

Authigenic mineral growth and copper corrosion in hydrothermal bentonite experiments.

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The United States' Department of Energy has initiated the Used Fuel Disposition campaign to evaluate various generic geological repositories for the permanent disposal of used nuclear fuel and wastes. The development and evaluation of engineered barrier system (EBS) design concepts and their potential interactions with the natural barrier or with other EBS interfaces are inherently important to the long-term (i.e., tens of thousands of years) safety and performance assessment of the safety case. In some designs, copper cladding can be added on to the steel canister. Japan and Sweden currently incorporate this canister design.

The focus of this experimental work is to characterize interaction of bentonite with potential used-fuel waste container materials (i.e. copper). Experiments were performed up to 300°C at 150 – 160 bars for five to six weeks. Bentonite was saturated with a 1,900 ppm K-Ca-Na-Cl-bearing water with Cu-foils. Copper rapidly degrades into chalcocite (Cu₂S) and minor covellite (CuS) in the presence of H₂S. Chalcocite growth and corrosion pit depths were measured for four different experimental runs yielding corrosion rates between 8.8-116 μm/yr depending on duration of experiment, brine composition, and clay type (bentonite vs. Opalinus Clay). Results of this research show that nuclear waste containers act as a substrate for mineral growth in response to corrosion and that Cu clad canisters are a possible engineered barrier system material.