



ABSTRACT



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Corrosion of metals is a common problem that has an impact on the economy as well as the environment. The corrosion of mild steel is severe in the presence of an aggressive medium. Processes like acid cleaning, etching and pickling of metals, where metals come in contact with the acidic solution require the use of an inhibitor. Organic compounds have been widely used as corrosion inhibitors for metals and alloys. Most of the inhibitors are expensive synthetic chemicals having hazardous property to living creatures and environment. These toxic, expensive chemical inhibitors have to be replaced by the inhibitors obtained from natural sources which are environmentally safe, biodegradable and economical. A number of plant materials have been evaluated for their inhibition efficiency.

Plant extracts contain mixture of compounds and are biodegradable in nature. Hence the present study is to explore the performance of acid extracts of *Cassia fistula* and *Bougainvillea spectabilis* leaves and *Mirabilis jalapa* flowers (CFL, BSL and MJF) as corrosion inhibitors for mild steel in 1M HCl and 0.5M H₂SO₄. These plants are selected on the basis of their easy availability, biodegradability and less or non toxicity.

The effectiveness of the selected plant materials were studied using weight loss method (at different concentrations, various immersion periods and at room temperature and elevated temperatures) and electrochemical methods as linear polarization and impedance spectroscopy. All the three selected plant materials were found to be effective under the studied conditions. A maximum efficiency of above 90% was obtained at 5%v/v concentration of the extracts. The extracts behaved as effective inhibitors at the studied range of temperatures (303 K-343 K). The weight loss data were fit into Langmuir, Freundlich and Temkin isotherms. From the adsorption parameters it was found that the adsorption is physical at lower temperatures and at higher temperatures it became chemisorption. $1/Y$ calculated from El-Awady thermodynamic model showed that the adsorption of the phytochemical constituents present in the extract occurred by the displacement of 1-3 molecules of water.

The activation and thermodynamic parameters were calculated from the Eyring and Arrhenius plots. These parameters suggested spontaneous adsorption of the constituents of the extracts on the mild steel surface. The process was exothermic and the rate of adsorption was controlled by activation complex.

The polarization studies suggested mixed type of inhibition in all the cases. Nyquist plots confirmed the formation of inhibitive film and the mild steel-inhibitor system was under charge transfer control. Bode plots showed the adsorption process as a single step process.

The efficiencies obtained by different methods were compared. Eventhough there was difference in magnitude, there was a regular increase in efficiency with increase in concentration of the inhibitor and all the adopted methods showed maximum efficiency at 5% v/v concentration of the extracts in both the acid media. Among the three inhibitors, BSL was found to the best.

Monitoring the pickling baths showed that the same bath can be used for 3 sets of samples effectively before changing the acid. The extracts were stored under different storage conditions and tested for the stability. The extracts were stable and effective for six months even when stored under laboratory conditions. Hence it minimizes the storage cost.

A pilot study was done by preparing extracts i) after washing the leaves/flowers with petroleum ether and ii) by soaking in the acid for 12 hours. The efficiency was lower than that of the normal refluxed extract in both the methods. All the extracts were found to be environmentally safe when tested for bioaccumulation. The extracts were effective under the industrial conditions also.