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The Role of Capillary Barriers in Reducing Moisture Content on Waste Packages

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Assessment of the performance of engineered capillary barriers at the potential Yucca Mountain nuclear waste repository site, in which 1.67-m-diameter waste packages are to be emplaced in 5-m-diameter tunnels according to current design, brings up aspects not commonly considered in more typical applications of capillary barriers (e.g., near-surface landfills). Engineered capillary barriers typically consist of two layers of granular materials with a sloping interface, in which the contrast in capillarity between the layers keeps infiltrating water in the upper layer.

One issue is the effect of thermohydrologic processes that would occur at elevated repository temperatures (and temperature gradients). For example, backfill materials may be altered from that of the as-placed material by the hydrothermal regime imposed by the emplacement of waste in the repository, changing hydrologic properties in a way that degrades the performance of the barrier. A reduction of permeability in the upper layer might diminish the capacity of the upper layer to divert incoming seepage or to cause a "vapor lid" whereby buoyant vapor flow would be trapped, then condense and drain onto waste packages. Other concerns are the result of highly spatially and temporally variable seepage distribution and the very limited spatial scale available for flow attenuation and diversion.

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