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Green Corrosion Inhibitors for Mild Steel in HNO_3 and H_3PO_4 Solutions-A Review

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ABSTRACT: Corrosion is the deterioration of metal by chemical attack or reaction with its environment. Prevention would be more practical and achievable than complete elimination. One of the methods of control is adding inhibitor to the corrosive medium. However, the toxic nature of organic and inorganic inhibitors of corrosion to the environment has forced the enquire for harmless corrosion inhibitors called 'green corrosion' inhibitor due to their personal effects like non-toxicity, biodegradability, cheap and easily available. As result of extensive research towards green technology quite significant numbers of green inhibitors from plant extract are evolved in recent years.The inhibitor is chemically adsorbed on the surface of the metal and forms a protective thin film with inhibitor effect or by combination between inhibitor ions and metallic surface. Adsorptions of these ingredients on metal surface obey various adsorption isotherms. Corrosion of mild steel and its inhibition was analysed by weight loss (Gravimetric), effect of time of immersion and temperature, Gasometric andGas chromatography mass spectrometry (GC-MS) were employed. Electrochemical methods such as, Potentiodynamic polarization and Electrochemical Impedance Spectra (EIS) were employed. The protective films formed on metal surface have been analysed by various techniques such as Scanning Electron Microscope (SEM), Atomic Force Microscopy (AFM), Fourier transform infrared spectroscopy (FT-IR), Ultra-violet Spectrophotometry (UV).Energy Dispersive X-rays photoelectron spectroscopy (XPS) X-ray Spectroscopy (EDX) and electrochemical frequency modulation (EFM)analysis techniques. The results obtained from weight loss data and electrochemical techniques were in good agreement. This review paper presents a works published on plant extracts as green inhibitors for preventing corrosion of mild steelin HNO_3 and H_3PO_4 solutions.

KEYWORDS: Corrosion, Mild Steel, Green inhibitors, HNO_3 and H_3PO_4, Polarization, EIS, SEM.

I. INTRODUCTION

Corrosion is the destruction of material resulting from an exposure and interaction with the environment.Corrosion occurs due to the metals spontaneous need to revert to a more stable form as it is found in nature [1].It is a constant and continuous problem, often difficult to eliminate completely.Corrosion processes develop fast after disruption of the protective barrier and are accompanied by a number of reactions that change the composition and properties of both the metal surface and the local environment, for example, formation of oxides, and diffusion of metal cations into the coating matrix, local pH changes, and electrochemical potential[2].

Several techniques have been applied in order to reduce the corrosion of metals. The use of inhibitors was one of the most practical and efficient methods for protection against corrosion. Corrosion inhibitors are substances added in very small concentrations that they effectively reduce the corrosion rate [3]. Inhibitors retard metal corrosion by adsorbing on metallic surface and the process is influenced by some factors, which include molecular size of inhibitor, nature of substituents, inhibitor concentration, solution temperature and nature of test solution.Various synthetic organic and inorganic chemicals have been studied as corrosion inhibitors for mild steel in different aqueous media. Synthetic inhibitors being toxic in nature are less preferred, which has made the exploration of natural compounds which are cheap, nontoxic, and eco-friendly have a strong affinity towards the metal surface important. The plant extract are rich sources of molecules which have appreciably high inhibition efficiency and hence termed as "Green Inhibitors" [4]. This area of research is of much importance because in addition to being environmentally friendly and ecologically acceptable, plant products are inexpensive, readily available and renewable sources of materials. The polar functions of these molecules with S, O or N atoms, heterocyclic compounds and pi electrons are believed to be responsible for corrosion inhibition capacity of green corrosion inhibitors [5]. These compounds get adsorbed on metal surfaces and hinder the active corrosion sites formation, consequently protect the metal from deterioration. Among the ecofriendly inhibitors, biopolymers are the class of compounds that contain a greater number of heteroatoms. They are readily available, non-toxic, biodegradable and capable to control metals corrosion [6].