

Effect of Acidified *Feronia elephantum* Leaf Extract on the Corrosion Behavior of Mild Steel

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Mild steel is used as a structural material for pipes, tank, reaction vessels, etc. which are known to corrode invariably in contact with various solvents. From the view point of a nation's economy and financial implications of corrosion hazard, it is necessary to adopt appropriate means and ways to reduce the losses due to corrosion. The use of eco-friendly corrosion inhibitors are increasing day by day. *Feronia elephantum* leaf extract (FELE) has been tested as eco-friendly corrosion inhibitor for A262 mild steel in 1 M H₂SO₄ and 1 M HCl solutions using non-electrochemical (Gravimetric, X-ray diffraction analysis, scanning electron microscopy, and Fourier transform infrared spectroscopy) and electrochemical techniques (open circuit potential, potentiostatic polarization, and electrochemical impedance measurements). The protection efficiency is found to increase with increase in FELE concentration but decrease with temperature, which is suggestive of physical adsorption mechanism. The adsorption of FELE on mild steel surface obeys the Langmuir adsorption isotherm. SEM results confirm the formation of a protective layer by FELE over mild steel surface.

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I. INTRODUCTION

ACID solutions play a vital role in various industrial processes such as acid pickling, acid descaling, acid cleaning, and oil wet cleaning.^[1] They are extremely corrosive to mild steel. One way of protecting mild steel from corrosion is the use of organic inhibitors.^[2] The role of inhibitors is to form a barrier of one or several molecular layers against the acid attack. Several studies^[3–8] have been published on the use of natural products as corrosion inhibitors in different media. Most of the natural products are non toxic, biodegradable, and readily available in plenty. Various parts of plant seeds,^[9,10] fruits,^[11] leaves,^[12–14] and flowers^[15–18] have been extracted and used as corrosion inhibitors. Currently, naturally occurring organic molecules exhibiting a strong affinity for metal surfaces are the focal point of research oriented toward the development of environmentally friendly corrosion inhibitors which show good inhibition efficiency and low environmental

risk. Lorenz and Mansfeld^[19] classified the modes of inhibition effect of interface inhibitors into three classes:

- (i) The geometric blocking effect of adsorbed inhibitive species on the metal surface.
- (ii) The effect of blocking the active sites on the metal surface by adsorbed inhibitive species.
- (iii) The electro catalytic effects of the inhibitor and its reaction products.

Most of the efficient inhibitors used in industries are organic compounds which mainly contain nitrogen, sulfur, oxygen atoms, and multiple bonds in the molecule which donate a lone pair of electrons to the unoccupied orbitals of the metal atom. Stable and strong bonds are formed between the inhibitor and the metal surface during the self-assembling process.^[20,21] It has been observed that absorption of organic inhibitor depends on the physico-chemical properties of the functional groups and the electron density of the donor atom.^[22]

The choice of the inhibitors is based primarily on two considerations:

- (i) They can be synthesized easily from inexpensive material.
- (ii) The presence of an electron cloud on the aromatic ring, the electronegative nitrogen, oxygen atoms, and the presence of a CN group on steel surface prompting effective inhibition^[23]

Feronia elephantum is one of the medicinally important plants belonging to Rutaceae, commonly known as wood apple. The leaves are used traditionally in Ayurveda as anti-septic, aromatic, expectorant, purgative, useful in anorexia, bronchitis, calculus, cardiac debility, cough, and gastropathy. Taking into consid-

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