Synthesis and Characterization of Cyclic Cationic Polymer and its Anti-corrosion Property for Low Carbon Steel in 15% HCl Solution

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A new cyclic cationic polymer (CCP) bearing bis-3-phosphorylpropyl pendants was synthesized using chain-growth polymerization technique with ammonium persulphate (APS) as initiator. The synthesized polymer was characterized using FTIR, ¹H NMR and ¹³C NMR techniques. The corrosion inhibition performance evaluation of the newly synthesized polymer for low carbon steel in 15% HCl was carried out using weight loss measurements at 25 – 60 °C, electrochemical impedance spectroscopy (EIS), potentiodynamic polarization (PDP) and linear polarization resistance (LPR) techniques. The effect of addition of small amounts (5 mM) of ZnCl₂ and KI on the corrosion inhibition performance of CCP was also assessed. Results obtained indicate that CCP acts as an inhibitor for low carbon steel corrosion in the aggressive acid environment. Inhibition efficiency increased slightly with increasing CCP concentration. Also, inhibition efficiency was found to decrease with increase in temperature. Addition of ZnCl₂ and KI to CCP has profound effect on the corrosion inhibition performance, which was more pronounced with KI compared to ZnCl₂. Corrosion protection efficiency followed the trend CCP + KI > CCP + ZnCl₂ > CCP. The enhanced corrosion inhibition of CCP on addition of ZnCl₂ and KI is due to synergistic effect as confirmed from the calculated synergistic parameter which was found to be greater than unity. Inhibition of low carbon steel corrosion in 15% HCl occurs by virtue of physical adsorption of CCP onto the steel surface which can be approximated by Langmuir adsorption isotherm model. The SEM/EDS images confirm the adsorption of CCP to form protective film on the low carbon steel surface.

Keywords: Polymer; Hydrochloric acid; steel; Acid corrosion; Corrosion inhibition; Synergism

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