High-temperature Corrosion Investigation of the Inconel-600 in Molten Sulfate/Vanadate Mixtures Using Electrochemical Techniques

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In this paper, the results obtained from polarization curves (PC) and Electrochemical Impedance Spectroscopy (EIS) for Inconel-600 exposed in two different compositions of corrosive molten salts are presented. The Inconel-600 samples were exposed to high sulfate (80 mol% Na₂SO₄-20 mol% V₂O₅) and high vanadium (80 mol% V₂O₅-20 mol% Na₂SO₄) molten salts at 700 °C during 120 h. Tafel slopes, current densities and corrosion potentials were obtained from polarization curves for both corrosive systems. EIS was used to determine the controlling corrosion mechanism, either charge transfer (activation) or mass diffusion, and the charge transfer resistance R_{ct}. Scanning electron microscopy analysis (images and mappings) showed that Inconel-600 exposed to the high sulfate molten salt suffered inter-granular corrosion, which was due to an oxidation process through the grain boundaries, just below the metal-scale interface; whereas exposed to the high vanadium molten salt, Inconel-600 corroded by means of a generalized corrosion process, which was due to the diffusion of sulfur to the surface and inside the alloy. The corrosion mechanisms suffered by the Inconel-600 in both corrosive molten salts were supported by X-ray diffraction analyses of the corrosion products, which showed the presence of chromium, iron and nickel oxides together with some vanadates as secondary compounds.

Keywords: Superalloy, molten salts, hot corrosion, EIS.

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