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INDEX

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Letters to the editor are always welcome. We invite your suggestions, comments and views on the Newsletter as well as articles for publications. To publish your article, submit it to rishikesh@naceindia.org

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- Sea/river water intake/Outfall system including concrete structures
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Editorial

Dear Colleagues, dear Readers

It is my pleasure to introduce the first newsletter of the Year 2021. I hope this message finds you well and sound. Last year has been a challenge for all. However, it has been an outstanding learning experience for all of us, both personally and professionally. But as a society, we are more resilient and have virtually carried out our professional duties diligently. Last year NIGIS celebrated "International Corrosion Awareness Day (ICAD)" on May 01, 2020, on a virtual platform, which was well attended by students, academicians, industry professionals, dignitaries from the government the industry, and CEO, NACE International. We also virtually celebrated NIGIS foundation day on July 18, 2020, with enthusiasm. Professional activities continued by organizing online training courses and technical talks. The latter was arranged as part of the new Technical Talk series initiated by the Chairman. Technical Talks will be conducted once a month to benefit the students, members, and corrosion fraternity.

Thank you all for making it a successful year through pandemics. We'll continue our journey into the new year with more zeal and determination. I hope you'll enjoy reading the articles presented on this issue.

Dr. S. Parida
Editor - Corrosion Combat

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Anti-bacterial hybrid nanostructured coatings: a sustainability perspective

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Abstract

In this newsworthy article, we attempt to capture some of the sustainable hybrid nanocomposite coatings for the anti-microorganism application on structural metals. Shipping industries are familiar with anti-fouling coating because of the urgent imperative of replacing tributylt in self-polishing copolymer paints (TBT-SPC paints), biocidal copper oxide pigment, and arsenic/mercury/lead based anti-fouling coating which is extremely harmful to aquatic life. On the macroscopic view, we use coatings to prevent and control microbial corrosion in one hand and on the other hand we damage environment by using harmful ingredients for manufacturing functional smart coatings (e.g., anti-bacterial, microbial induced corrosion (MIC), several anti-corrosive conversion coatings etc.,) therefore we are in a dilemma of standing between a collapsing past by controlling /preventing corrosion and an uncertain future by causing problem to environment.The responsibility of a surface corrosion scientist and technologist to design of new concept coating should address the environmental concerns, materials criticality considerations, the need for maintaining structural integrity and function under extreme environments, and a changed incentive towards smart surface. We discuss various modes of anti-bactericidal and anti-sporicidal activity and the drive towards multi component nanostructured coatings that synergistically unite multiple modes of bacteria, fungus inhibition within a single coating system. Nanocomposite coatings where different nanoparticles of one phase are dispersed within a continuous phase, usually a polymeric matrix, provide an integrated design approach to multifunctional coatings. The fundamental challenges such as dispersion, compatibility, film forming and surface texture can be undertaken by focusing on their surface-to-volume ratios, the concentration of nanoparticles and morphology. Particle morphology reatly alters the adjacent polymeric matrix, giving rise to an 'interphase' region with modified properties, at relatively low filler loadings. The effect of implications of incorporating hazardous element free metallic compounds(tin, cadmium, lead, chromium etc.,), porous metal oxides, and carbon nanomaterials (graphene oxides and carbon nanotubes) within polymeric matrices have been explored with an emphasis on anti-bacterial growth. The availability of effective biocidal nanoparticles that are either electro active (e.g., ZnO_2, TiO_2, MgO, graphene oxides, and carbon nanotubes) or are capable of serving as reservoirs for active biocidal ingredients (e.g., porous silicon oxide, layered double hydroxides, halloysite, soluble / insoluble microsphere) or organometallic complexes (e.g.,copper pyrithione, benzmethylamide, zinc acrylates, copper acrylates) provides unprecedented functionality and opportunities for multifunctional coatings.

This article highlights different types of anti-bacterial coatings with mechanistic considerations where these have been elucidated with a view towards developing systematic coating design principles for future anti-bacterial, anti-fungal, and anti-virus coating. The properties of anti-bacterial coatings not only depend on the biocidal agents used in the coating formulation but also depend on the tenacity of the attachments through modification of surface free energy. The outlook for the future design of multimodal coatings is presented with an emphasis on the emergence of rational design of nanoparticles, nanoparticle surface chemistry, high-throughput testing, materials informatics, and integrated materials engineering approaches.

Microbial growth: a brief on the growth mechanism and modes of prevention

There are various epidemic diseases such as H1N1, avian influenza, SARS, MERS[1, 2], and other unexpected multiplication of germs or other bacteria which pose serious health issues. The sudden spreading of these epidemic diseases caused awareness around the world [3]. There is great deal of antibacterial products in various applications such as antibacterial coatings [3-5], antibacterial textiles[6, 7],antibacterial plastics[8], antibacterial

steels[9], antibacterial glasses[10, 11], antibacterial ceramics[12], antibacterial cement[13] and so forth. This has been a great threat to mankind for several thousand years ever since the beginning of human creation. Indeed, the very definitions of wealth and prosperity that have underpinned much of human civilization can be thought to have evolved from the possession of objects resistant to microbe's attack: the noble metals, lead and silver and other metals such as copper (Cu), arsenic (As), mercury (Hg) and being valued for the very properties that base metals cannot be used for fabricating structures. In modern times, where structural metals are called upon to deliver increasing levels of performance in complex situations like medical equipment, kitchen floorings, hand rails, toilets sections, storage and packing cans for food stuffs etc., the stakes for preventing bacteria growth on their surfaces are higher than ever, encompassing the protection of human life.

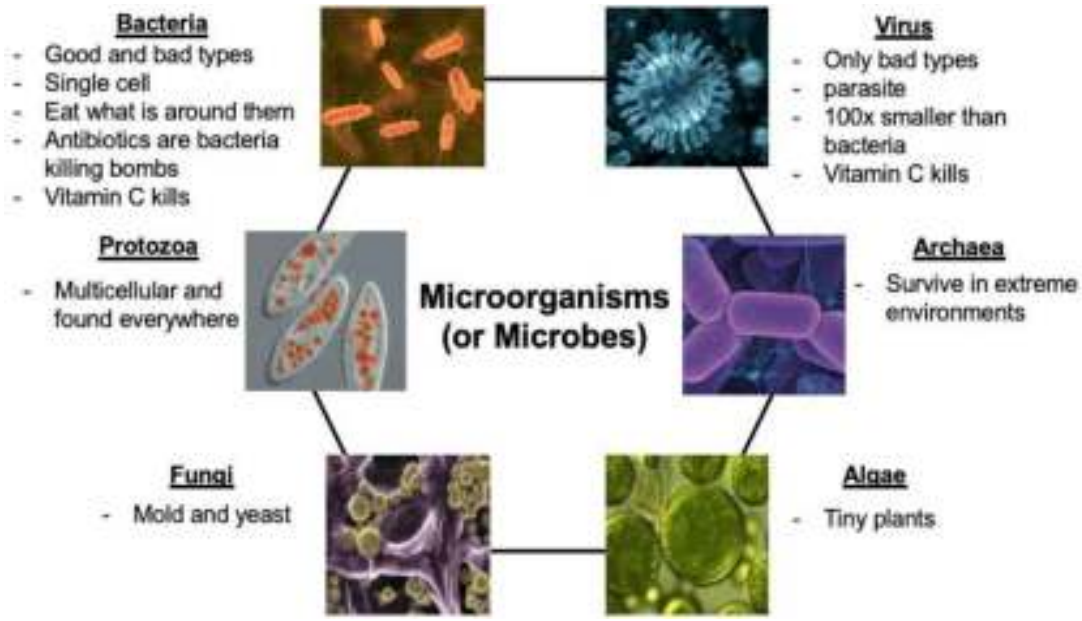

Fig. 1 Different types of microorganisms with their properties[14-19].

Monetary costs associated with the inhibition and control of bacterial growth are staggeringly high and represent a colossal drain on worldwide resources. The settling life of bacteria on steel and textiles are so high that this may further contaminate human being and goes ultimately to the body. It is therefore needed an antimicrobial coating on those surfaces to prevent cell growth. The important point required to be stressed upon is that the antimicrobial coating should not release harmful ions to kill bacterial as this is a common coating system which has been practiced since long time. The fundamentals of microbe attacks are taught in introductory microbiology and health science courses across the world and will only be briefly outlined here. No matter how revolutionary in concept, coating design approaches, both new and truly ancient, are derived from seeking to slow or completely inhibit the fundamental electrochemical processes underlying microbes attack. Given the wide use of different steels and plastics (composites) as primary structural components, the basal surface is the source of carbon and iron as nutrients for facilitating anabolism process. There are different types of microbes as shown in the Fig. 1. These microbes are not seen in the naked eyes as the size of their cells are in micron scales as presented in Fig. 2. One colony of bacteria is approximately having more than 1000 bacteria. This can be quantified in terms of colony forming units (CFU). The growth process is shown in Fig. 3.

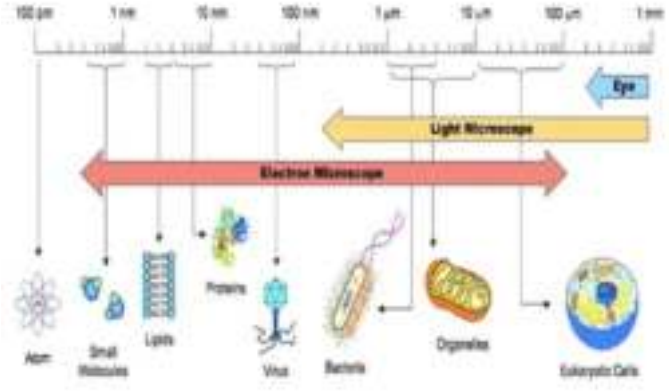

Fig. 2 Size of different microorganisms (microbes).

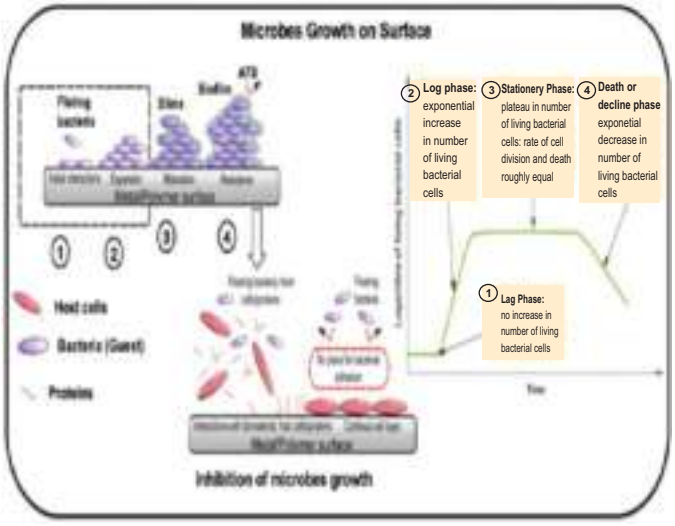

Fig. 3 Growth process of the microbes on the surface

The time scale vs logarithmic growth of bacteria cells is indicating that the curve is following four different stages starting from no growth to exponential growth and then becoming saturation and followed by weakening due to cell death. Here, we have reviewed different modes of the biocidal mechanisms to suppress or control the cell growth. In general, coatings designed to retard microbes cell growth on the surface of metals or polymers by one (or more) of the following mechanisms: (1)controlled biocides releasing (leaching); (2) passive surface (non-stick surface); (3) bio-imitating biocidal active surface (contact killing),(4) electrolytic and electrochemical inhibition and (5) smart coatings (piezoelectric, magnetic, photo active). These concepts are schematically illustrated in Fig.4.Biocides releasing process is achieved by coating with a bioactive metal that metabolize the shell and serves as a bio-organism inhibitor. For many years, arsenic, lead, silver, zinc, tin, and magnesium have been the basis for composite paints that provide bio-inhibition to bacteria growth. Release based antibacterial coatings is limited due to the limited reservoirs of antibacterial agents and often beneficial to environments. The electrochemical and electrolytic process helps to disrupt the bacteria cell growth by direct electron transfer between an electrode and the microbial shells, causing the electro chemical oxidation to generate reactive oxygen species (ROS) to disrupt the intracellular substance. Electrolytic inhibition impedes the growth process is also by blocking the transport of ions between the proteinic molecules (host) and the guest (nourishment) using a low-ionic-conductivity matrix and transmission barriers. Such coatings attempt to fundamentally limit the bacteria stick onto the metal. Oleophobic passive surface does not attract the protein mass to physically adsorbed on the surface to further grow by a surface mediated interaction. This concept was explained by Gucinski and Baier in 1968 based on critical surface tension theory where they found bio-adhesiveness is very minimum at a critical surface tension of 20–30 dynes/cm and match with the surface tension of skin of Whale. The micro rippled surface along with the critical surface energy provide a non-sticking surface for protein binding of bio-adhesives.The coating with both polar and non-polar groups may provide opposite wettability on the same surface due to chemical heterogeneity and should have long term biocidal reduction efficiency. Biocidal active surface where the most effective compounds for these coatings are either enzymes or cationic compounds (e.g. chitosan) are incorporated into the coating matrixes. These enzymes get activated and capable of creating such a complex surface where proteinic shell of bacteria may not be able to stick on the surface.

MODE OF MICROBES INHIBITION

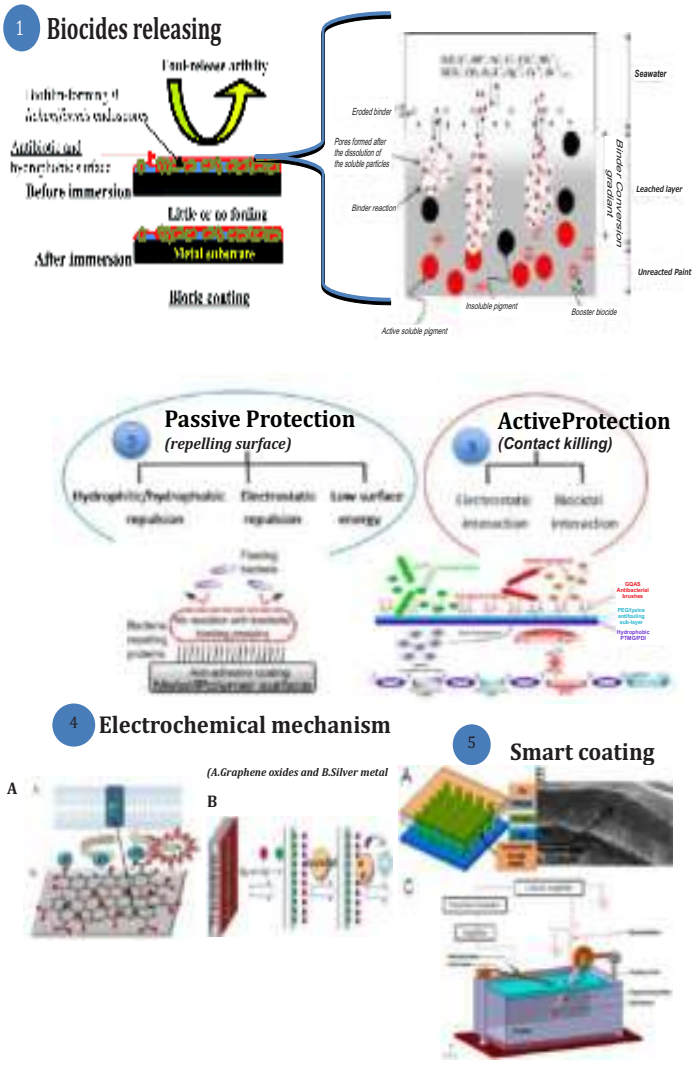

Fig. 4 Mode of microbe's prevention mechanisms

There are no published reports of any potential technologies developed directly from this idea. The smart coating is thought to be supported the idea of shell detachments of bacteria by several types of stimuli and responses. Piezoelectric coating is used for electricity generation in response to stress, as soon as the bacteria adsorb on the surface, the charge gets generated and transferred to the proteinic molecules to disrupt the shell by rapid redox chemical process. This phenomenon is also happened in magnetic and photo electro-active coatings. Nanozinc oxide, aluminium nitride in vinylidene fluoride co-polymer matrix may provide the piezoelectric response. Similarly, Ag-doped TiO_2 has great potential for anti-microbial response, and where TiO_2 is known for its photo oxidation property. This photo oxidation ability along with bioactive materials may enhance the biocidal effect at a great intensity.

Driving forces for change and some critical considerations for the design of anti-bacterial coatings

The bacteria and virus are remained a threat for human race forever. We can invest in research, engineering and awareness program to win over maladies by control and prevention. The series of viruses in the past such as plague, Ebola, Zika, Swine Flu, H1N1, SARS-CoV or SARS-CoV-1 and the recent virus corona (COVID 19) has globally proliferated and halted drive due to its formidable outbreak via water droplets and physical contact to homicide human being. Around 217 counties are under pandemic from 2019 year and countries economic has come to a sneaking pace. Eminent scientists, doctors, engineers and strategist are struggling to find appropriate medicine and efforts must turn to future preventative measures. In addition to health care, effort must to address nanocoating's to combat bacteria and viruses though a preventive mechanism as explained in Fig.4. There are many effective technologies are available against bacteria, mold and viruses and this techno-commercial market is growing in the market. There are many nano coating companies and their brand products are available in surface coatings area. The global anti-microbial coatings market is expected to perceive significant growth within the forecast period till 2026. Global anti-microbial coatings market is expected to reach USD 5.30 Billion by 2022, growing at a CAGR of 11.7% between 2017 and 2022 as shown in Fig.5.

Fig.5 Anti-bacterial coating market growth

Nanoparticles of different materials such as metal nanoparticles, carbon nanotubes, metal oxide nanoparticles, and graphene-based materials have demonstrated enhanced anti-microbial and anti-viral activity. The use of inorganic nanomaterials when compared with organic anti-microbial agents is also desirable due to their stability, robustness, and long shelf life. At high temperatures/pressures organic antimicrobial materials are found to be less stable compared to inorganic antimicrobial agents. The various antimicrobial mechanisms of nanomaterials are mostly attributed to their high specific surface area-to-volume ratios, and their distinctive physico-chemical properties. As we discussed above, silver has antibacterial properties. There are other materials which don't possess any antibacterial properties. However, materials modified/functionalized with silver (Ag) nanoparticles show antibacterial properties and extended up to certain areas to protect i.e., called bacterial protection zone for example Graphene oxide with Ag, Graphene oxide with sand and graphene oxide with Mxyenes etc.,as shown in Table1. The time to kill the bacteria and their colonies is also presented in Table2. Silver ions, silver-doped and silver-based biomaterials have been developed extensively due to the advantages of harmless and broad-spectrum of antibacterial activity, as well as the poorer bacterial resistance than organic antibiotics[20]. Wei Dong et. al. has investigated the antibacterial property of micro-porous Titanium with Silver doped nanoparticles Fig. 4. They found that the zita potential of the samples (Ag on Ti) play an important role to kill bacteria. This potential change in contact with the bacterial solution where silver ionizes to form silver ions (Ag^+) and leaving electron on the surface thereby the sample surface becomes negatively charged.

Table 1 Effect of the nanoparticles on E.coli BL21 inhibition, using plate assay method.

Nanoparticles used	Inhibition zone diameter, mm
Graphite Oxide	8 .00
Silver Nanoparticle	16 .00
GO (1g)-Ag (0.1mol/L)	10 .00
GO (1g)-Ag (1 mol/L)	15 .00
GO (1g)-Ag (1.5mol/L)	17 .00
GO (0.35 wt%)Sand	14 .00

The concentration of silver ions is more near the surface of Ti-substrate and diffuses in solution away from the Ti-substrate. The negatively charged surface attracts the positively charged silver ions in order to make the interfacial potential neutral, hence behave as an electrical capacitor. When the bacteria comes in contact with substrate, the specific adsorbed body might disrupt the capacitance by taking part in the charge transfer reaction therefore the food required for the bacterial growth gets decomposed[21]. Wei He et. al. have designed a novel coating by incorporating both antibacterial and antifouling properties in one system based on gemini quaternary ammonium salt waterborne polyurethanes (GWPU) and their blends. The high interfacial energy of gemini quaternary ammonium salt (GQAS) accumulates the chain segments containing GQAS at polymer/air interface to form an antibacterial upper-layer spontaneously during the film formation. In the meantime, the soft segments composed of polyethylene glycol (PEG) formed the antifouling sub-layer. This coating provides a long-lasting antifouling and contact-active antibacterial properties, with a more than 99.99% killing efficiency against both gram-positive and gram-negative bacteria attached to them. The mechanism of bacteria contact killing was seen from the morphological changes (using SEM) of the bacteria attaching to the film after 2 days(Fig. 6b, f). There was death of E. coli cell membranes which directly attached to the film. However, some E. Coli still retain their regular shape which adhere to other cells rather than directly to the film(Fig. 6b-1). Similar observations are made on S. aureus cells killed on the surface of a GWPU20/GWPU0-01 film(Fig. 6e). Both gram-positive and gram-negative bacterial cells contain a net negative charged outer envelope. So, the cationic gemini ammonium salts can interact with the negative charged cell wall of gram-positive bacteria or the outer membrane of gram-negative bacteria or the cytoplasmic membrane of the both bacteria.

Table 2 Total viable count as affected by the time exposure to different nanoparticles under shake flask technique.

Nanoparticles	Contact time (Hours)	CFU/ml×10^4
Graphite Oxide	0.0	68.0
	1.0	29.0
	3.0	0.0
	24.0	0.0
Sand	0.0	96.0
	1.0	52.0
	3.0	24.0
	24.0	13.0
GO-Coated Sand	0.0	56.0
	1.0	36.0
	3.0	0.0
	24.0	0.0
Silver	0.0	15.0
	1.0	4.0
	3.0	0.0
	24.0	0.0
GO-Ag (0.1 mol/L)	0.0	21.0
	1.0	0.0
	3.0	0.0
	24.0	0.0
GO-Ag (1mol/L)	0.0	0.0
	1.0	0.0
	3.0	0.0
	24.0	0.0
GO-Ag (1.5mol/L)	0.0	0.0
	1.0	0.0
	3.0	0.0
	24.0	0.0

Moreover, the positively charged quaternary ammonium salts on the polyurethane film surfaces first interact with the negatively charged phospholipid head groups of the bacteria cytoplasmic membrane, causing general perturbation of the lipid bilayer. The long hydrophobic alkyl chains then pierce the membranes of these surface - attached bacteria, forming holes that cause cytoplasm leakage, lysis, and death [22]. As we explained earlier about the effectiveness of silver against bacteria, we want to give bit more information about the engineering addition of silver into various system for the propose where silver, silver-based and silver doped compounds are highly antimicrobial by virtue of their germ killing properties to several kinds of bacterium, including Escherichia coli and Staphylococcus aureus. Silver based antimicrobial agents receive much attention, because of the low toxicity of the active Ag ion to human cells as well as it being a long-lasting biocide with high thermal stability and low volatility. As the size of the silver particles decreases down to the nanoscale regime, their antibacterial efficacy increases because of their larger total surface area per unit volume. Silver doped system is also provide similar effect like silver based system but, the benefit over silver based system is that the consumption of silver metal is very minimal as its particle size is in nanometer. Another example, in-situ organo metallic system like ttributyltin self-polishing copolymer paints (TBT-SPC paints) where graphene doped TBT-SPC has shown excellent results in killing bacteria due to the interaction of graphene with cells of bacteria. The orientation of the graphene sheets immobilized at the interface has a clear influence on the bactericidal action. Single layer graphene and graphene oxide have a thickness of about 0.3 nm, or atomic thickness, and hence have been speculated to be able to rupture the cell membrane. This was shown with both Gram-positive and Gram-negative bacteria which suggest the ultra structure of prokaryotic cell walls is not a factor in the observed bactericidal activity. Silver, Graphene oxide doped silver, graphene oxide coated sand has also shown excellent results in inhibiting bacterial growth. However, the ion releasing mechanism has been always a threat to the environment and mankind. The way forward for the bacteria inhibition mechanism shall be based on electrochemical mechanism and development of smart coatings.

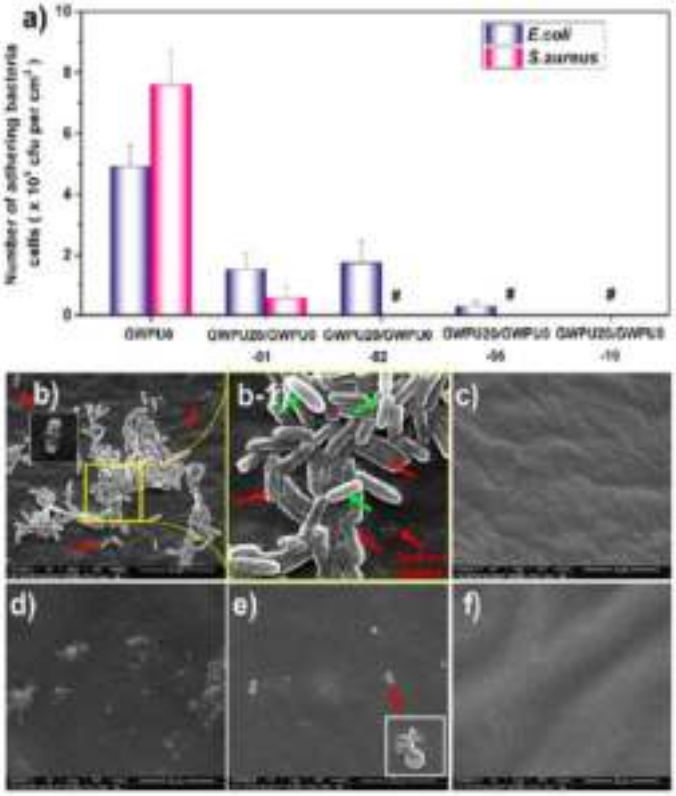

Fig. 6 Antibacterial and antifouling performances of GWPU blends films. (a) Amounts of living bacteria cells attached on GWPU blend films. # no living bacteria cells were observed. Morphology of E. coli (b,c) and S. aureus (d–f) attached to GWPU blend films. (b) GWPU20/GWPU0-05, (b-1) The magnified image of (b), (c) GWPU20/GWPU0-10. (d) GWPU0, (e) GWPU20/GWPU0-01, (f) GWPU20/GWPU0-05. Red arrows indicate distortions and wrinkles in the membrane of dead bacteria after contact with the film; green arrows indicate living bacteria. Scale bars in b-f represent 10 μm. [Reproduced with the permission from Scientific reports][21]

Conclusions and outlook: just scratching the surface?

Given impending concerns regarding the criticality of use of toxic biocides or biocidal base metals and materials, smart coatings are increasingly being engineered as substitutes for various anti-bacterial applications via different stimuli and responses in combination with mesoscale surface texturing. Decades of research on development of advanced bi-functional composite coatings has created a platform for inhibiting the microbe growth. The ecofriendly responses such as the mechanical stress to generate electric charge on surface, the electro-magnetic active and the photoactive surface are effective to prevent bacterial growth.However, their ability to

withstand prolonged exposure to corrosive environments remains a challenge. Protecting mankind against the harsh, even hostile, conditions of contamination and exponential microbes growth is rather difficult unless we have a right technology conducive to the environment. The drive towards replacement of toxic compounds and minimization of leaching are key considerations. The preceding sections have provided an illustrative description of the opportunities for microbial inhibition with hybrid nanostructured coatings. The multiple modes of inhibition are as follows: active, passive and electrolytic inhibition, can be engineered in amodular fashion within these coatings via the choice of the included nanoparticle and the host polymeric matrix as well as the interface between the two components. The inclusion of bactericide metallic and non-metallic nanoparticles with various shapes, aspect ratios and inherent porosity shall bedis charging their functions in various ways to disrupt the interaction between host and guest. The vast multi-dimensional parameter space that remains to be explored for better integration between multi-scalemodeling, high-throughput formulation and testing. In-situ and operando studies of anti-bacterial processes, rapid deployment of advances in nanoscience and polymer processing, and integrated computational materials science and engineering approaches have been very successful in predictively enabling smart coating development but are far more challenging to apply to hybrid systems where electrolyte ion transport, nanostructured forms, and stimuli-responsivematerials that sense the changes in pH, temperature, and incident radiation. It is our hope that this article will further allow for bridging the gap between academic research and industrial deployment that has been a particular challenge in this discipline.

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A Report - International Corrosion Awareness Day (ICAD) Celebrations

NACE International Gateway India Section (NIGIS), Mumbai has been celebrating "International Corrosion Awareness Day (ICAD)" every year since 2012 at multiple locations like Mumbai, Chennai, and Delhi. The main objective of ICAD is to highlight the damage caused by corrosion to the environment and its impact on the public, which is similar to NACE's mission "to equip society to protect people, assets, and the environment from the adverse effects of corrosion".

Due to the spread of Corona virus and then Covid-19 disease consequence lockdown is prevailing all over the world including in India, and considering this aspect, NIGIS announced this year ICAD Celebrations on May 01, 2020 from 17.00 to 18.30 hrs via CII Webex online platform for the first time in the history of NACE India section. The entire corrosion community of India including NACE members were specially invited free to join online for this event. Invitation was also extended to all stakeholders affected by Corrosion damage, including supporters, associates, and all industry professionals.

The event started at 5 pm on 1st May 2020 with Welcome Remarks by Vice Chair of NIGIS, Shri Dipen Jhaveri. Followed by this, Dr. U. Kamachi Mudali, Chair, NIGIS spoke about NACE and ICAD. In his address he briefed about NACE International, its mission and objectives, and myriad of activities being carried out worldwide. He has brought about the significance of ICAD and the objectives in celebrating the day. He has also highlighted the present scenario of lock down in India and asked everyone to look into various possibilities of corrosion Engineering and Management.

Followed by this, individual Video messages of the Patrons and dignitaries giving immense support and best wishes to NIGIS on this occasion was shown. They include: Mr. Binoy Kumar, Secretary, Ministry of Steel, Government of India; Mr. T.V. Narendran, CEO & MD of Tata Steel Limited; Mr. B. Narayan, Group President, Reliance Industries Limited; Mr. Bob Chalker, CEO, NACE International, USA; and, Mr. Tushar Jhaveri, Past President, NACE International, USA.

It is a matter of pleasure and pertinent to state that Confederation of Indian Industry (CII) and NIGIS have entered into a collaboration and agreement to start online courses relevant to corrosion management in Indian industries. This venture of NIGIS is the outcome of the lockdown we are facing in the country and to carry out diversity in the business. Dr Kamachi Chairman, NIGIS and Mr.Pikender Pal Singh, Executive Director, CII & Head, CII-Centre of Excellence for Competitiveness for SMEs, inaugurated jointly and announced it from online floor. To begin with two online courses, "Pipeline Corrosion Management" during May 13-15, 2020 and"Fundamentals of Coatings and Linings" during May 23-25, are offered by CII & NIGIS.

The details of the courses including the scope was briefed to the participants.

The online event had a take away for the 173 participants who attended the programme. Dr. U. Kamachi Mudali, Chairman, NIGIS delivered a Special Lecture on "Impact of Lockdown on Corrosion Issues: Practical Approach" which was apt for the present situation in the country, and was lucidly presented by him. The lecture was very informative and relevant in the present state of lockdown for various corrosion issues that would crop up due to sudden unscheduled shut down of plants/ industries and the challenges to restart them as soon as the lockdown is lifted.

The event went off very successfully with online presence of 173 members from all over India. The vote of thanks was presented by Mr. P. K. Taneja, Executive Director, NIGIS who expressed his sincere gratitude to Chairman, Trustee, all the Board members, the EC members for their unlimited support. Support of all participants, NIGIS & Student Chapter members was acknowledged, and the entire CII team who provided the online facilities and the NIGIS staff were appreciated for their team work in making the event a grand success.

The event ended with an assurance for the continued support, guidance and encouragement of all our supporters, industries, associates, Patrons, and from NIGIS Chairman, entire board and all stake holders in our quest to share knowledge and expertise leading to the defined goal of NACE International "to equip society to protect people, assets, and the environment from the adverse effects of corrosion".

A Report – NIGIS FOUNDATION DAY 2020

NACE International Gateway India Section (NIGIS), Mumbai has been celebrating its "Foundation Day" every year at Mumbai. Foundation Day is an important milestone for each organization, where we show our gratitude for the wisdom, courage and commitment demonstrated by those who contributed to the establishment and operations of the Section.

Due to the current pandemic of Covid 19 and the consequent lockdown prevailing all over the world including in India, NIGIS announced this year Foundation day Celebrations on July 18, 2020 (Saturday) from 17.30 to 18.30 hrs via its own Virtual Media for the first time in the history of NACE India section. The entire Corrosion Community of India were specially invited through email invitation and to join this event online.

NACE International Gateway India Section (NIGIS) celebrated FOUNDATION DAY on 18th July 2020 on Virtual Media by inviting all NACE Members, EC Members , Mr. Bob Chalker, CEO and Mr. Tim Bieri , President of NACE USA as guest of Honors and Mr. R Ramachandran, Director(Refineries) BPCL as Chief Guest of the function.

The function started traditionally by Invoking the blessings of Deity by e-lighting the Lamps on a virtual platform.

Mr. Dipen Jhaveri, Vice Chairman [2019-20] NIGIS welcomed all Invitees and in particular Mr. Bob Chalker, CEO, NACE International, Mr. Tim Bieri, President NACE International, Mr. R Ramachandran, Director (Refineries) BPCL with a bouquet of flowers.

Mr. Sumeet Kataria, Secretary welcomed and recognized the past Trustees by giving bouquet to all former Trustees Hall Of Fame namely Mr. V G Kulkarni [1992-95], Mr. O P Degan [1995-98], Mr. S L Kataria, [1998-2000], Late Mr. P F Anto,[2000-2003], Mr. Rajan Bahri , [2003-2012], Late Mr. R P Nagar , [2012-2015], Mr. Anand Kulkarni, [2016-2019] and Mr. Tushar Jhaveri Past President [2013-2014].

He read out the Annual report on Performance and achievements made by the section in the 2019. Briefly, also updated the members about the CORCON conference, NIGIS Awards, Training program and the commitment of NIGIS to enhance the quality and range of its services through activities in the field of Corrosion Awareness.

Mr. Kataria specially narrated Achievements of Indian Members Viz Mr. N. Manohar Rao being the Vice Chairman 2020-21 and Ms Khushboo Sharma Secretary/ Treasurer 2020-2021 on the East Asia Pacific Area (EAPA) and Mr N. Manohar Rao, Trustee being a recipient of the Distinguished Service Award from NACE International.

Dr. U Kamachi Mudali-Chairman, then briefed the members about the future activities of NIGIS and the online training programs, Technical talks and webinar planned on two fronts from May 2020. One with NIGIS own dedicated Virtual Platform and second by collaborating with CII-NIGIS joint Virtual Platform. He also stated that online courses have invited a very good response and already conducted 3 Training programs and 2 Technical Talks so far and many more are lined up in next 6 months.

Dr Kamachi Mudali also informed about list of the NACE USA approved training courses planned from October 2020 onwards till Dec 2020. 6 No's of specialized programs are on cards.

It was, further, informed that CORCON-2020 which is scheduled in September 2020 at Chennai has been cancelled due to the Covid-19 due to the Pandemic affecting one and all activities. Dr. Kamachi also announced that proposed CORCON 2021 will be scheduled suitably next in 2021 in Chennai. And requested all to participate and share their knowledge & expertise in the conference.

Secretary NIGIS introduced Guest of Honour, Mr. Bob Chalker, CEO, NACE International, Mr. Tim Bieri, President, NACE International and Chief Guest Mr. R Ramachandran, Director (Refineries) BPCL and invited them for their address.

Mr. Bob Chalker in his address appreciated the leadership of Mr. Rao and Dr. Kamachi and said that the activities of NIGIS and the initiatives of adoption of online platform for continuation of the Training courses and a very good step in this Pandemic situation. He complimented and wished all the success to NIGIS and all support from NACE USA. Mr. Bob was also felicitated and honored by presenting an e-Trophy as token of appreciation.

Mr. Tim Bieri , President, NACE International also expressed his happiness to be a Guest of Honor on this day and appreciated the activities of NIGIS specially with constraints of Pandemic, severe effect on Economic activities and Lockdowns imposed for the months together all world over including in India.

He also assured his all-out support. He further briefed about the merger of NACE with SSPC and the outcome of the discussions with the two organizations. Mr. Tim was felicitated and honored by presenting an e-Trophy as token of Appreciation.

The Chief Guest of the Function Mr. R Ramachandran, Director (Refineries) BPCL in his address stated his gratitude for having been invited and appreciated the role of NIGIS in educating the Indian Industry and to fight / combat the Corrosion issues by conducting various training programs, NACE USA certification programs and adoption of NACE standards and imbibing the awareness in the younger generation. He also complimented the leadership of NIGIS including very Professional SGB and the Staff members executing the NIGIS Mission towards their fight for Corrosion.

Mr. Ramachandran was felicitated and honored by presenting an e- Trophy as token of Appreciation.

Mr. N. Manohar Rao, Trustee introduced the House to the NIGIS Section Governing Board Members for 2020-21 consisting of Self as Trustee, Dr. U Kamachi Mudali, Chairman NIGIS, Heramb Trifley, Vice Chairman, Mr. Sumeet Kataria, Secretary and Mr. Denzil D Costa , Treasurer.

He also introduced a Galaxy of highly Experienced and Professional Personalities as NIGIS Executive Committee Members- Dr. Anil Bhardwaj, Dr. V S Raja, Amrit Rekhi, K B Singh, Dr. Buddhadeb Duari, Ashish Khera, Dr. Deepashi Nage, Mahesh Aradhye, Dr. Rani P. George, Sandeep Vyas, Dr. C. Kannan, Dr. D. Parvatalu, Dr. N. Rajendran, Dr. S Parida, Dr. SupratikRoy Chowdhary, Dr. Prabhakar Rao, Mr. Niraj Kumar, Dr. C V Manian, Ajay Popat, Dr. Radha Krishna Pillai, Lt. Col. Atul Joshi, Dr. R Venkatesan, and Mr. S Ravichandran..

He went on to introduce the NIGIS Office Team lead by P K Taneja, Former Executive Director ONGC, Manoj Mishra, Manager, Rishikesh Mishra, Manager Technical, Kusuma Poojary Accounts, Anita D Souza, Executive Assistance, Ankita Rane, Admin Assistant and Altaf Bhojani , Finance Assistant who are a Strength of NIGIS for executing various activities.

He further thanked Mr. Dipen Jhaveri, Vice President 2019-20 for his outstanding Services to NIGIS for a period from 2012-20 and felicitated by an e-bouquet and e-trophy as token of appreciation.

The Foundation day was attended by 106 participants. The Function ended with Vote of thanks by Mr. Denzil D'Costa Treasurer, thanking all Invitees, Members, EC Members , SGB , Office Team and in particular Guest of Honor Mr. Bob Chalker, Mr. Tim Bieri of NACE International and Chief Guest Mr. R Ramachandran, Director [Refineries], BPCL He finally requested for support from all dignitaries to help further step up the operations to take NIGIS to greater heights in terms of closely understanding and working with the Industry.

The function was closed in an animated form of Curtains Closing Down.

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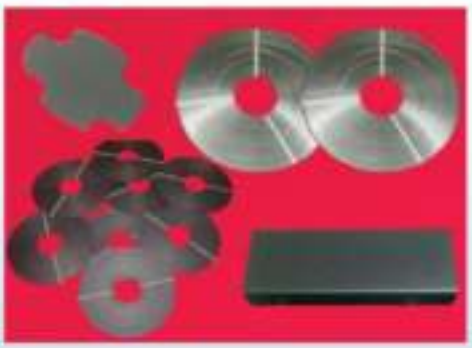

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Introduction To PECT

Swanand A. Hatimkar
NDTS. India (P) Ltd., Navi Mumbai, India

The first practical Pulsed Eddy Current Testing (PECT) instruments for in-service detection of Corrosion Under Insulation (CUI) were developed in the late 1990's in The Netherlands by Applus-RTD and by Shell Global Solutions. PECT remained largely proprietary technology till the basic patents on PECT for CUI expired in 2009 (Spies, B.R., 1989). Since then, the technology gained wider industry acceptance, with the latest milestone the publication of an ISO 20669 and an AMSE standard expected in December 2020.

PECT determines steel thickness by measuring inducing eddy currents in the steel surface and measuring the time it takes for these eddy currents to decay. Fig. 1 displays A PECT probe placed on top of an insulated steel pipe. The probe is connected to a pulse generator and computerized data acquisition system.

Figure 1: A Pulsed Eddy Current sensor is placed on top of an insulated steel pipe to detect wall loss caused by corrosion under insulation(CUI). **Picture Credit – Maxwell NDT BV , Netherlands

A measurement is initiated by sending a strong electrical current pulse through transmitter coils of the probe which generates a powerful magnetic field. The pulsed magnetic field penetrates any non-magnetic materials between coils and steel pipe. The change in magnetic field strength induces eddy currents in the steel underneath the insulation. These eddy currents will initially be concentrated at the top of the steel surface for a ferromagnetic steel, such as carbon- and low-alloy steels. Subsequently, the eddy currents will diffuse from the top surface into the material and at the same time decay in intensity due to ohmic losses in the material. So long as the eddy currents diffuse freely, the decay is relatively slow, because the diffusion induces new electrical currents in the steel. The diffusion stops when the eddy currents sense the back wall. The PECT signal collapses at this moment because new currents are no longer induced. The decaying eddy currents themselves generate a magnetic field in and around the object, which is picked up by a receiver device in the PECT probe, which can be either a magnetic sensor or receiver coils.

The signal amplitude can be plotted as a function of time, in an A-scan, which is usually presented on a double logarithmic scale

(Figure 2). The A-scan has a straight section and a curved section. The point between the straight and curved sections is referred to as the “bending point” and occurs at the onset of the fast decay, which occurs when the back wall has been sensed. The time of the bending point is the critical time and is indicative of the steel thickness. The bending point in PECT can be compared to the back wall echo in pulse echo ultrasonic thickness measurements.

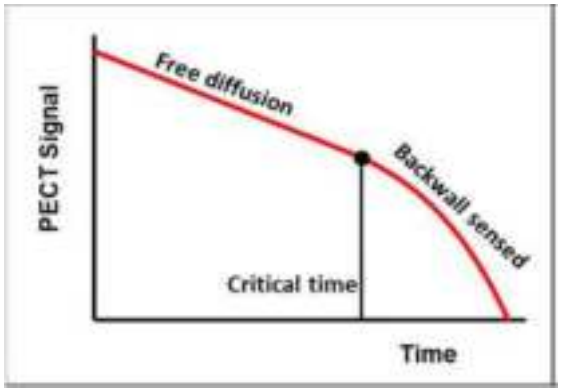

Figure 2: PECT signal as function of time(A scan). The remaining wall thickness is determined from the 'critical time', Which is the moment the eddy current sense the back wall of the test specimen**Picture Credit – Maxwell NDT BV , Netherlands

The most important strength of PECT is its ability to measure through thick layers of insulation material, up to 10”(250mm) thick, and, depending on its properties, often also through thin metal cover sheets, chicken wire and steel reinforcement bars. PECT can also inspect through bricks, refractory, concrete, plastics, bitumen, sea water etc. PECT does not require any surface preparation, can measure through up to 1” (25mm) of corrosion product, and is not influenced by changes in insulation thickness. It can be applied at high temperatures of the steel, up to about 1000°F (550°C) and is remarkably repeatable, making it suitable for wall thickness trending through repeat surveys. Finally, PECT is well suited for robotic inspections, since multi-probe systems are available, and PECT is tolerant against probe tilt and misalignment.

The main limitation of PECT is its large 'footprint', over which the wall thickness is averaged. The size of the footprint is roughly 1.5 x the lift-off, with a minimum of 1" (25mm). PECT will therefore detect general wall loss, but not isolated pitting. In addition, PECT measures percentage variations in wall thickness, not absolute thickness. PECT needs therefore an independent calibration, for instance with pulse-echo ultrasound, to convert the PECT wall thickness measurements to inches or millimeters. PECT requires a simple geometry since other steel equipment within 2x insulation thickness will influence the measurements. The curvature of the steel surface influences the PECT readings as well.

This results in deviations around flanges, supports, re-enforcement pads etc. The requirement of a simple geometry also makes inspections of small-bore pipes difficult in practical situations.

The operation of PECT is illustrated in Figure 3, showing a probe placed on an insulated elbow. A C-scan wall thickness graph is built up through spot measurements on the object. Data recording can be with and without position encoders in either step-by-step, stop & go or dynamic mode, dependent on the specific requirements.

PECT wall thickness readings ["]

Position along axis ["]	Position around circumference 1"	2"	3"	4"	5"	6"	7"
4	0.219	0.224	0.232	0.235	0.230	0.222	0.230
7	0.219	0.211	0.216	0.216	0.216	0.214	0.207
10	0.206	0.192	0.183	0.168	0.172	0.185	0.198
13	0.210	0.204	0.191	0.175	0.189	0.202	0.221
16	0.244	0.251	0.244	0.243	0.241	0.253	0.250
19	0.253	0.257	0.254	0.255	0.251	0.252	0.254
22	0.249	0.250	0.252	0.250	0.249	0.245	0.246

Figure 3: PECT inspection in progress on an insulated elbow (left) and an example of a color-coded PECT wall thickness table (C-scan).**Picture Credit – Maxwell NDT BV , Netherlands

APPLICATIONS:

The PECT instruments developed in the late 1990's was intended for detecting CUI; as this presents one of the most expensive integrity challenges facing the process industry. PECT is not the only noninvasive method that can detect CUI; other methods include guided wave ultrasound, radiography and detecting moisture in the insulation by neutron backscatter or thermography. None of these methodologies is the full solution for CUI and each technique has its own strength and weaknesses. The location on the equipment where CUI will occur is largely unpredictable and therefore the asset owner often requires full inspection coverage. This creates a challenge for these NDE methods to compete on economic terms with the conventional stripping of the insulation for visual inspection.

The best conditions for PECT inspection are in cases where access can be arranged without scaffolding. Creating access to the inspection object is often far more expensive than the inspection itself. This is particularly true for large equipment such as distillation towers and storage tanks, where the cost of erecting scaffolding can only be justified for maintenance during shutdowns. In such cases, in-service inspection is a more attractive proposition using rope-access techniques such as displayed in Figure 4. The second condition in favor of PECT is large-diameter objects, typically above about 12" OD, i.e. large diameter piping, vessels, columns, and storage tanks. In this case, the geometry is often 'simple' and alternative NDE methods are less applicable. PECT has e.g. been applied on a large scale for on-stream inspection of insulated towers near the insulation support rings. Small bore piping, e.g. 2" pipes are more challenging for PECT, mainly because the geometry is complicated and stripping the insulation is often faster and more cost-effective.

Whilst magnetic PECT was developed for detection of CUI and remains the most common application, it is the most difficult application; the main reason being the footprint averaging and large lift-off. During the PECT-CUI development, it was found that there are many more applications of PECT that are not only easier from the technical point of view, but often also very cost effective. One example is corrosion under fireproofing of supporting legs of column spheres Figure 4: and column skirts. To a first approximation, the load-bearing capacity of such leg is it's cross-sectional area. Unlike pressure containers, localized wall loss is therefore much less relevant for structural steel, which makes the PECT footprint averaging less of a drawback. Furthermore, removing and reinstating fire proofing is much more expensive than replacing thermal insulation on a pipe.

Color legend			
larger than		15.2	mm
11.4	to	15.2	mm
10.2	to	11.4	mm
8.9	to	10.2	mm
less than		8.9	mm
Calibration			

Another category of 'easy and beneficial' PECT applications are underwater and splash zone inspections. This includes coated risers and sea water lift caissons of oil rigs, surface casings of offshore wells, jetty piles (Figure 5), sheet piles of canals and in harbors and sub sea pipelines with weight coating. The simple geometry and the absence of metals between the probe and steel surface make the inspection easy for PECT. The low lift-off, typically less than 0.5" (12mm), implies a small footprint so that the PECT measurement is much closer to the minimum wall thickness than in the case of CUI. At the same time, alternative NDE techniques are impractical because of coatings, deposits and corrosion products that block direct access to the steel surface.

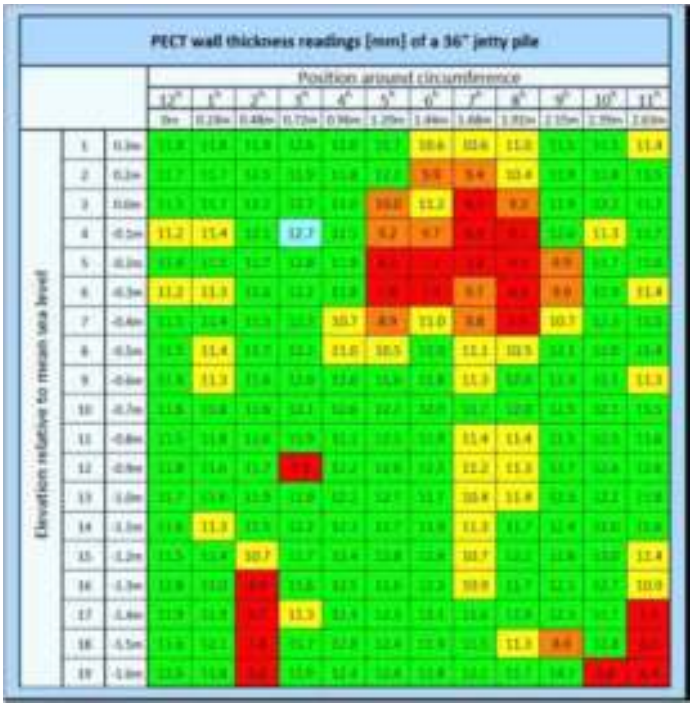

Figure 5: Example of a color-coded wall thickness table of PECT wall thickness measurement recorded on a jetty pile, showing areas of severe wall loss. These data serve as input to mechanical assessments and helps to optimize maintenance programs **Picture Credit – Maxwell NDT BV , Netherlands

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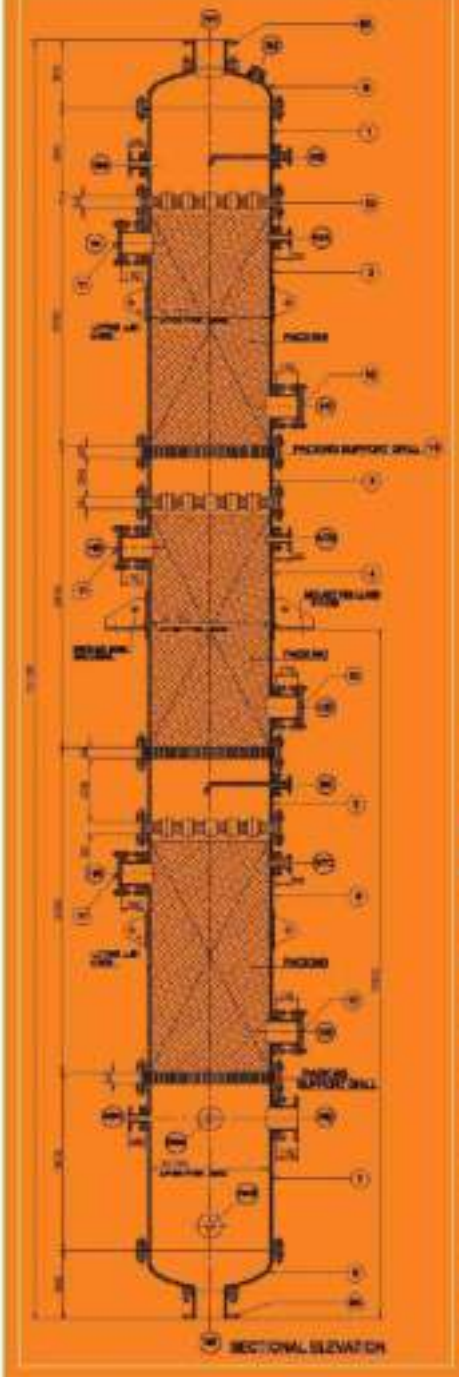

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A Report - Online training course Pipeline Corrosion Management 13 to 15 May 2020

NACE International Gateway India Section (NIGIS) in association of Confederation of Indian Industry (CII) had organized first online training course on "Pipeline Corrosion Management " during 13 - 15 May 2020.Mr. Manohar Rao, Trustee, NIGIS has inaugurated the program and welcome all participants.

NIGIS India has entered into an agreement with Confederation of Indian Industry (CII), the largest industrial organisation in India, to jointly provide courses of interest via online platform. In order to support Indian Industry & other stakeholders to better deal with corrosion & its management, NIGIS & CII developed a pool of corrosion professionals who would be able to address corrosion in their respective organization.

As we aware Pipeline are the most reliable, efficient, safe and economic mode of transport for oil, gas, hydrocarbons and water. Rightly considered as lifelines of modern industrial infrastructure, steel pipelines are vulnerable to atmospheric corrosion above ground and electrolytic corrosion in underground / marine environments. Pipeline corrosion can result in colossal losses and create safety hazards for people, assets and environment.

The faculty includes professional experts from organizations and academic institutions. The topics which were covered were Introduction to Pipeline Corrosion & its Prevention / Control - Prof V S Raja - Indian Institute of Technology Bombay, Galvanic Anode & Impressed Current Cathodic Protection Systems - Pankaj Panchal - Corrosion Protection Specialist Pvt. Ltd., Tests/Measurements/Surveys - K Shashidhar - SSS Engineers, Pipeline Internal Corrosion Monitoring / Measurements and Prevention, Dr Anil Bhardwaj – Ex. Oil and Natural Gas Corporation Ltd, Selection & Application of Corrosion Protection Coatings, K B Singh - K B Singh & Associates, Intelligent Pigging, Maintenance and Repairs, N Manohar Rao – Ex. Bharat Petroleum Corporation Ltd.

Forty one Professional Engineers from various industries such as Cipla Ltd, Cipla Pharmaceutical Ltd, Corrosion Cures Pvt Ltd, Corrtech International Private Limited, Goodrich Gasket Private Limited, Himoya Corrosion Technology Pvt. Ltd., Hindustan Petroleum Corporation Ltd., Indian Oil Corporation Ltd, PS Coating Pvt Ltd, Reliance gas pipelines Ltd, Reliance Industries limited, Technocrat Solutions, Wood Group Saudi Arabia etc. participated. Mr. Rishikesh Mishra, NIGIS, Mr. Sanjay Namdeo & Ms. Priyanka of CII has co-ordinated the Course.

Dr. U. Kamachi Mudali, Chairman, NIGIS provide the Vote of Thanks during the Open Forum Discussions & Conclusion. The program provided an excellent platform for interaction on matters concerning corrosion problems and solutions. The training program had stupendous success and received high appreciation from participants.

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A Report - On-line training course "Fundamentals of Coating & Lining" 26 to 28 May 2020

NACE International Gateway India Section (NIGIS) in association of Confederation of Indian Industry (CII) had organized online training course on "Fundamentals of Coating & Lining" during 26 - 28 May 2020.

NIGIS has entered into an agreement with Confederation of Indian Industry (CII), the largest industrial organisation in India, to jointly provide courses of interest via online platform. In order to support Indian Industry & other stakeholders to better deal with corrosion & its management, NIGIS & CII developed a pool of corrosion professionals who would be able to address corrosion in their respective organization.

Protective Coatings are the most widely used method to control and/or mitigate Corrosion. Protective coatings are the first line of defence against the costly effects of corrosion and are designed to prevent or limit contact between a structure's surface (usually steel or concrete) and its corrosive environment. When a coating system is properly selected and installed, it is able to achieve its designed service life with minimal maintenance and repair. The majority of coating failures are caused by faulty surface preparation, application technique, or selection of the wrong coating for the intended service environment. Rework and replacement is expensive and can be avoided by good practices and understanding the standards and recommendations of the trained coating inspector so that problems can be identified before project moves on to the next step. This reduces the potential for coatings failures that can result in costly repairs, downtime, environmental issues and health hazards.

The course started with a welcome to dignitaries and participants by Ms. Priyanka, CII.

Dr. U. Kamachi Mudali, Chairman, NIGIS had inaugurated the course and welcome to all participants, faculty members and other dignitaries. He said participants to take the benefits and advantage of on-line training course and utilized in quality of work for paint and coatings. Other dignitaries who attended the inauguration program were Mr. N Manohar Rao, Trustee, NIGIS, Mr. Tushar Jhaveri, Past President, NACE International.

Mr. Manoj Mishra, Manager Admin., NIGIS briefed the faculty members among the participants. Mr. Mahesh Aradhye - Associate Vice President - R & D, Grauer & Weil (India) Ltd & Executive Committee member-NIGIS and Mr. Denzil Dcosta, National Sales Manager, Graco Inc. & Treasurer-NIGIS and also informed about the topics cover in on-line course - Principles of Corrosion, Coatings Basics, Environmental Effects on Corrosion and its Monitoring, Surface Preparation & Surface Preparation- Inspection, Paint Applications, Safety and its Importance in our Industry.

Twenty four professional engineers from various industries Wood Wood group, Vibgyor Infra Decor Pvt Ltd, K.B Singh & Associates, Anupam Rasayan India Ltd, Endress & Hauser Flowtec (India) Pvt Ltd., TDK Nashik, Saurashtra Cement Ltd, E A Constructions and Indian Oil Corporation Ltd.

Dr. U. Kamachi Mudali, Chairman, NIGIS provide the vote of thanks during the Open Forum Discussions & Conclusion. The program provided an excellent platform for interaction on matters concerning corrosion problems and solutions. The training program had stupendous success and received high appreciation from participants.

Cracking the code to develop damage-tolerant aluminum alloys for aerospace applications

Ajay Krishnan[1*], V S Raja[1], S M Vaidya[2]
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[2]Executive Vice President, Godrej Aerospace, Vikrohli, India

Aluminum alloys are used in aircraft since 1903, thanks to the accidental discovery of a novel process called 'Precipitation Hardening' by Alfred Wilm. Higher-strength to weight ratio and ease of manufacturing have favored aluminum alloys to be the prime choice of material for various aerospace applications. Researchers in the early 1940s showed that aluminum alloys containing zinc, magnesium, and copper, commonly addressed as 7xxx series alloys, can provide very high strength levels after a processing treatment called 'Peak Aging' (a regular practice under precipitation hardening). Promising strength levels after peak aging encouraged designers to employ aluminum alloys in various aircraft structures (wings, fuselages, etc…). However, 7xxx alloys under peak aging treatment suffered various catastrophic failures under service conditions due to Environmentally Assisted Cracking (EAC).

Environmentally Assisted Cracking (EAC) is a material degradation process in structural materials that occurs due to the harmful interaction of mechanical loading and corrosive environmental conditions such as humidity and salty atmosphere. Corrosion is relentless; incidents such as Aloha airlines crash and Alaskan oil spill testify the fact. Therefore, in the early 1960s, the research focus shifted from developing more durable alloys to damage-tolerant alloys led to the development of a processing technique called 'Over Aging.' However, over-aged alloys faced a massive drawback in the commercial market. The strength levels of over-aged alloys were found to be ~15-20% lesser than the peak aged alloys in spite of its better EAC resistance. Such drop-in strength levels had an enormous consequence in design, leading to higher material usage and various other economic constraints. Therefore, in the case of high strength aluminum alloys, there always exists a compromise between strength and EAC resistance, also known as the 'Inverse Effect.'

Over the last four decades, tremendous research efforts have gone through in developing process routes (also known as heat treatments) to eradicate the inverse effect (Strength vs. EAC resistance). The introduction of jumbo aircraft like Airbus A380 has increased the demand for more robust alloys/processing techniques with better EAC resistance to save production costs. However, the state-of-the-art heat treatment techniques reported so far either failed to break the inverse effect or have been found to be impractical to implement. Indian Institute of Technology Bombay, in collaboration with Godrej Aerospace under the Prime Minister's Fellowship scheme, has developed a technology that could change the prospective of manufacturing high strength aluminum alloys that can be used for aerospace applications.

The newly developed technique is addressed as 'Modified aging,' which demonstrates the possibility of retaining the strength levels of peak aged alloy (maximum strength) yet deliver an EAC resistance better than the conventionally used over aged alloys. This newly developed technique has been patented (India, USA, and Europe) and granted for licensing in Europe. A proof of concept was successfully tested on three different commercially used aluminum alloys AA 7010, AA 7050, and AA 7085. Samples from each alloy (AA 7010, AA 7050, and AA 7085) were qualified for their EAC susceptibility using slow strain rate tests in a corrosive environment (3.5 wt.% NaCl) until failure; a test used to simulate the simultaneous effect of corrosion and mechanical loading conditions. Tests were carried out in 3.5 % of sodium chloride (NaCl), as it is believed to be the most aggressive condition for aluminum alloys. Results showed that the modified aging exhibits an increase in the strength levels (~100 MPa [~20-25 % improvement]) compared to the conventionally used over-aged condition. At the same time, the samples under modified aging could stretch (strain to failure) twice in its value compared to the peak aged condition in a corrosive environment, as shown in Figure 1.

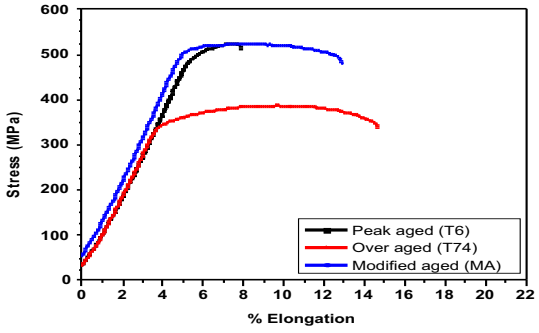

Figure 1: Stress-strain curves of AA 7010 in 3.5 wt.% NaCl at a strain rate of $10^{-7}s^{-1}$

Such results clearly show that modified aging broke the 'Inverse Effect.' The slow strain rate tests used to qualify the EAC resistance lasted only between 2-10 days. More extended exposure tests are required to validate the effectiveness of the modified temper as corrosion is a time-bound phenomenon. Therefore, samples of alloy AA 7010 were exposed to a corrosive environment (3.5 wt.% NaCl) for 1000 hours (~40 days) under different static loading conditions, and their respective crack growth behavior was measured. The crack growth behavior of the modified aged alloy was found to be in the range of $\sim 10^{-10}$ ms^{-1} in comparison to $\sim 10^{-7}$ ms^{-1} (peak aged alloy), showing that they are highly resistant to EAC (1000 times slower crack growth rate) as shown in Figure 2.

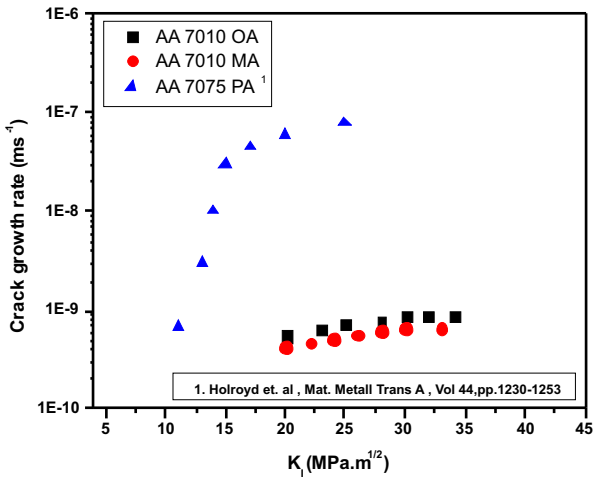

Figure 2: Log crack velocity vs applied K_I for AA 7010 under cyclic exposure to 3.5 wt. % NaCl (PA: Peak aged, OA: Overaged, MA: Modified aged)

In addition, modified aging condition was tested against various cyclic loading conditions in a corrosive environment to simulate the behavior of a typical aircraft as well. Extensive microscopy analysis revealed that the modified aging has finer and densely populated precipitates in the grains with higher copper content on its grain boundary in comparison with the conventionally available conditions (peak and over-aged). The finer and denser network of precipitates imparted strength to the material whilst the grain boundary precipitates enriched with copper brought down the reactivity of those precipitates in the corrosive environment.

Prof V.S Raja, Institute Chair Professor and thesis advisor to the author, said that the novel process technique (Modified aging) could produce aluminum alloys to have a combination of very high strength and EAC resistance, which is a formidable task as these two properties are mutually exclusive. We have achieved this by understanding the EAC mechanisms and tailoring the heat treatments. Prof Raja added that this is a culmination of efforts that Aqueous Corrosion Laboratory has been putting for a decade in developing alloys resistant to EAC. Mr. S.M Vaidya, Executive Vice President and Business Head, Godrej Aerospace and Industrial mentor to the author commented that this patent-protected technology would be a key to Indian Space Research Organization (ISRO) under 'Make in India' initiative as they are looking forward to reducing the cost per kg of their launch vehicles. Mr. S.M Vaidya added through modified aging, the thickness of the walls used in launch vehicle tanks can be reduced (~100 MPa higher strength), thereby cutting down the cost.

The research team comprised of Ajay Krishnan (Research Scholar), Prof. V S Raja (Institute Chair Professor, IIT Bombay) and Mr. S.M Vaidya (Executive Vice President and Business Head, Godrej Aerospace). The author is currently working as an Asst. Manager at HPCL, Bengaluru. The author acknowledges the support provided by M/s Godrej Aerospace, The Science and Engineering Research Board (SERB) and the Confederation of Indian Industries (CII) under the Prime Minister's fellowship scheme. The author also acknowledges the Fulbright Foundation for their support under the Nehru-Fulbright Doctoral Fellowship.

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A Report on Online Training Course
Pipeline - Regulations & Standards : 03 – 04 July 2020

Due to the Corona virus (COVID-19), the world has turned into a different place in just three months. The training industry has responded with online programs so that the professionals take benefit and enhance their knowledge and expertise during the lockdown.

NACE International Gateway India Section (NIGIS) also organized first online Educational & Training Programme on "Pipeline - Regulations & Standards" during 03 – 04 July 2020 on NIGIS own platform. Mr. N Manohar Rao, Trustee, NIGIS inaugurated the course and briefed the activities of the NIGIS and the benefits of attending the newly developed program.

The program mainly discusses standard procedures, operation and maintenance to achieve the safety standards of petroleum products and natural gas pipeline at minimum cost and high level of protection and the frame work of audits procedure so to ensure high standards of compliance. The topics which were covered are PNGRB Guidelines, Codes of Practices for Emergency Response and Disaster Management Plan (ERDMP Audit), Technical Standards and Specification Including Safety Standards (T4S Audit), Standard Layout of Terminals and fire fighting layout, Design and Maintenance of Cross-Country Pipelines and Control of External Degradation on Underground or Submerged Metallic Piping Systems.

The faculty included professional experts from organizations vis-a-vis Mr. A K Bhaduri - Retd. Sr. General Manager, IFCO, Mr. N Manohar Rao - former Executive Director, BPCL. Mr. Ganesh Wankhede - former Executive Director, BPCL, Mr. K B Singh - K B Associates, S C Gupta - Dy. Advisor, PNGRB and Mr. Kailash C Kushwaha - Joint Director, OISD. Mr. Rishikesh Mishra and Mr. Manoj Mishra of NIGIS were the coordinated for the program.

Sixty Seven Professional Engineers from various industries such as Bharat Petroleum Corporation Limited, Boekhoff Technocrates, BPCL-Kochi Refinery, Cormit Elect Projects Private Limited, Harita - NTI Limited, Indradhanush Gas Grid Limited, Indian Oil Corporation Ltd, JACOBS ZATE, Mahanagar Gas Ltd, Pipeline Management Services Pvt Ltd, Reliance Gas Pipelines Ltd, Shalimar, STEM Consultancy, Tractebel Engineering Pvt. Ltd., Wood Group. Participants were from countries like UAE, Saudi Arabia apart from India who attend the program.

Mr. Sumeet Kataria, Secretary, NIGIS attended the valedictory session and conducted the open forum of the session. The training program had stupendous success and received high appreciation from participants. Due to the overwhelming response we couldn't accommodate the large number of participants, hence we decided to organize the same training program on 07 – 08 August 2020 and 11 – 12 Sept 2020.

A Report on Online Training Course
Corrosion Control of City Gas Distribution Pipeline Network: 23 to 25 July 2020

NACE International Gateway India Section (NIGIS) also organized second online Educational & Training Programme on "Corrosion Control of City Gas Distribution Pipeline Network" during 23 – 25 July 2020 on NIGIS own platform.

Mr. N Manohar Rao, Trustee, NIGIS inaugurated the Programme and briefed the activities of the NIGIS and welcomed all the participants. In his inaugural speech he stated that NIGIS India has started online training to support Indian Industry and other stakeholders to better deal with corrosion and its management. NIGIS developed a pool of corrosion professionals who would be able to address corrosion prevention and control in different domains of their expertise.

City Gas Distribution (CGD) is the fastest-growing end-user segment in India's burgeoning and to form an integral part of the country's economic development. To promote the development of CGD network, the Government has accorded the priority in domestic gas allocation to PNG (Domestic) and CNG (Transport) segments. It has become imperative to have a rapidly growing gas distribution infrastructure to be built up along with the back-up of appropriate supply sources. Requirement for developing and implementing an effective and efficient integrity management plan for city gas distribution network through evaluating the risk associated with it, protect the personnel, property, public & environment, streamline the operation and minimise the CGD network failure.

The faculty included professional experts from organizations and academic institutions. The topics which covered were :

1. Basics of Corrosion and Corrosion prevention through material Design, Prof V S Raja, IIT Bombay

2. City Gas Network – Description of Network, Layout, Planning & Operations,
   Mr. Srinivasan Murali, Mahanagar Gas Ltd.

3. CP Design Concepts (TCP & PCP),
   Mr. H Rashid, HCT Global

4. Cathodic Protection Equipment's & Components, Mr.Krishna Kamat, Kristron Systems

5. Monitoring & Measurement, Mr. T Harish Tallam, Gujarat Gas Ltd

6. AC / DC Interference, Mr. Prashanth BG, Jef Techno Solutions Pvt. Ltd.

7. Primary Protection through Coatings (FBE, Internal, 3LPE), Dr. Buddhadeb Duari, Lalita Infra projects Pvt Ltd

8. External Corrosion Direct Assessment, Mr. Kaushik Duari, Lalita Infra projects Pvt Ltd

9. Internal Corrosion Direct Assessment, Dr. Anil Bhardwaj, Ex. ONGC Ltd.

10. Regulation, Mr. N Manohar Rao, former. ED, BPCL

Fifty nine Professional Engineers from various industries such as Graco, 3M India Limited, Aavantika Gas Limited, Bharat Petroleum Corporation Limited, Boekhoff Technocrates, Corrosion Technology Services (India) Pvt. Ltd., Engineers India Limited, GAIL India Ltd., Himoya Corrosion Technology Pvt. Ltd., Hindustan Petroleum Corp Ltd, HPCL-Mittal Energy Limited, Indian Oil Corporation Ltd, JNTUH College of Engg, Metal Samples Co., Oil India Limited, Sandvik Asia Pvt Ltd, Undts Corrosion Services (P) Ltd., etc. participated. Mr. Rishikesh Mishra and Mr. Manoj Mishra of NIGIS were the coordinaters for the program.

Mr. N Manohar Rao, Trustee, NIGIS chaired the closing session and conducted the open forum of the session. It was summarised that it is an excellent platform provided for very interactive sessions on the different types of corrosion problems faced in City Gas distribution. The training program had stupendous success and received high appreciation from participants. The closing of the training programme ended with thanks to all participants.

A Report on Online Training Programmes
Pipeline Integrity Management System

NACE International Gateway India Section (NIGIS) had organized online Educational Training Programme on "Pipeline Integrity Management System". This program was organized three times in two months due to the tremendous response and appreciation received from industry for conducting this informative program. The program was conducted during 28 – 29 August, 04 - 05 September 2020 and 18- 19 September 2020.

Mr. N Manohar Rao, Trustee, NIGIS inaugurated these programmes and briefed the activities of the NIGIS and welcomed all the participants and explained the importance of Pipeline Integrity Management System to the industries. The programme inaugurated virtually.

Pipeline Integrity Management techniques are essential for maintaining a safe and reliable pipeline asset. Essentially, there are three ways to confirm the condition of pipelines viz Monitoring, Testing and Inspections cover under Integrity Management system. This will also explain deeper into the pivotal role of Coating, Cathodic Protection (CP), AC/DC Interference detection and mitigation and how it relates to the overall pipeline integrity.

The faculty included professional experts from organizations and academic institutions. The topics which covered were :

1 Introduction to Integrity Management Plan, Mr. N Manohar Rao, former Executive Director, BPCL

2 Materials and Design, Prof V S Raja, IIT Bombay

3 Pre-Design Survey, Mr. Pankaj Panchal, Corrosion Protection Specialist Pvt Ltd

4 Coatings and Lining, Dr. Buddhadeb Duari, Lalita Infra projects Pvt Ltd

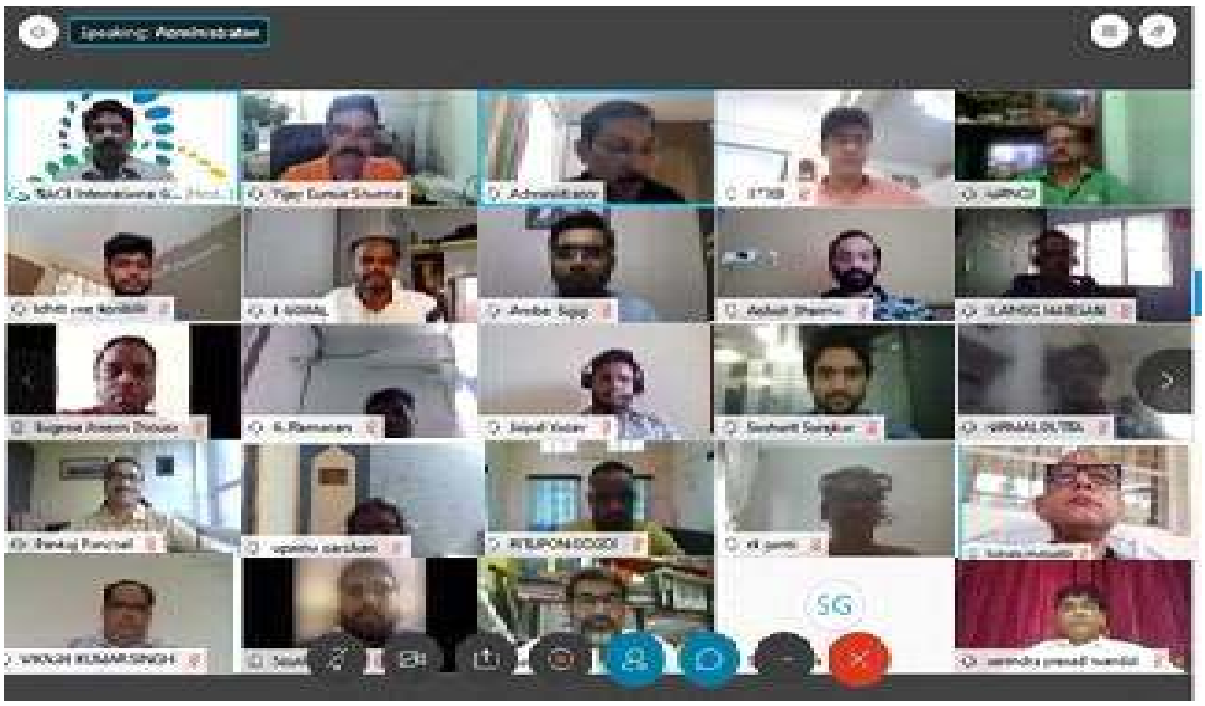
5 Pre-Commissioning Integrity, Mr. Sumeet Kataria, Electro Corr-Damp Pvt. Ltd

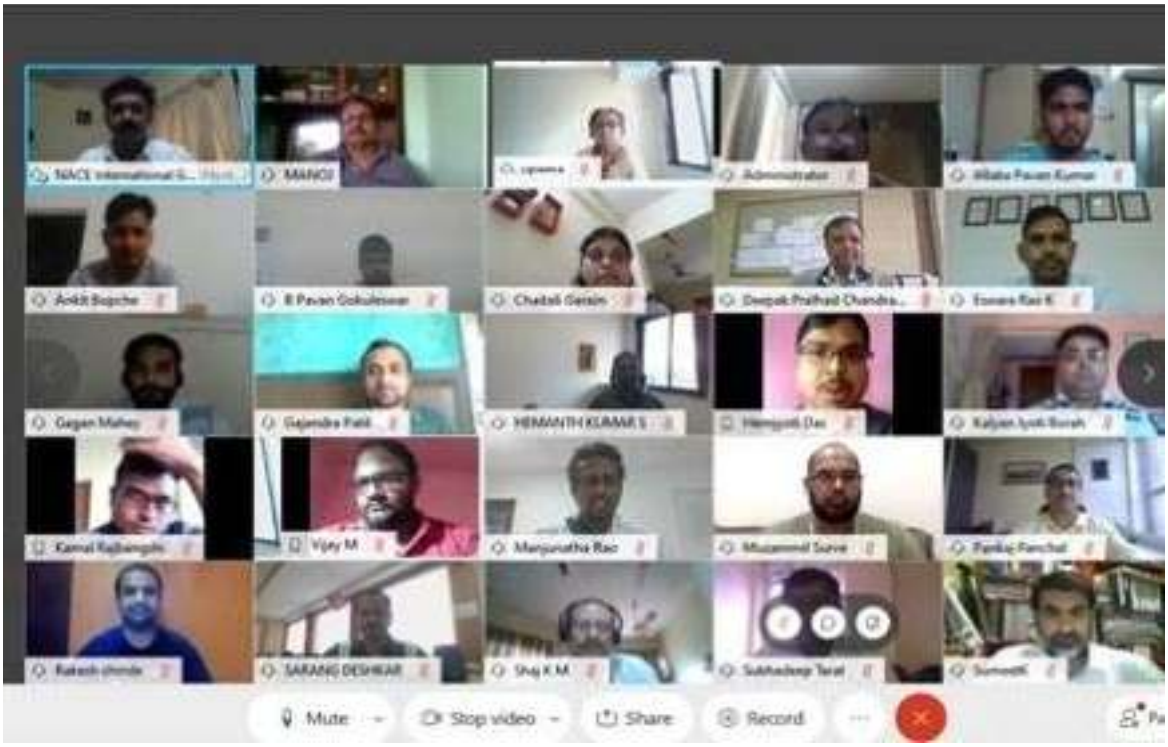
6 Integrity Assessment Tool, Mr. Ashish Khera, Allied Engineers

7 Data Analysis and Interpretation, Mr. Pankaj Panchal, Corrosion Protection Specialist Pvt Ltd

8 Risk Assessment, Ms. DarshanUpama, GM(Elect), IEOT, ONGC

9 Regulatory Requirements, Mr. N Manohar Rao, former Executive Director, BPCL





One Hundred sixty eight Professional Engineers from various industries such as Adnoc Offshore, Assam Gas Company Limited, Bharat Oman Refineries Limited, Bharat Petroleum Corporation Limited, Boekhoff Technocrats, Bpcl-Kochi Refinery, Bureau Veritas (India) Private Limited, Certification Engineers International Ltd,DNP Limited, DNVGL, Engineers India Limited, Gujarat Gas Ltd., Gujarat State Petroleum Ltd., Himoya Corrosion Technology Pvt. Ltd., Hindustan Petroleum Corp Ltd, Indian Institute Of Technology Madras, Indian Oil Corporation Ltd, Integrity Research Labs Pipeline Inspections Pvt Ltd, Jacobs Zate, Larsen & Toubro Ltd., Mahanagar Gas Ltd. MCPI Private Ltd., Nayara Energy Ltd.,Numaligarh Refinery Limited, Oceaneering International, Oil India Limited, ONGC–IEOT, Pipecare Manufacturing Private Limited, Qatar Gas, Quest Global Engineering Services Private Limited, Rabigh Refining & Petrochemical Co., Reliance Industries Limited, Saudi Aramco, Sembcorp Marine Singapore, SGB-Matcor, Skytech Asset Integrity Solutions, Sneham International,Tessarat Consulting, Vedanta Ltd. (Cairn Oil & Gas).etc. participated. Mr. Rishikesh Mishra, Manager Technical Services, NIGIS was the coordinator for the programmes.

Mr. N Manohar Rao, Trustee, NIGIS chaired the closing sessions and conducted the open forum of the session. It was summarised that it is an excellent platform provided by NIGIS for very interactive sessions on the different types of corrosion problems faced in pipeline industry. The training programme had stupendous success and received high appreciation from participants. The closing of the training programme ended with thanks to all participants and speakers. The programme closed virtually with Curtain closed animation.

A Report – Technical Lectures on Asset Integrity Management and Artificial Intelligence

NACE International Gateway India Section (NIGIS) had organised a technical talk on "Asset Integrity Management and Artificial Intelligence" by Mr. Tarun Mishra, Co-founder and Director, Detect Technologies on 16th January 2021 at online platform.

Mr. N Manohar Rao, Trustee-NIGIS welcomed the Speaker and participants who attended the talk from across the globe. He also introduced the speaker Mr. Tarun Mishra to the participant through his bio data.

Tarun Mishra is the founder and director of prominent Indian start-up in the industrial domain – Detect Technologies. He has had more than 10 years of global research experience in the field of Ultrasonics, Thermography, Artificial Intelligence, Industrial Software and Digital Twin, with multiple papers and patents published in well recognized journal. In his presentation on Asset Integrity Management and Artificial Intelligence he briefly touched about the Cost effective and quality. Asset Integrity Management (AIM) has been a long-standing challenge for process intensive industries. Many of the solutions and new innovations that cater to this have so far been isolated, segregated, and require intensive field testing before being adopted on a large scale.

The presentation had showcased the beginning of a new era where an integrated approach for Digital Inspection and corrosion monitoring through combination of robotics, sensors and automated analysis which form the basis for all asset inspection and reliability in process plants

The talk was well attended by 88 members with a good interaction with the Question & Answers session at the end. Mr. N Manohar Rao proposed thanked the speaker and as well as the participants who had shown keen interest on the subject.

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A Report – Technical talks

NACE International Gateway India Section had organised two technical talks on at online platform on 11th July 2020 (Saturday).Dr. U Kamachi Mudali, Chairman, NIGIS welcomed the participants and about the various activities of NIGIS. He also informed the members that NIGIS has started a new series of Technical talk once in a month for the benefit of the member and corrosion fraternity.

The first invited talk was delivered on "Pipeline Integrity System" by Mr. S. S. Gupta, CGM, IOCL, Noida. Mr. Gupta is a Metallurgical Engineer from Punjab Engineering College, Chandigarh. Currently he is working in the capacity of Chief General Manager (M&I), Pipeline- HQ -IOCL. In his talk he explained Pipeline integrity management techniques which are essential for maintaining a safe and reliable pipeline asset. Based on the operators need, a pipeline may be assessed with a combination of various integrity tools during the life of a pipeline.

The second talk was delivered on "Corrosion testing and monitoring by electrochemical impedance spectroscopy" by Dr. S. Parida, Associate Professor, Dept. of MEMS, IIT Bombay, Mumbai. Dr. S. Parida received his Ph.D. degree from University of Saarland, Germany in engineering science. In his talk he explained that the Testing and monitoring are important components of complete corrosion management. Various electrochemical, chemical, physical, and surface analysis techniques are at the disposal for this purpose. Typical electrochemical tests, such as potentiodynamic polarization, linear polarization, are D.C. techniques, which measure only a surface average corrosion response, while obscuring other parallel processes occurring during the corrosion of a coated or uncoated metal. The electrochemical impedance (EIS) is an A.C. technique, which is a fast process, and can differentiate signals from parallel processes to give more information about a corroding system.

The talk was attended by more than 260 members. Mr. Sumeet Kataria, Secretary-NIGIS had proposed vote of thanks to the speakers and participants.

A Report – Technical Lectures on Cathodic Protection

NACE International Gateway India Section (NIGIS) had organised Ramesh Nagar Memorial Virtual Technical Lectures on Cathodic Protection" on 10th October 2020 being his birthday.

NIGIS had arranged two technical lectures related to Interference, as Interference is a problem corrosion engineers face every day and are still learning about it. Interference Corrosion caused by electric railways, stray current and by others whose direct discharge into the ground cause many failures of nearby piping system.

Mr. Sumeet Kataria, Secretary-NIGIS welcomed the Speakers and participants who attended the talk from across the globe. He also introduced the speakers Mr. Shailesh Javia & Dr. Narendra Kumar to the participants and read out the bio data of Speakers.

Mr. N Manohar Rao, Trustee-NIGIS, read out the memorial of Late Ramesh Nagar on his 77thbirth anniversary. He spoke about the legacy of Ramesh Nagar and his meritorious contribution to the growth and development of the Gateway India Section. He also mentioned his special contribution in developing local educational & training programs and establishment of guidelines & procedures for the technical programs in CORCON Conferences and NIGIS Corrosion Awareness Awards. He also mentioned him to be a simple, straight forward and a man of principles. His family also witnessed the proceeding of the program. One minute silence was observed and Shradhanjali was offered to him.

The first invited talk was delivered on “AC Interference Modeling and Mitigation Materials” by Mr. Shailesh Javia, Senior Estimating Manager MATCOR. Inc USA. He is an Electronics Engineer who has spent 27+ years focused solely on corrosion Engineering and Cathodic Protection Systems. In his talk he explained High Voltage AC Transmission lines can adversely influence pipelines that are laid along the same right of way. This presentation discussed key requirements of AC Modeling utilizing sophisticated software solution. This software helps to analyze AC interference risks and design AC mitigation systems addressing high potential voltage conditions. AC modeling enables accurate analysis of grounding issues, electromagnetic fields, interference and various aspects of cathodic protection system. This presentation discussed AC interference modeling aids in determining safety risks and requirements for pipeline AC mitigation for Step and touch potential, Induced AC, shorted or fault conditions and AC corrosion.

The second invited talk was delivered on “Challenges in Corrosion control in City Gas Distribution system (CGD)” by Dr. Narendra Kumar, Executive Director, Torrent Gas, Lucknow, India. He is an electrical engineer having around 40 years of experience related to City Gas Distribution, Oil & Gas and Fertilizers. He spoke about the City gas distribution networks that are exposed to external damages caused by third parties. In many cases such external damages are the main cause of network failures. It is essential that a system is introduced which ensures maximum availability of the network with minimum disruption and damages to pipeline networks. In CGD system lot of steel and MDPE pipelines are laid in urbal area. All Natural Gas feeding underground pipelines are made up of steel and require adequate corrosion protection measures for un-interrupted natural gas supply to consumer which are large in numbers. This presentation discussed the challenges which are specific to CGD Steel pipelines' corrosion.

The talk was well attended by 396 members. Mr. Sumeet Kataria proposed vote of thanks to the speakers and as well as the participants

A Report - on-line training course
"Corrosion Control in Concrete Structures" - 15 to 17 July 2020

NACE International Gateway India Section (NIGIS) in association of Confederation of Indian Industry (CII) had organized on-line training course on "Corrosion Control in Concrete Structures (C3S) during 15 – 17 July 2020. Attended by forty five professional engineers from various industries.

NIGIS has entered into an Agreement with CII, the largest industrial organisation in India, to jointly provide courses of interest via online platform. In order to support Indian Industry & other Stakeholders to better deal with Corrosion & its Management, NIGIS & CII developed a pool of corrosion professionals who would be able to address Corrosion in their respective specialised segments.

The course will educate you on both theoretical and practical aspects on how to prevent and control corrosion in concrete structures. In particular, the topics include corrosion mechanisms in concrete structures, durability-based design procedures, performance specifications, condition assessment, corrosion prevention/control methods for concrete structures.

The course started with a welcome to dignitaries & participants by Manoj Mishra, NIGIS.

Mr. N Manohar Rao, Trustee, NIGIS had inaugurated the course and welcome to all participants and faculty members. He said participants to take the benefits and advantage of training course.

Dr. Radhakrishna G Pillai, Associate Professor, IIT Madras, faculty and course coordinator briefed about the course. He also introduced the faculty members Prof. Manu Santhanam, IIT Madras, Mr. David Whitmore, Vector Corrosion, Canada, Dr. Suriya Prakash, IIT Hyderabad and Mr. S. Ravichandran, Berger Paints, Kolkata

Broadly, the topics covered in this on-line course –

1. Corrosion Mechanisms in Concrete Structures
2. Performance Specifications for Durable Concrete
3. Corrosion Survey of Concrete Structures
4. Structural Strengthening of Concrete Structures
5. Cathodic Protection of Concrete Structures
6. Surface Coatings for Concrete Structures
7. Approaches to Extend the Residual Service Life of Concrete Structures

Dr. U. Kamachi Mudali, Chairman, NIGIS provide the vote of thanks during the Open Forum Discussions & Conclusion. The program provided an excellent platform for interaction on matters concerning corrosion problems and solutions. He also informed for planning another advance course on corrosion control of concrete structures.

The training program had stupendous success and received high appreciation from participants.

The closing of the training course ended with vote of thanks by Dr. Radhakrishna Pillai to dignitaries, faculty members, participants, Mr. Sanjay Namdeo, Mr. Rohit Yadav & Mr. Ravinder Singh, CII and Mr. Manoj Mishra, NIGIS for their efforts in managing the course.

A Report - Educational Virtual Training Course
Microbiological Corrosion in Oil & Gas Industry - 25 to 26 Sept 2020

NACE International Gateway India Section (NIGIS) had organized on-line educational training course on "Microbiological Corrosion in Oil & Gas Industry" during 25-26 September 2020. The course was attended by fifty seven (57) professional from industries. NIGIS created a pool of corrosion professionals, who would be able to fight against corrosion in their respective specialised segments.

The course started with a welcome to dignitaries & participants by Mr. Manoj Mishra, Manager Administration, NIGIS.

Mr. N Manohar Rao, Trustee, NIGIS inaugurated the course and welcomed all participants and faculty members. Dr. Jaya Rawat, Dy. GM, (R&D), BPCL, faculty and course coordinator briefed about the course. She also introduced the faculty members Dr. Mohan Yama, Manager (R&D), BPCL. Dr. Amit Bhattacharya, VP-Operations, Livinguard Technologies, Ms. Veena Kothe, Former GM, RGL-ONGC, Dr. Manoj Upreti, Sr. Research Manager (R&D – Ind. Biotechnology), IOCL, Dr. Meeta Lavania, Convener, Microbial Biotechnology Area, TERI and Dr. T Subba Rao, SO/H & Head BTES, BARC.

The participants gained both theoretical and practical aspects on how to prevent and control corrosion. In particular, lectures followed by an interactive session on the following topics were conducted.

1. Basics of MIC – their Presence in Oil & Gas System & Consequences
2. Role of Different Bacteria in Hydrocarbon System in Corrosion- Lab Studies
3. MIC Monitoring Techniques – Lab and Field Studies
4. MIC problems in Upstream Sector of Oil industries- Case Studies
5. Advance Molecular Biology Bases Techniques for Enumeration of Microbial Population
6. Microbiological Corrosion issues in Gas Pipeline – Case Studies
7. Metallurgical Aspects of Microbiologically Induced Corrosion
8. MIC issues in Water Systems and their remedies- Case Studies

We received excellent feedback from multiple participants on the way each of the lectures were organized and delivered. The program provided an excellent platform for interaction on matters concerning corrosion problems and solutions.

Mr. N Manohar Rao, Trustee, NIGIS provided the vote of thanks. The efforts by SGB & EC members, Faculty members, participants and NIGIS staff Mr. Manoj Mishra & Mr. Rishikesh Mishra were appreciated. Dr. Jaya Rawat also informed that NIGIS is planning for Advanced Program on Microbiological Corrosion in March 2021.

A Report - Educational Virtual Training Course
Advanced Program on Coating Technology & Quality Control

NACE International Gateway India Section (NIGIS) had organized three online educational training course on "Advanced Program on Coating Technology & Quality Control" during Oct & Nov 2020 and created a pool of corrosion professionals, who would be able to fight against corrosion in their respective specialised segments.

First program during 30 - 31 October 2020 attended by fifty nine (59) professional from industries. The course started with a welcomed to dignitaries & participants by Mr. Manoj Mishra, Manager, Administration, NIGIS.

Mr. N Manohar Rao, Trustee, NIGIS inaugurated the course and welcome all participants and faculty members. Mr. Maheshkumar Aradhye, Associate VP (R&D), Grauer & Weil (India) Ltd and course coordinator briefed about the course and also introduced faculty members Mr. Heramb Trifaley, MD, AGEP India Pvt. Ltd, Mr. Denzil Dcosta, National Sales Manager, Graco India Ltd, Dr. Buddhadeb Duari, Director, Lalita Infraprojects Pvt Ltd, Mr. K V Badrinarayan, Technical Manager, Akzo Nobel India Ltd. Mr. Sachin Sontakke, Sr. Manager (HSSE), Castrol India Ltd and Mr. Amol R Bakre, Technical Manager, 3M India Ltd.

The participants gained both theoretical and practical aspects on how to prevent and control corrosion. In particular, lectures followed by an interactive session on the following topics were conducted.

1. Corrosion and its Control with Protective Coatings
2. Surface Preparation
3. Coating Application
4. Application for Pipeline (Internal & External - Coating) and its Challenges
5. Specification & Standards Recommendation for Coating Project
6. Quality Control, Inspection & Responsibilities
7. Coating Project Safety & Health Hazards
8. Coating Failures & Coating Selections.

Mr. Heramb Trifaley, Vice-Chairman, NIGIS said to participants to take the benefits and advantaged of online training course and utilized in quality of works for combat corrosion. Mr. Maheshkumar Aradhye, course coordinator appreciated to faculty members, participants, SGB & EC members and staff members Mr. Manoj Mishra and Mr. Rishikesh Mishra for support and organized the excellent program.

Mr. Sumeet Kataria, Secretary, NIGIS provided the vote of thanks and also informed future programs.

Second program during 06 – 07 November 2020 attended by fifty nine (59) professional from industries. The course started with a welcomed to dignitaries, faculty members and participants by Mr. Manoj Mishra.

Mr. Maheshkumar Aradhye, course coordinator appreciated to Faculty members, participants and staff members Mr. Manoj Mishra and Mr. Rishikesh Mishra for one more excellent program. Mr. Heramb Trifaley, Vice-Chairman, NIGIS provided the vote of thanks and informed about NIGIS future programs.

Third program during 10 – 11 November 2020 attended by forty five (45) professional from industries. The course started with a welcomed to dignitaries, faculty members and participants by Mr. Manoj Mishra.

Excellent feedback received from all three training programs from multiple participants on the way each of the lectures were organized and delivered. The program provided an excellent platform for interaction on matters concerning corrosion problems and solutions.

Mr. N Manohar Rao, Trustee, NIGIS provided the vote of thanks and informed future programs. The efforts by SGB & EC members, Faculty members, participants and NIGIS staff Mr. Manoj Mishra & Mr. Rishikesh Mishra were appreciated.

A Report on Online Training programme
Corrosion & Safety Aspects in Refinery Operations: 27 – 28 November 2020

NACE International Gateway India Section (NIGIS) had organized Online Training programme Corrosion & Safety Aspects in Refinery Operations during 27 – 28 November 2020.

Mr. N Manohar Rao, Trustee, NIGIS & Co-ordinator of the programme inaugurated the Programme and briefed the activities of the NIGIS and welcomed all the participants. In his inaugural speech he stated that NIGIS India has started online training to support Indian Industry and organised many online programs in past like Pipeline–Regulation & Standards, Corrosion Control of City Gas Distribution Pipeline Network, Pipeline – Integrity Management System, Coatings, Cathodic protection and O&M In Tanks, LPG Mounded Bullets and Plant piping. The training programme of Refinery corrosion has also been added to better deal with corrosion.

Corrosion control has always been one of the major problems in oil refineries. Refinery is a hazardous industry and safety is paramount in refinery. The main focus of corrosion control in Refinery is focused on saving the Human life and Environment. Corrosion knowledge is to be implemented in such a way, that there is no leakages, fires and or interruption in running of plant.

The faculty included professional experts from organizations and academic institutions. The topics which covered were:

1) Overview of Refinery Corrosion - Mr. Lal Gopalani, Former CGM, IOCL

2) Polythionic acid corrosion issues in hydro cracker units of refinery - Mr. B S Negi, CEO - PDMCS3)

3) Corrosion under insulation – safety concerns and remedies - Mr. Rajesh Wadhawan, Former CGM, BPCL

4) Case studies – safety in refinery process operations - Mr. D B Kamble, Former GM, BPCL

5) Safety Practices in refinery maintenance & inspection schedules - Mr. Omprakash Makde, Chief Manager - Fire & Safety, BPCL

6) Case Studies – Sulphidation corrosion - Mr. D B Kamble, Former GM, BPCL

Thirty Four Professional Engineers from various industries such as Bharat Oman Refineries Limited, Boekhoff Techno crates, BPCL-Kochi Refinery, Chennai Petroleum Corporation Limited, GAIL Gas Limited, Harita - NTI Ltd., Indian Oil Corporation Ltd, Ion Exchange India Limited, Mangalore Refinery and Petrochemicals Ltd., Metal Samples Co., Saudi Aramco Base Oil Company - Luberef, Technip India Limited, Worley Parsons & others participated. Mr. Rishikesh Mishra, Manager – Technical Services, NIGIS was the coordinator for the program.

Mr. N Manohar Rao, Trustee, NIGIS chaired the closing session and conducted the open forum of the session. He also stated that to extend the Refinery series we are planning to conduct programmes on Asset Integrity Management For Oil Refineries And Petrochemical Complex, Refinery corrosion – Operational and Metallurgical challenges, Refinery corrosion – Corrosion monitoring techniques and their applications and Inspection based approach for corrosion management.

The training program had stupendous success and received high appreciation from participants. The closing of the training programme ended with thanks to all participants.

Participants of Corrosion & Safety Aspects in Refinery Operations

A Report - Educational Virtual Training Program
"Coating Survey – Planning & Budgeting Coating Maintenance" 08 - 09 Jan 2021

NACE International Gateway India Section (NIGIS) had organized on-line educational training program on "Coating Survey – Planning & Budgeting Coating Maintenance" during 08th – 09th Jan 2021. The training program was attended by forty five (45) professional from industries. NIGIS created a pool of corrosion professionals, who would be able to fight against corrosion in their respective specialised segments. The program started with a welcome to dignitaries & participants by Mr. Manoj Mishra, Manager Admin-NIGIS.

Dr. U Kamachi Mudali, Chairman, NIGIS inaugurated the program and introduction of speakers. He also informed that NACE International and SSPC have united to serve the corrosion prevention and now called as "Association for Materials Protection and Performance" (AMPP).

Mr. Heramb Trifaley, Vice-Chairman, NIGIS and Course coordinator briefed about the training program.

The faculty members for this program were Mr. Heramb Trifaley, MD, AGEP India Pvt. Ltd, Mr. Maheshkumar Aradhye, Associate VP (R&D), Grauer & Weil (India) Ltd, Dr. Buddhadeb Duari, Director, Lalita Infraprojects Pvt Ltd, Mr. K V Badrinarayan, Technical Manager, Akzo Nobel India Ltd., Mr. Amol R Bakre, Technical Manager, 3M India Ltd. and Dr. Anil Bhardwaj, Former Group General Manager, ONGC.

The participants gained both theoretical and practical aspects through the talks on how to prevent and control corrosion. In particular, lectures followed by an interactive session of questions and answers on the following topics were conducted.

1. Introduction to Coating Surveys
2. Coating Defects
3. Challenges in Coating Maintenance
4. Maintenance Specifications and Standards
5. Planning and Conducting Coating Survey, Documentation and Reporting and Coating Maintenance Project
6. Preparing Budgets, Long-Term Maintenance Plan and Safety during Coating Maintenance
7. Vendor Assessment / Audits
8. Corrosion Control & Coating Survey for Offshore Structures

We received excellent feedback from multiple participants on the way each of the lectures were organized and delivered. The program provided an excellent platform for interaction on matters concerning corrosion problems and solutions.

Dr. U Kamachi Mudali, Chairman, NIGIS provided the vote of thanks. The efforts by SGB & EC members, Faculty members, participants and NIGIS staff Mr. Manoj Mishra & Mr. Rishikesh Mishra were appreciated.

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