Effects of Stray AC Interference on Corrosion Behavior of X70 Pipeline Steel in a Simulated Marine Soil Solution

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The effects of stray alternating current (AC) on the corrosion behavior of X70 high strength pipeline steel in a marine soil simulated solution was investigated. For a comparison, the study was operated in 3.5% NaCl solution and with an application of 150 MPa tensile stress as well. The electrochemical measurements of open circuit potential (OCP) and potentiodynamic polarization were used to exam the electrochemical process on the X70 steel surface under AC interference. A digital camera and scanning electron microscope (SEM) were used to analysis the corrosion morphology. The results show that a 30 A/m² AC interference slightly shifted the corrosion potential -0.03 V, while a 300 A/m² AC signal changed the value as much as -0.2 V. It was well explained with a mathematic model of AC interference. The corrosion rate increased with the AC current density in all test conditions. A corrosion mechanism was proposed to describe the occurrence of AC corrosion on the X70 steel sample surface. A net anodic current, implying an anodic dissolution, was resulted from a complete cycle of AC interference. The corrosion morphology changed from uniform corrosion to pitting corrosion under the AC interference. Thus, stray AC promoted the localized corrosion.

Keywords: Stray alternating current corrosion, X70 pipeline steel, corrosion mechanism, corrosion morphology, simulated marine soil solution

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