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Synergistic Inhibition between Benzyl Triphenyl Phosphonium Chloride and Halide Ions on the Corrosion of Mild Steel in Acidic Medium

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The effect of benzyl triphenyl phosphonium chloride (BTPPC) and halide ion (KI) on the corrosion of mild steel in a solution of 0.3 M phosphoric acid have been investigated at various inhibitor concentrations and temperatures by potentiodynamic polarization, electrochemical impedance spectroscopy (EIS), temperature kinetic, scanning electron microscopy (SEM) and atomic force microscopy (AFM) studies, respectively. Results obtained from potentiodynamic polarization studies, reveal that BTPPC and KI are mixed type inhibitors for mild steel in 0.3 M phosphoric acid. The synergistic effect of BTPPC and KI in corrosion inhibition of mild steel in 0.3 M H_3PO_4 containing low concentration of I^- has been evaluated by potentiodynamic polarization studies. The experimental results suggest that the presence of iodide ions in the solution stabilized the adsorption of BTPPC molecules on the metal surface and improved the inhibition efficiency of BTPPC. The corrosion behavior of mild steel in 0.3 M H_3PO_4 without and with the inhibitor at various concentrations was studied in the temperature range from (298 to 338) K. The inhibition efficiency increases with an increase in concentration at all temperatures. The inhibition efficiencies decrease with an increase in temperature. The adsorption of BTPPC + KI accords to the Temkin adsorption isotherm. Kinetic and thermodynamic parameters such as effective activation energy (E_a), Gibbs free energy of adsorption (ΔG^o_{ads}) and heat of adsorption (ΔH^o_{ads}) indicate that the adsorption of BTPPC + KI on the mild steel surface is primarily physical in nature. The results of scanning electron microscopy and atomic force microscopy are in agreement with the electrochemical analysis results.

Keywords: Polarization; Synergism; EIS; SEM; AFM