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Potential Microbial Effects on Near-Field Chemistry for Alternative Waste Management Scenarios

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Abstract

Existing assessments of disposal system performance have typically attributed low consequence to microbially influenced corrosion processes for two reasons. The microbial population in deep geologic formations is generally dormant due to constraints on the availability of nutrients in the subsurface, and the high temperatures and radiation fields that would be associated with high-level radioactive waste packages upon emplacement would tend to reduce or eliminate microbial effects in the vicinity of the waste packages for hundreds or thousands of years. However, alternative spent fuel management scenarios may involve waste packages or disposal system designs that are less radioactive and have lower thermal output. For example, prolonged storage (e.g., 100 years or more) of high-level wastes prior to disposal may result in the emplacement of lower temperature waste packages and, consequently, a wetter near-field environment during the early postclosure period. Both of these conditions could maintain or promote microbial activity in the vicinity of the waste packages, potentially providing a corrosion environment that is more locally aggressive than the conditions that have been assumed for other repository performance assessments.

The simulation and evaluation of long-term performance in potential future disposal system designs may need to identify microbially influenced environmental conditions that could significantly affect the corrosion of engineered barriers important to waste isolation. An initial step in this process for a prospective geologic environment and disposal system design would be to compare the expected range of temperature-related corrosion rates for the engineered materials with the expected viability of microbes under the range of thermal conditions in a disposal system. The near-field environment of potential interest would be one that is not too hot to restrict microbial activity but is still warm enough to support temperature-enhanced corrosion rates for the engineered barriers. Further investigations may be necessary to characterize the expected microbial population of the near-field environment and to assess the likelihood that the microbes would flourish to produce corrosive conditions for engineered materials.

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