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Inhibition of Mild Steel Corrosion in Hydrochloric Acid Medium Using an Aromatic Hydrazide Derivative

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Abstract : Mild steel has been widely employed as construction materials for pipe work in the oil and gas production such as down hole tubular, flow lines and transmission pipelines, in chemical and allied industries for handling acids, alkalis and salt solutions due to its excellent mechanical property and low cost. Acid solutions are widely used for removal of undesirable scale and rust in many industrial processes. Among the commercially available acids hydrochloric acid is widely used for pickling, cleaning, de-scaling and acidization of oil process. Mild steel exhibits poor corrosion resistance in presence of hydrochloric acid. The high reactivity of mild steel in presence of hydrochloric acid is due to the soluble nature of ferrous chloride formed and the cementite phase (Fe3C) normally present in the steel is also readily soluble in hydrochloric acid. Pitting attack is also reported to be a major form of corrosion in mild steel in the presence of high concentrations of acids and thereby causing the complete destruction of metal. Hydrogen from acid reacts with the metal surface and makes it brittle and causes cracks, which leads to pitting type of corrosion. The use of chemical inhibitor to minimize the rate of corrosion has been considered to be the first line of defense against corrosion. In spite of long history of corrosion inhibition, a highly efficient and durable inhibitor that can completely protect mild steel in aggressive environment is yet to be realized. It is clear from the literature review that there is ample scope for the development of new organic inhibitors, which can be conveniently synthesized from relatively cheap raw materials and provide good inhibition efficiency with least risk of environmental pollution. The aim of the present work is to evaluate the electrochemical parameters for the corrosion inhibition behavior of an aromatic hydrazide derivative, 4-hydroxy- N '-[(E)-1H-indole-2-ylmethylidene)] benzohydrazide (HIBH) on mild steel in 2M hydrochloric acid using Tafel polarization and electrochemical impedance spectroscopy (EIS) techniques at 30-60 °C. The results showed that inhibition efficiency increased with increase in inhibitor concentration and decreased marginally with increase in temperature. HIBH showed a maximum inhibition efficiency of 95 % at 8×10-4 M concentration at 30 °C. Polarization curves showed that HIBH act as a mixed-type inhibitor. The adsorption of HIBH on mild steel surface obeys the Langmuir adsorption isotherm. The adsorption process of HIBH at the mild steel/hydrochloric acid solution interface followed mixed adsorption with predominantly physisorption at lower temperature and chemisorption at higher temperature. Thermodynamic parameters for the adsorption process and kinetic parameters for the metal dissolution reaction were determined.

Keywords : electrochemical parameters, EIS, mild steel, tafel polarization
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