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Eco-Friendly Polymeric Corrosion Inhibitor for Sour Oilfield Environment

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Abstract : Although natural polymers have been shown to have some inhibitory properties on sour corrosion, they are not considered very effective green corrosion inhibitors. Accordingly, effective corrosion inhibitors should be developed based on natural resources to mitigate sour corrosion in the oil and gas industry. Here, Arabic gum was employed as an eco-friendly precursor for the synthesis of innovative polyurethanes designed as highly efficient corrosion inhibitors for sour oilfield solutions. A comprehensive assessment, combining experimental and computational analyses, was conducted to evaluate the inhibitory performance of the inhibitor. Electrochemical measurements demonstrated that a concentration of 200 mM of the inhibitor offered substantial protection to mild steel against sour corrosion, yielding inhibition efficiencies of 98% and 95% at 25 ºC and 60 ºC, respectively. Additionally, the presence of the inhibitor led to a smoother steel surface, indicating the adsorption of polyurethane molecules onto the metal surface. X-ray photoelectron spectroscopy results further validated the chemical adsorption of the inhibitor on mild steel surfaces. Scanning Kelvin probe microscopy revealed a shift in the potential distribution of the steel surface towards negative values, indicating inhibitor adsorption and corrosion process inhibition. Molecular dynamic simulation indicated high adsorption energy values for the inhibitor, suggesting its spontaneous adsorption onto the Fe (110) surface. These findings underscore the potential of Arabic gum as a viable resource for the development of polyurethanes under mild conditions, serving as effective corrosion inhibitors for sour solutions.

Keywords : environmental effect, Arabic gum, corrosion inhibitor, sour corrosion, molecular dynamics simulation
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