

## ■ Mahua Roy

**C**orrosion has a massive economic as well as environmental impact on virtually all aspects of infrastructure, be it highways or bridges to water and wastewater systems, oil & gas installations. Besides, it cannot be ignored that effects of corrosion lead to severe damage and threat to public safety. Corrosion costs account for around 1-5 per cent of a nation's GDP, as per Corrosion Control & Monitoring Consultancy Company. In the US, it is approximately 3.1 per cent. The annual cost of corrosion worldwide is estimated to be \$ 2.2 trillion. This cost incorporates

**Studying the underlying causes**

In the recent past, India has seen several investments in the oil & gas industry. Downstream processing mainly utilises corrosion-resistant alloys in its installations. The real effect of corrosion is seen in exploration & production (E&P). Elaborates Dr David Horsup, Vice President - Research & Development, Energy Services, Nalco - An Ecolab company, "In E&P processes, large amount of water is used. Also, this water is at a particularly high temperature. The combined effect leads to aggressive corrosion. More so, nowadays deeper wells are being explored, which are at a much hotter temperature." Corrosion is the primary factor affecting the longevity

have an adverse effect upon the reliability of a plant.

As industrialisation is happening at a fast pace, corrosion mitigation and management needs to be deliberated and implemented right at the design stage. Corrosion expert Mukul Gupta, Managing Director, Chemtreat India, notes, "Corrosion is a function of temperature, velocity, raw material composition and external atmospheric conditions. Quick industrialisation pace tends to ignore the location of an installation and its effects on corrosion. Coastal areas are preferred for new facilities as they ease logistics. However, industrial use of sea-water and the salinity in the air could be the major issue for corrosion."

## Protection through real-time monitoring

India loses ₹ 2 lakh crore (\$ 45 billion) every year to corrosion of infrastructure, industrial equipment and other vital installations, as per a 2011 report by the Indira Gandhi Centre for Atomic Research. This figure raises questions about the immense under-utilisation of technologies that can help erase this colossal damage.

various direct and indirect effects due to corrosion, including premature deterioration or malfunctioning resulting in the need for maintenance, repair or replacement of damaged equipment.

Other sources of costs come from lost production and prolonged shutdown of equipment as a result of corrosion. In certain cases, corrosion costs also include utilisation of additional capacity put to use due to unscheduled maintenance procedures. Currently, the industry maintains a reactive status to mitigation of corrosion. This outlook needs to be transformed, making the industry adopt predictive measures towards alleviation of corrosion.

and reliability of pipelines that transport crucial energy sources throughout the nation.

Contrary to the popular belief, corrosion occurs neither continuously nor at a uniform rate. Chemical impurities such as halides (especially chlorides and fluorides), sulfates and sulfides get adsorbed on metal surfaces and inhibit the natural passivation process. This causes a localised destruction of passive films and leads to pitting corrosion. Besides, environmental factors lead to corrosion by accelerating erosion. This can amplify the corrosion rate of stainless steel by several magnitudes through a synergistic effect. The occurrence of corrosion can

**Technologies at a glance**

Corrosion monitoring is the most effective way of dealing with this menace. It includes a broad range of techniques to evaluate the degradation of metallic materials. These techniques can be categorised into two groups: those providing indications of the cumulative damage (off-line, retrospective) and those providing indications of the prevailing corrosion rate (usually on-line and continuous). Nalco - An Ecolab company's advanced 3DT technology is developed on the continuous online monitoring method. Enabling sophisticated remote access of plants and immediate notification of hazards, this technology combines chemistry with technology.



Monitoring helps detect effects of corrosion. To prevent it, various technologies are in place. "New advanced materials like non-metals – composites, engineered polymers, reinforced plastics, conducting polymers – are significant advancements in material science, which should be widely employed to curb corrosion. The control process parameters taken into account are the corrosivity of the media involved. New chemistries like high-performing coatings and linings with better barrier properties are continuously evolving technologies, which should be more judiciously incorporated," adds Gupta.

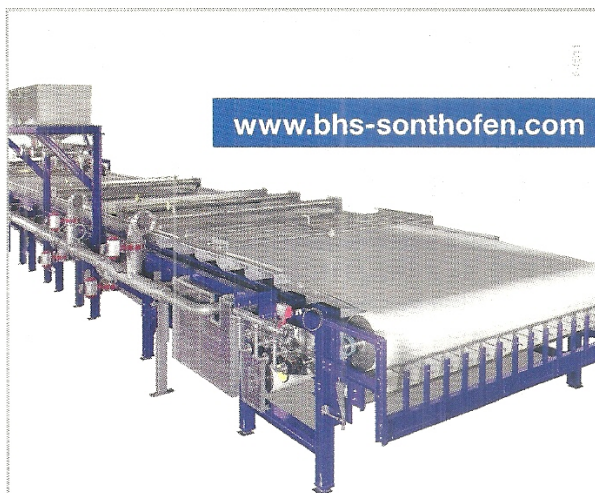
### A closer look at the hurdles

One of the significant reasons for the high cost of corrosion mitigation is that the marketplace for corrosion products and services is fragmented. It mainly comprises many smaller companies, which provide a limited number of services. In the wake of this, the government can certainly play a crucial role by partnering with bodies like National Association of Corrosion Engineers International India Section (NIIS), National Corrosion Council of India, and other international institutes. Besides, at this stage, it is important to create a general awareness and understanding about the losses due to corrosion. "Corrosion education is not yet taken as a full-time curriculum by institutes. Lack of information and qualified corrosion professionals is a major setback in combating the problem of corrosion, as a long-term measure," asserts Gupta. Also, codes and standards laid down for the industry need to be revisited. Gupta adds, "The first step in implementing any new corrosion protection technology is educating the right set of people not only on its advantages, but also explaining the root cause of the problem in detail, and how the new technology would pre-empt and try to curb the issue. Besides, awareness about corrosion and its effects should be initiated right at inception stage of any project (construction stage)."

### Opening up research avenues

Dr Horsup puts forward that bacterial metabolism leads to acid formation. This process is seen largely in E&P activities. "This acid gets deposited on pipelines and is a major cause of corrosion. An interesting research avenue would include identification of specific bacterial strains, which cause this corrosion," he adds. Identification of strains can then be used as data to develop counteracting measures. Also, composites constitute another lucrative area where work needs to be done at a larger scale. Says Gupta, "Continuous research in the field of composites, new materials, non-metals with the desired mechanical and electrical properties are the primary steps one could look at, to combat the issue of corrosion right at the nascent stage." ■

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### Apart from safety, which other factors do you consider while designing Personal Protective Equipment (PPE)?

Each PPE manufactured by 3M conforms to the highest levels of international and Indian safety standards. Apart from safety, strong emphasis is laid on the comfort and fit of a PPE. An ill-fitting PPE does not offer complete protection, thereby defeating the purpose of wearing a PPE. PPEs are generally uncomfortable to wear for long time. Keeping that in mind, our PPEs are designed to ensure comfort to users who need to wear those for longer periods.



We also work towards customising the fit of PPEs to suit various ethnic groups, especially in the case of eye protection. The fit of an eyewear could vary considerably from a Caucasian face to an Asian face. We factor in these scenarios through extensive research. Style is also considered in the design of PPEs without compromising on safety or protection.

### How are the regulatory norms in India with regard to OHES?

The significance of safety and health in the chemical industry is critical towards achieving productivity and maintaining an edge in the competitive scenario. In India, environmental rules and regulations pertaining to the chemical industry are stringent as compared to other developing

countries and even some developed countries. Furthermore, though many rules like identification, notification and development of landfill sites were prescribed in 1989 under The Hazardous Waste (Management and Handling) Rules, the state governments are still unable to identify, notify and develop the required sites even today. However, an amendment enacted in 2000 placed the responsibility on industry associations as well as the government.

One of the factors to consider with respect to industrial growth and pollution prevention is the activism of several NGOs. Public opinion and numerous public interest litigation pleas

however, can work as a driver towards conservation; for instance, those that are inbuilt in the approval system require industries to take environmental issues into consideration.

Industries that are leaders on the environment front do not currently receive any specific advantages. Little special consideration is given even for processing their application for consents or authorisations. Consequently, there is no real driving force for the industries to adopt cleaner technologies and implementation of Environmental Management System standards ISO-14000. The environmental awareness is still low. Awareness-creating campaigns,

## “Legislation alone does not guarantee sustainable development”

...says Shrikant Kulkarni, General Manager - Occupational Health and Environmental Safety (OHES) Division, 3M India. Conversing with Mahua Roy, he gives a round up about the status of health and safety emphasis in the Indian chemical industry.

against pollution have led to greater awareness among the industrialists, authorities and communities. Many of the measures to be adopted for solving environmental problems should be based on the experience already gained by the developed countries. Presently, there is little institutional impetus provided for the adoption of cleaner technologies and waste minimisation techniques. Process technologies, however, have their own economic returns that mitigate the need for extensive regulatory interference.

### Which are the top problems faced by the sector that call for implementation of OHES solutions?

Legislation alone does not guarantee sustainable development. The situation is extremely tricky in a country like India, where implementation is difficult. Rules,

however, have become rather popular and their visibility has increased over the past years.

### What are the initiatives taken by 3M to promote OHES in the industry?

3M OHES is proactive in creating safety awareness in industry across various stakeholders – management, employees, EHS personnel. Some of our initiatives include:

- ❑ Walk-through surveys to assess the presence of hazards and recommend appropriate protection
- ❑ PPE maintenance camps
- ❑ Safety seminars, shop-floor and worker training programmes
- ❑ Safety guides (booklets) for employees in English, Hindi and multiple regional languages ■

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