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Metal Corrosion Inhibitors

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Editorial

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EDITORIAL

Corrosion is the destruction of metals by interaction with environment. It's a natural and inevitable cycle of events in which metal tends to return to the state whence they came. In the most common use of the word, this means a loss of an electron of metals reacting with water or oxygen. Evidence of corrosion is all around us and we cannot go a day without being reminded of its ever-present action. It is very difficult to make a precise estimate of the cost to the national economy of cession, but recent study, entitled "Corrosion Costs and Preventive Strategies in the United States," was conducted from 1999 to 2001 by CC Technologies Laboratories, Inc., with support from the FHWA and NACE and results of the study show that the total annual estimated direct cost of corrosion in USA is a staggering $276 billion- approximately 3.1% of the nation's Gross Domestic Product (GDP) [1].

Metals like Mild steel and Aluminium are widely used in most of the chemical industries due to its low cost, easy availability for fabrication of various reaction vessels, tanks, pipes, etc. Because it suffers from severe corrosion in aggressive environment it has to be protected. A great deal of the study has been devoted to corrosion in multidisciplinary field of chemistry, engineering and metallurgy. Immense efforts have been made to understand the mechanism through which metals corrode in different environment and to minimize it by adopting various preventive measures, methods to reduce corrosion includes application of protective coatings, cathodic and anodic protection, alloying and use of different class of inhibitors alone or in combination. The first class of inhibitors function by reacting chemically with the metal to form a non-penetrable layer over the metal surface and the last of inhibitors operates in a mechanical barrier fashion by increasing the viscosity of the corrosive medium to such an extent that it is effective in blocking the diffusion of corrosion reactants and products.

Adsorption inhibitors are generally organic compounds including substances of colloidal character. They appear to form a film over the metal surface and interface with the corrosive medium thereby acting as a barrier between the metal and the corrosive media. This type of inhibitors may also preferentially inhibit either at anodic or cathodic sites depending on their chemical constitution. The pickling inhibitors, however appear to attack especially at those cathodic regions which favor the hydrogen evolution. Anodic inhibitors are those substances that function by shifting the reaction at anode area. Anodic polarization is generally used to describe its action. Examples of some anodic inhibitors are alkali chromates, sodium silicate, sodium phosphate etc. Cathodic inhibitors, on contrast, obliterate the cathodic reaction and similarly cathodic polarization is used to describe their action. In acidic solution the main cathode reaction is evolution of hydrogen.

$$2H^{+}+2e^{-} \longrightarrow H_2\,(g)$$

(Aqueous)

Corrosion may be reduced by slowing down the diffusion of hydrated H+ ions to the cathode. Example of cathodic inhibitors is salt of nickel, zinc, arsenic and antimony.

The corrosion of aluminum and mild steel in hydrochloric acid solutions has been extensively studied [2-3]. Some chemicals as corrosion inhibitors are currently using in industries to prevent or to reduce the corrosion rate of metals in acidic media. Due to toxic nature and high cost of these compounds, development of green corrosion inhibitors (plant extracts) has attracted great deal of attention globally because they have been considered to be cheap, ecofriendly, non-toxic and a renewable source of material.

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Several naturally occurring substance have been investigated as corrosion inhibitors for a variety of metals and their alloy in different corrosive environment such as *Prosopis juliflora*, *Prosopis laevigata*, *Portulaca oleracea*, *Prosopis cineraria*, *Capparis decidua*, *Calotropis* Extract and *Solanum surrattence* [2-9]. In these studies crude extract of different parts of plant used as corrosion inhibitors and found that inhibition efficacy increases with increasing concentration of inhibitors. All inhibitors reduces corrosion rate to a significant extent.

Generally inhibition of metal corrosion occurs due to adsorption of organic molecules on metallic surface involves O, N, and S atoms. In most cases N and O of alkaloid is responsible for the adsorption. This process may block the active sites, hence decreasing the corrosion rate. The N atom of the alkaloid acts as the reaction center because of higher electron density, resulting in the formation of a monolayer on the metal surface. Organic inhibitors with active portions contain generally large C–H chains or rings with positively charged amine nitrogen group at the one end. In acids and water, the terminal primary, secondary and tertiary amines groups take additional hydrogen that gives them a net positive or cationic charge. The polar amine group is adsorbed on the metal and the hydrocarbon portion forms an oily water repellant surface film. The molecular shape (dissymmetry) helps these materials act as surfactants and can stabilize emulsions of oil and water.

Green corrosion inhibitors may function by:

1. Chemisorption of the molecule on the metallic surface.
2. Complex formation of the molecule with the metal ion, which remains in a solid state.
3. Neutralizing the corrosive agent.
4. Adsorbing the inhibitor.

They offered large coverage due to the long hydrocarbon chain and by the presence of OH groups. Being hydrophilic in nature, the OH groups counteracted the effects of chain length and ensured higher solubility.

CONCLUSION

Loss due to corrosion is very significant therefore it is important to minimize metal corrosion by using corrosion inhibitors. They appear to form a film over the metal surface and interface with the corrosive medium thereby acting as a barrier between the metal and the corrosive media. Green corrosion inhibitors are found to be cheap, effective and majorly non-toxic and can replace toxic chemicals.

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