-site monitoring center staffed with experienced human monitors who can advise on best responses.

Recent advances in instrumentation and monitoring enable plant operators, reliability managers and maintenance teams to maximize their time by focusing on critical assets that need the most attention.

From reactive to predictive

Years ago, IoT seemed like a dream, given the high cost of incorporating wired instrumentation systems into existing infrastructures. The labor — which included breaking up concrete, burying wires, and filling it all back in — was cost-prohibitive. Add in the high cost of instrumenting and underwhelming, reactive analytics capabilities and you can

understand why IoT wasn't a viable option for most operations.

Today's advanced IoT architectures, devices and monitoring solutions can be implemented in weeks rather than months at a fraction of the cost, making IoT a reliable way to avoid

equipment failures, downtime and costly repairs while increasing predictability and productivity. ■

Author

Chris Riché
Product manager
Flowserve Corporation

R.N.I. No. 11403/1966 Date of Publication: 29th of every month

CHEMICAL ENGINEERING WORLD

www.jasubhaimedia.com

Dynamic Platform
to
Connect with Chemical Industry Ecosystem
Direct Reach
to
>200,000 Readers
across
>25 countries

Embed Product Video

Choose the embedded features: insert all embedded features Contact: sales@jasubhai.com

Jasubhai MEDIA