Some Phenothiazinyl-thiazolyl-hydrazine Derivatives as Corrosion Inhibitors for Carbon Steel in 1.0 M HCl: Electrochemical, SEM-EDX and DFT Investigations

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The inhibition proprieties of two phenothiazinyl-thiazolyl-hydrazine derivatives, namely (*E*)-ethyl 2-((10-ethyl-10*H*-phenothiazin-3-yl)methylene)hydrazinylthiazole-4-carboxylate (CxTP) and (*E*)-10-ethyl-3-((2-(4-phenyl thiazol-2-yl)hydrazono)methyl)-10*H*-phenothiazine (PhTP) on carbon steel corrosion in 1.0 M HCl solution were studied at various concentrations, temperatures and exposure times using electrochemical techniques, SEM-EDX and quantum chemical calculations. Potentiodynamic polarization revealed that the phenothiazinyl-thiazolyl-hydrazine derivatives act as mixed-type corrosion inhibitors; their inhibition efficiency increases with increasing the inhibitors concentration (91.6% at the optimal concentration of 150 μM for CxTP) and slightly decreases at elevated temperatures and after 24 hours exposure to the corrosive solution. Based on the electrochemical impedance spectroscopy results, two suitable structural models of the carbon steel/1.0 M HCl interface were proposed to describe the processes taking place in the absence and in the presence of the organic inhibitors, respectively. The adsorption of the organic inhibitors on carbon steel surface obey Langmuir isotherm. SEM-EDX investigations confirmed that the phenothiazinyl-thiazolyl-hydrazine derivatives are able to significantly retard the carbon steel dissolution. Density functional theory was used to understand the nature of the interactions between the protonated organic molecules and the metallic surface.

Keywords: carbon steel; corrosion inhibition; polarisation; electrochemical impedance spectroscopy; scanning electron microscopy

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