Study on corrosion and delamination behavior of X70 steel under the coupling action of AC-DC interference and Stress

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The combined influences of AC-DC interference and stress on the corrosion and delamination behavior of X70 steel in the neutral environment was studied using COMSOL Multiphysics software, electrochemical tests, weight loss experiments, and surface analysis techniques. Results showed that, under the stress of 364 MPa, as the stray current density increased, the corrosion potential shifted towards the negative side, with no passive region on polarization curves, but only an active dissolution region. Under the influence of DC interference, the anodic polarization curves showed a significant inflection point, due to the accumulation of a large number of corrosion products on the surface of X70 steel, which hindered the anodic polarization. At the same time, the corrosion rate and the maximum depth of the corrosion pits increased with increase in DC density. The corrosion reaction followed Faraday's law of electrolysis. Under the influence of combined AC and DC interferences, the corrosion rate and the depth of the corrosion pits were in the following order: combined AC and DC interferences > DC interference > AC interference. The influence of AC interference on the delamination was less than that of DC interference. The delamination area of the anticorrosive coating under DC interference with a current density of 300 A/m² was about 5 times that under AC interference. Also, under the combined influence of AC and DC interference, the delamination area of the coating was larger than that under the influence of either AC or DC interference. In this paper, a model for delamination process under the influence of stray current was proposed, in which, the corrosion reaction occurred first at the sample defects. When the amount of corrosion product accumulated to a certain extent, separate cathode and anode regions were formed on the sample surface, which resulted in delamination of the coating.

Keywords: AC-DC interference; stray current; stress; corrosion; delamination

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