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## **Evolution of Chemistry and Its Effects on the Corrosion of Engineered Barrier Materials**

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### **Abstract**

The evolution of environmental conditions within the emplacement drifts of a potential high-level waste repository at Yucca Mountain, Nevada, may be influenced by several factors, including the seepage water composition, temperature, and relative humidity. Environmental conditions in the emplacement drifts will affect the degradation processes that determine the performance of the waste package and drip shield. The formation of aggressive environmental conditions, characterized by the concentration of chemical species that promote localized corrosion or stress corrosion cracking, could cause early degradation of the waste package or drip shield. In contrast, slow degradation rates and long lifetimes can result if the environmental conditions are not aggressive and the corrosion rates are controlled by the slow dissolution of passive oxide layers on the titanium alloy drip shield and the Alloy 22 waste package outer barrier. Although the corrosion behavior of the waste package and drip shield materials has been studied over a wide range of conditions using standard corrosion testing methods, our understanding of the evolution of environmental conditions within the emplacement drifts continues to develop. In this study, tests were conducted to evaluate the evolution of environmental conditions on the waste package surfaces and in the surrounding host rock. The tests were designed: (i) to simulate the conditions expected within the emplacement drifts; (ii) to measure the changes in near-field chemistry; and (iii) to determine the influence of the environment on the performance of the engineered barrier materials. The tests focused on determining the evolution of water chemistry and the formation of salts on the simulated waste package surface using initial water chemistries representative of neutral-, alkaline-, and calcium-chloride-type brines. Preliminary results indicate that all the initially dilute aqueous solutions evaporated and formed solid salt deposits. The formation of brines was not observed at a temperature of 110 °C [230 °F]. The composition of the salts that formed was dependent on the composition of the starting water chemistry. The measured salt compositions suggest that the deliquescence of the salt deposits will not result in brines that promote either localized corrosion or stress corrosion cracking of the titanium alloy drip shield and the Alloy 22 waste package outer barrier. Corrosion sensors are being integrated into the test system to measure the time-dependent changes in environmental conditions and corrosion rates.

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