Cathodic Protection Criteria for X80 Steel in Soil Extract

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Potentiodynamic polarization, electrochemical impedance spectroscopy and slow strain tensile rate tests were used to establish the negative critical potential range for cathodic protection of X80 steel in soil extract. The results showed that the hydrogen-charged potential was around -800 mV (vs. SCE), and the applied cathodic potential was of great significance for X80 steel's hydrogen embrittlement. Besides, when the cathodic protection potential was in the range prior to -850 mV, the amount of hydrogen evolution was insignificant, which had a little effect on the mechanical performance of X80 steel. Meanwhile, the fracture morphology showed dimple-like plastic fracture characteristics. On the contrary, with negative shift of the cathodic potential to -900 mV or more, a plastic brittle transition occurred owing to the large amounts of hydrogen released at this time. Thus, the negative critical potential range of X80 steel during the cathodic protection process at room temperature in soil extract was determined as -800 mV ~ -850 mV.

Keywords: API X80 steel, potentiodynamic polarization, EIS, SSRT, hydrogen embrittlement

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