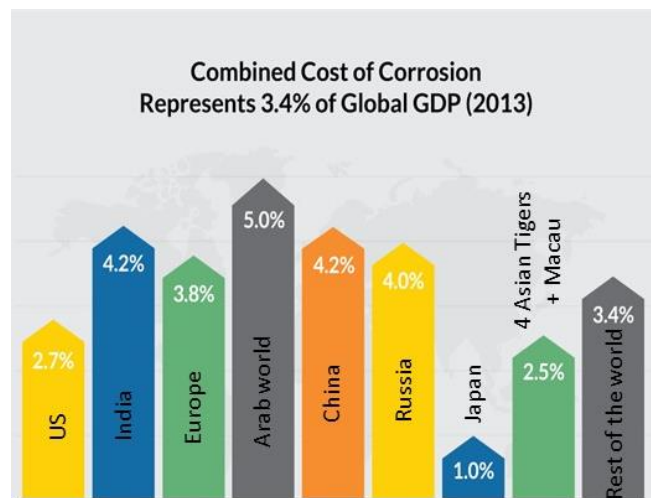


Designing of Conducting polymer composites for corrosion protection in marine environment

Corrosion has no national boundaries, it's a global interest phenomenon in which metal and alloys degrades due to electrochemical and chemical reactions on exposure to environmental conditions. Corrosion causes undesirable effects not only at service life of the metal but economically also. Extensive research has been carried out throughout the world to understand the mechanism of corrosion and its inhibition for various metals and alloys. In order to mitigate the corrosion, they have developed superior alloys, modified the microstructure of alloys, applying anticorrosive coatings and varying the conditions. The ultimate aim is to improve the service life of the metal and alloys to utmost extent.



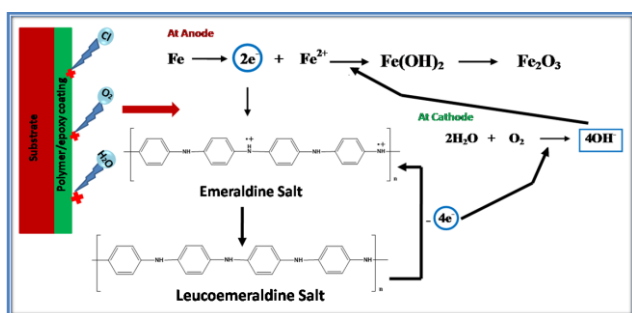
The estimated global cost of corrosion is about US\$2.5 trillion, which is equivalent to 3.4% of the global GDP (2013). There are number of surveys has been carried out to estimate loss arises due to the corrosion. The economical loss arises due to corrosion are classified into two category, direct loss and indirect loss. Direct loss includes losses occurred on the personal possessions, while indirect loss such as breakdown of machinery, pollution, degradation in production efficiency and maintenance charges etc. Whereas it's very difficult to estimate the loss due to indirect losses.



Global Cost of Corrosion

In past few decades lot of research has been carried out on conducting polymer-based coatings. Conducting polymers have been used for anticorrosion application either by electrodepositing it on metal surface or by direct addition to the corrosive medium as an inhibitor. Various conducting polymers like Polypyrrole, polyaniline, and polythiophene etc have been studied for anticorrosive properties. Among the various conducting polymers polyaniline and its derivative exhibit excellent anticorrosive properties. This conducting polymer shows dual protection mechanism by providing anodic protection to underlying metal and shifting its potential to passive region. Secondly it acts as a barrier against highly corrosive conditions. Conducting polymer coatings on various metal substrates has been used in various industries and are economically cheap to produce and can withstand against ambient corrosive condition.

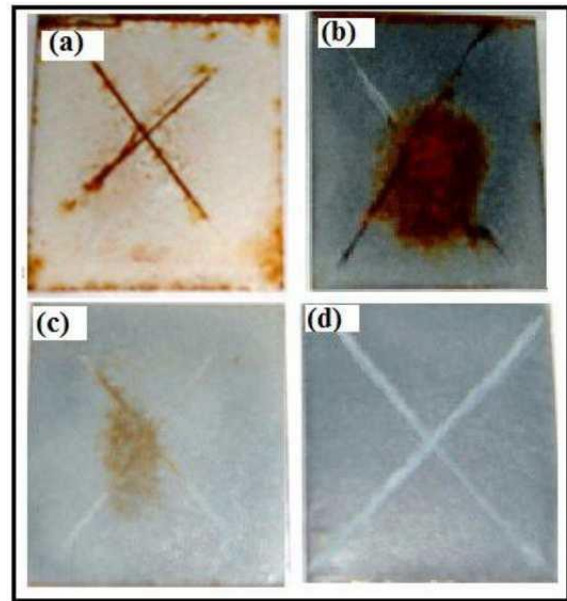
A new concept based on polymer composite is employed for designing material that exhibit modified properties resulting from the synergistic effect of fillers and polymer matrix. In present study, various properties of conducting polymers such as anti-corrosiveness, light weight, mechanical strength, and tuneable electrical conductivity and environment stability, can be utilized along different filler for designing the copolymer composite for fabrication of anticorrosive coatings. Conducting polymer based nano composites due to their unique electrical properties, superior corrosion resistance, mechanical strength and thermal stability has been shown their potential application in anticorrosive coatings. However, the difficulties of processing of conducting polymers are yet to be overcome. Recently, polymer matrix having nanofillers found to be better alternative to the conventional epoxy and other coating materials. Due to the unusual chemical and physical properties of these nanocomposite are finding a permanent place in the field of corrosion inhibition, anti-bio-fouling and self-cleaning of marine vessels etc.



Corrosion inhibition mechanism of polyaniline

Development of polymer based anticorrosive coating is a subject of huge recent research interest. Conducting polymers have been identified as corrosion inhibitors for metals exposed to various corrosive environment. These polymers inhibit corrosion by forming a protective oxide layer on the surface of the metal. Study of this material has received worldwide attention due to its potential application.

Although lot of work has been done in the field of corrosion but there is still a lot to be done in order to design anticorrosive coating barrier which eco-friendly, super hydrophobic and self healing in nature. Conducting co-polymer composites can be considered as a useful approach for the fabrication of anticorrosive coatings. As a coating material conducting polymer are non-toxic, have high environment stability and demonstrate corrosion resistant properties. Various fillers (Fly ash, chitosan, silica nanoparticles) enhance the physical properties of copolymers due to their excellent mechanical stability and thermal stability, non-toxicity, and good film forming ability.



Salt spray images of powder coated sample on mild steel surface (a) Epoxy coated (b) PANI coated at 6% loading, (c) & (d) conducting polymer nanocomposite coated at 1.5 and 6% loading level.