Corrosion Behavior of Aluminum in Dilute Acetic Acid Solution Simulating Cooling Water in HVDC Transmission

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The concentration, temperature effect and thermodynamic activation energy of aluminum corrosion in dilute acetic acid solution were explored by the polarization curve and the electrochemical impedance spectroscopy. With the increase of concentration and solution temperature of acetic acid solution, the corrosion resistance and charge transfer impedance of aluminum decreased. From 0 mM to 1.00 mM of acetic acid solution concentration, the corrosion potential, corrosion current density, anodic Tafel slope and charge transfer impedance of aluminum corrosion at 25 °C changed from -1.316 V, 0.207 $\mu\text{A cm}^{-2}$, 5.581 V dec⁻¹, 10.890 k $\Omega\text{ cm}^{-2}$ to -1.141 V, 0.525 $\mu\text{A cm}^{-2}$, 4.264 V dec⁻¹, 7.344 k $\Omega\text{ cm}^{-2}$. And with the solution temperature increase from 25 °C to 55 °C, the corrosion potential, corrosion current, anodic Tafel slope and charge transfer impedance of aluminum in 0.1 mM acetic acid solution changed from -1.248 V, 0.337 $\mu\text{A cm}^{-2}$, 5.387 V dec⁻¹, 9.590 k $\Omega\text{ cm}^{-2}$ to -1.046 V, 1.651 $\mu\text{A cm}^{-2}$, 5.031 V dec⁻¹, 1.633 k $\Omega\text{ cm}^{-2}$. The aluminum corrosion in dilute acetic acid solution was a transition chemical reaction of four processes (diffusion → surface adsorption → surface reaction → desorption).

Keywords: aluminum, corrosion, acetic acid, radiator, high voltage direct current transmission

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