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Adsorption and Inhibition Behavior of Calcium Lignosulfonate on Steel in NaCl + $Ca(OH)_2$ Solutions with Different pH Values

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Potentiodynamic polarization measurements, microscopy infrared imaging (M-IR) and X-ray photoelectron spectroscopy (XPS) were used to study the adsorption and inhibition behavior of calcium lignosulfonate (CLS) on Q235 steel in 0.1 mol/L NaCl + $Ca(OH)_2$ solution (pH 7 ~ 12.5). In the solution of pH between 7 and 9.5, carbon steel was in active state. 0.001 mol/L CLS in the solution effectively inhibited both the cathodic and the anodic reactions. When the solution pH value increased to 9.5~10.5, passivation occurred and the main compositions of the passive film include Fe_2O_3, FeOOH, FeO and $CaO/Ca(OH)_2$. CLS promoted the passive state and raised the pitting corrosion potential E_b. In the solution of pH 7~9.5, an inhibition film formed by adsorption of the sulfonic acid group and benzene ring in CLS molecular on the surface. When the pH value increased to 10.5, a Ca-O-S co-adsorption structure could form between $-SO_3$ group in CLS and the outer side layer of the passive film which is composed of $CaO/Ca(OH)_2$. The strong adsorption characteristic between $-SO_3$ group in the adsorbed CLS on the surface and Ca^{2+} ions in solution may further improve the compactness of the adsorption film.

Keywords: Carbon steel; Corrosion; Inhibitor; CLS; Microscopy infrared imaging; XPS

FULLTEXT