Key Factors of Stress Corrosion Cracking of X70 pipeline Steel in Simulated Deep-sea Environment: Role of Localized Strain and Stress

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The effect of the localized strain and stress on the stress corrosion cracking (SCC) of X70 steel in simulated seawater at 500 m depth was investigated by performing finite element analysis, electrochemical measurements, slow strain rate tensile (SSRT) tests, and scanning electron microscopy (SEM). The results suggested that the deformation accelerates the electrochemical reaction rate. The SCC susceptibility increases with the increase of elastic deformation, and it reaches the maximum value when stress strength increases to the yield point. In the plastic deformation, the deformation firstly increased then reduced SCC susceptibility because of hydrogen embrittlement (HE) and Bauschinger effect. The decrease of SCC susceptibility in plastic deformation was influenced by the increase of irreversible traps. It was observed that the cracks initiated at corrosion pits.

Keywords: deep sea environment; finite element analysis; mechanical electrochemistry; stress corrosion cracking

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