Effect of Chloride and Sulfate Ions on the SCC of API-X70 Pipeline Welds in Diluted Carbonated Solutions

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The stress corrosion cracking (SCC) susceptibility of longitudinal weldments of API-5L X-70 PSL1 pipeline steel in diluted bicarbonate solutions with and without the addition of chloride and sulfate ions by using slow strain rate tests (SSRTs) has been evaluated. The tests were complemented with potentiodynamic polarization curves, and hydrogen permeation measurements using the Devanathan-Stachurski method. Solution concentrations varied from 0.1 to 0.0001M NaHCO₃. In addition, chloride (Cl⁻) and/or sulfate (SO₄²⁻) ions were added to the 0.01M NaHCO₃ solution. Results showed a high corrosion rate and an increase in the hydrogen permeability rate in the 0.01 M NaHCO₃ solution presented by the welding samples. The addition of Cl⁻ ions increased the activity of the solution, but with the additions of SO₄²⁻ ions, the metallic surface developed a passive layer that was associated with surface crack initiation. Analysis of fractured surfaces showed mainly of ductile rupture, but some indications of micro cracks and quasi-cleavage mode fracture characteristic of hydrogen embrittlement at the weldment were found in both the 0.001M NaHCO₃ and 0.01M NaHCO₃ with Cl⁻ + SO₄²⁻ ion solutions.

Keywords: API X-70 steel; Stress Corrosion Cracking; Hydrogen permeation; Weldment.

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