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4-(2-(2-(2-(2-(Pyridine-4-yl)ethylthio)ethoxy)ethylthio)ethyl)pyridine as New Corrosion Inhibitor for Mild Steel in 1.0 M HCl Solution: Experimental and Theoretical Studies

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Abstract
The inhibition effect of 4-(2-(2-(2-(2-(pyridine-4-yl)ethylthio)ethoxy)ethylthio)ethyl)pyridine (P4E4P) on mild steel corrosion in 1.0 M HCl solution was investigated by quantum chemical calculations, electrochemical techniques, and weight loss measurements. The experimental results reveal that this compound has a good inhibiting effect and the inhibition efficiency, increased with the inhibitor concentration to reach 97% at 1 mM. The effect of temperature on the corrosion behavior of mild steel has been examined in the temperature range of 308–353 K. The inhibition efficiency increases with increasing inhibitor concentration, but decreases with increasing temperature. The adsorption of the inhibitor on mild steel surface obeyed the Langmuir adsorption isotherm. The kinetic and thermodynamic parameters for mild steel corrosion and inhibition adsorption, respectively, were determined and discussed. Potentiodynamic polarization suggested that it is a mixed type of inhibitor. Data obtained from EIS measurements were analyzed to model the corrosion inhibition process through the appropriate equivalent circuit model. Quantum chemical calculations were employed to study the electronic properties of P4E4P to ascertain the correlation between the inhibitory effect and the molecular structure. Both the experimental and theoretical results are in good agreement with each other in this regard and confirm that P4E4P is an effective inhibitor. © 2018, Springer Nature Switzerland AG.

Author Keywords
Adsorption; Corrosion inhibition; Mild steel; Pyridine derivative; Theoretical study

Index Keywords
Adsorption, Carbon steel, Chlorine compounds, Corrosion inhibitors, Corrosive effects, Efficiency, Electrochemical corrosion, Electronic properties, Equivalent circuits, Hydrochloric acid, Low carbon steel, Pyridine, Quantum chemistry, Temperature; Corrosion inhibition, Electrochemical techniques, Equivalent circuit model, Kinetic and thermodynamic parameters, Langmuir adsorption isotherms, Pyridine derivatives, Quantum chemical calculations, Theoretical study; Steel corrosion

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