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A New Inhibitor for Steel Rebar Corrosion in Concrete: Electrochemical and Theoretical Studies

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An original Schiff base 4-hydroxy-3-[1-(3-hydroxy-naphthalen-2-ylimino)-ethyl]-6-methyl-pyran-2-one (L_1) is synthesized using the condensation method and characterized by X-ray diffraction spectroscopy (XRD). The compound obtained is a mono-crystal. The study of its inhibitory efficiency with respect to the corrosion of mild steel in reinforced concrete was realized using the potentiodynamic polarization and impedance spectroscopy (EIS) as electrochemical methods. The inhibition power of this Schiff base against the corrosion of mild steel in concrete is studied in the aggressive medium 0.5M NaCl as a function of the concentration of the inhibitor, immersion time and temperature. High inhibition power 90**%** is determined for the low concentration 10^{-6}M at t=28 days and T= 30°C. This inhibition increases as a function of temperature. The thermodynamic study was used to identify the mechanism of inhibitory action of L_1. The inhibiting power (EI%) and the apparent activation energy (Ea) have been calculated at different concentrations of L_1. The values of ΔG_{ads}, E_a, ,ΔH_a, and ΔS_a showed that L_1 is a good inhibitor of corrosion of the rebar in concrete in an environment of 0.5M NaCl. The inhibitor studied follows a chemisorption process. The adsorption behavior of this product obeys to Langmuir isotherm. The electrochemical results were confirmed with scanning electron microscopy (SEM). The quantum chemical parameters determined by theoretical calculations were used to elucidate the relationship between inhibiting effect of L_1 and its molecular structure.

Keywords: Corrosion, Concrete, Inhibitor, Schiff bases, XRD, EIS, SEM, DFT.

FULL TEXT