ANALYSIS OF ELECTROCHEMICAL IMPEDANCE DATA FOR ALLOY C-22 IN PROTOTYPICAL HIGH LEVEL NUCLEAR WASTE ENVIRONMENTS

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Alloy C-22 has emerged as the material of choice for the fabrication of canisters for the disposal of High Level Nuclear Waste (HLNW) in the Yucca Mountain Repository in Nevada. This nickel-based alloy, which contains chromium (20.0-22.5 %), molybdenum (12.5-14.5 %), tungsten (2.5-3.5 %), and iron (2.0-6.0 %) as major alloying elements displays excellent corrosion resistance when in contact with saturated, low pH brines and other solutions at temperatures up to at least 100 ^{o}C. The corrosion resistance can be attributed to the high stability of the passive film that forms on the alloy surface. The barrier layer of the passive film appears to comprise Cr_2O_3, although some cation substitution by Fe and Ni may occur. In any event, the passive film is such that general corrosion rates corresponding to a few tens of nA/cm^2 are commonly obtained under steady state conditions, even under severe environmental conditions. In order to better understand the origin of the high corrosion resistance of Alloy C-22, and to make available critical data for modeling the corrosion behavior of canisters in the Yucca Mountain Repository over the design life of 10,000 years, we have measured electrochemical impedance data on Alloy C-22 in NaCl solutions at 80 ^{o}C and as a function of potential across the passive range. We report here preliminary analyses of the data, including the extraction of values for various parameters contained within the PDM[1]. These parameter values are now being used to model the steady state and transient behavior of Alloy C-22 in prototypical HLNW environments, in order to predict the accumulation of general corrosion damage over the 10,000-year design life of the repository.

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[1] D. D. Macdonald, Pure Appl. Chem., **71**, 951 (1999).