Exploring the absorption and desorption behavior of 2-mercaptopyrimidine as an inhibitor in CO_2-containing solution

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Abstract: The injection of corrosion inhibitors is widely employed as an effective method to mitigate the corrosion rate [1-3]. The corrosion inhibition performance of inhibitors in the formation water may be affected by factors such as the inhibitor dosing, solubility and shear stress [4-6]. This work focuses on investgating the effect of inhibitor dosing and Cl^- content in solution on the 2-mercaptopyrimidine (2-MP) inhibitor film integrity.

In this study, the corrosion inhibition efficiency of 2-MP on L360 carbon steel was evaluated using Electrochemical Impedance Spectroscopy (EIS), weight loss measurements, and the adsorption behavior of 2-MP on an Au surface was explored via Quartz Crystal Microbalance (QCM). All experiments were conducted in CO_2-saturated formation water containing varying concentrations of 2-MP. Solutions with varying Cl^- content were selected to analyze the ionic influence on the corrosion inhibition behavior of 2-MP. The inhibition performance of 2-MP at 20 ppm in CO_2-saturated solutions with varying NaCl contents on L360 carbon steel was assessed through electrochemical, weight loss, and surface analytical methods. The desorption behavior of 2-MP was monitored using QCM and Ultraviolet-Visible Spectroscopy (UV-vis). In addition, molecular dynamics (MD) simulations were employed to investigate the surface adsorption configurations of 2-MP. The Dynamic Light Scattering (DLS) technique was used to analyze the changes in micelle size and the diffusion coefficients of desorbed 2-MP molecules in varying NaCl content solutions. The main conclusions are as follows:

(1) As 2-MP concentration rises, corrosion inhibition efficiency increases and then stabilizes, peaking at 100ppm due to saturation;

(2) As the NaCl content increases, corrosion inhibition performance of 2-MP declines, and the corrosion rate of L360 carbon steel escalates from 0.0405 mm/a to 0.0914 mm/a;

(3) As NaCl content increases, it facilitates 2-MP desorption on the Au surface, which indicates intensified desorption and promotes the formation of 2-MP micelles.

Keywords: Carbon steel, Corrosion inhibitor, Adsorption, Desorption.

Reference

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