Microwave-assisted Synthesis of Green Inhibitor for Carbon Steel Acid Corrosion

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1-(3-bromopropyl)-4-(dimethylamino)pyridinium bromide (DPB) ionic liquid prepared via microwave-assisted synthesis was investigated as a potential corrosion inhibitor for carbon steel in molar hydrochloric acid solution by means of weight-loss method. The obtained results revealed the high inhibitive activity of the prepared ionic liquid with increasing inhibition efficiency reaching ca. 87.1% in the presence of 3×10^{-3} M DPB. The adsorptive nature of the inhibition process was proven by kinetics and thermodynamics investigations with a large adsorption constant ($K_{\text{ads}} = \text{ca. } 3.8 \times 10^3 \text{ mol}^{-1} \cdot \text{L}$) and an elevated activation energy ($E_a = \text{ca. } 83.1 \text{ kJ} \cdot \text{mol}^{-1}$). DPB was found to show a predominant physical adsorption onto the corroding carbon steel surface ($\Delta G_{\text{ads}} = \text{ca. } -35.9 \text{ kJ} \cdot \text{mol}^{-1}$). Electrochemical investigations revealed that DPB acted as a mixed-type corrosion inhibitor hindering both anodic and cathodic processes via blocking their respective active sites. The inhibitor was shown to form a protective layer resulting in increasing charge transfer resistance along with a decreasing double layer capacitance.

Keywords: Carbon steel; Corrosion; Ionic liquids; Gravimetric method; Langmuir isotherm; LPR; EIS.

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