Study of the Electrochemical Corrosion Behaviour of X70 Steel in H₂SO₄ Contaminated Silty Soil

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In this paper, electrochemical impedance spectroscopy (EIS), polarization curves (PC), scanning electron microscopy (SEM), and energy dispersive spectroscopy (EDS) were used to test the electrochemical corrosion behaviour of X70 steel in contaminated silty soil with different pH values under indoor simulation conditions. Four different pH values of contaminated silty soil (1.50, 3.78, 5.03 and 7.07) were obtained through different concentrations of H₂SO₄ solution. The experimental results show that silty soil contaminated with H₂SO₄ solution accelerated the corrosion rate of X70 steel. In addition, the corrosion rate increased with a decrease in the pH values of the contaminated silty soil. However, the corrosion rate decreased with an increase in corrosion time due to an accumulation of corrosion products on the X70 steel surface. In weakly acidic contaminated silty soil and neutral silty soil (pH=7.07 and 5.03), the corrosion morphology and corrosion type of X70 steel are similar, i.e., a large number of silty soil particles and deep reddish-brown corrosion products (iron oxides) were evenly covered on the X70 steel sample. Additionally, the corrosion of the sample was relatively slight after removing the cover layer, and the corrosion pits were shallow and small and evenly distributed on the surface of the X70 steel. However, in strongly acidic (pH=1.50, 3.78) contaminated silty soil, the X70 steel was seriously corroded. Among the contaminated silty soil with a pH of 3.78, a large amount of dark red-brown rust was generated on the X70 steel surface. Large-sized corrosion pits and grooves were evident after derusting. When the pH reached 1.50, two-thirds of the surface of the X70 steel were covered by a layer of milky-yellow corrosion products (sulfur-containing compounds), which protected it from corrosion. However, the area that was not significantly covered was seriously corroded, and a large number of deep and large pits appeared on the X70 steel surface.

Keywords: silty soil, X70 steel, pH values, EIS, polarization curves

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