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Corrosion inhibition of steel using different families of organic compounds: Past and present progress

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ABSTRACT

Application of organic compounds as corrosion inhibitors, particularly heterocyclic compounds, is one of the most economical and effective corrosion mitigation methods of steel alloys. These compounds become effective by forming a corrosion inhibitive hydrophobic film over the metallic surface. The corrosion inhibition potential of these compounds depends on numerous factors, including substituents present in their molecular structures. Literature investigation suggests that these compounds become effective by blocking the active sites (responsible for the corrosion) through their adsorption using their electron-rich polar functional groups and multiple bonds. Adsorption of these compounds on the metallic surface mostly follows the Langmuir adsorption isotherm model. Generally, these compounds act as mixed- and interface-type corrosion inhibitors as they retard both anodic and cathodic Tafel reactions and increase the value of charge transfer resistance, respectively. The present review article features the collection of reports on the inhibition of steel corrosion using different families of organic compounds. Other aspects of corrosion, such as the form of corrosion and its mitigation using experimental and computational methods, have also been discussed.

Contents

Abbreviations: ΔG_{ads}, Gibbs free energy of adsorption; ΔH_{ads}, Enthalpy of adsorption; **η**, Corrosion inhibitionefficiency; **PDP**, Potentiondynamic polarization; **FTIR**, Fourier transform infrared spectroscopy; **LCAO**, Linear combination of atomic orbital; **EIS**, Electrochemcial impedance spectroscopy; **OCP**, Open circuit potential; **ER**, Electrical resistance; **XPS**, X-ray photoelectron spectroscopy; **SEM**, Scanning electron microscopy; **AFM**, Atomic force microscopy; **MIC**, Microbiologically influenced corrosion; **UV–vis**, Ultra-violet-visible spectroscopy; **HR-TEM**, High-resolution transmission electron microscopy; **IGC**, Intergranular Corrosion; **XRD**, X-ray diffraction; **SPM**, Scanning probe microscope; **SVET**, Scanning vibrating electrode technique; **DSC**, Differential scanning calorimetry; **CV**, Cyclic voltammetry; **η**, Corrosion inhibition efficiency; **MD simulation**, Molecular dynamic simulation; **MC simulation**, Monte Carlo simulation; **SCC**, Stress Corrosion Cracking; **IFM**, Infra fluorescence microscopy; **LSCM**, Laser scanning confocal microscope; **SRB**, Sulfate-reducing bacteria.

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