Corrosion Characteristics of Aluminum in Sodium Bicarbonate Aqueous Solution at 50 °C

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This paper considers the corrosion behavior of aluminum in a range of low-concentration sodium bicarbonate solutions at high temperature (50 °C). Aluminum exhibits enhanced corrosion inhibition (passivation) in low concentration sodium bicarbonate solutions when compared to deionized water. It was determined that an aluminum electrode in 1×10^{-3} mol L⁻¹ sodium bicarbonate solution (pH 7.77) exhibited the lowest corrosion rate based on the lowest measured corrosion current, the most positive corrosion potential, and the maximum charge transfer impedance. The corrosion of aluminum was inhibited in sodium bicarbonate solution because HCO₃⁻ anions in the solution developed an ordered charge field at the interface of the aluminum/electrolyte, which limited the diffusion of aluminum ions. This ordered charge field may also enhance the formation of a protective aluminum oxide film, which can effectively inhibit the corrosion of aluminum. The scanning electron microscope (SEM), energy dispersive spectrometer (EDS) and X-ray diffraction (XRD) confirmed that the corrosion products covering the surface of the aluminum electrode were Al(OH)₃ and/or Al₂O₃. This paper provides a basis for resolving scaling problems associated with the grading electrode in high-voltage direct current systems caused by the corrosion of the aluminum radiator.

Keywords: Aluminum, Corrosion, Sodium bicarbonate solution, Bicarbonate radical, Radiator, Thyristor, High-voltage direct current

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