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Interaction between compacted bentonite and corrosion products in the KAERI Underground Research Tunnel

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Corrosion reaction in the disposal canister changes their mechanism and corrosion products as the disposal environment evolves, and the resulting corrosion products may remain in the form of sediments at the interface between disposal canister and buffer or penetrate into buffers by transformation, resulting in changes in buffer performance.

The disposal site is at high temperature state, it was intended to examine the long-term corrosion behavior of the canister materials at a 30C condition. This study conducted a field experiment to confirm whether the performance and characteristics of bentonite buffer materials surrounding a copper disposal canister for high-level waste disposal are maintained long term following the corrosion of the candidate materials in a deep geologic environment. We investigated density, swelling index, element concentration and chemical composition of the buffer using mineral oil, KS K 0764, FIB-EDS, ICP and XRF. Also, we analyzed mineral composition of the buffer using XRD.

As a result of analyzing the interaction between the buffer and corrosion products, the water content of the buffer changed from the initial 11% to 19-22%, maintaining a state close to saturation. At an initial dry density of 1.6 g/cm^3, the Ca-bentonite block was changed to 1.67-1.84 g/cm^3 and Na-bentontie block to 2.04-2.09 g/cm^3. The thickness of penetration of the resulting corrosion products in the Ca- and Na-bentonite was up to 2.0 and 0.5 mm for 10 years, with penetration rates of 0.2 and 0.05 mm/yr respectively. In Ca-bentonite, swelling was observed when in contact with RP and CSC Cu, with d-spacing expansions of 2.9% and 3.8%, respectively. In comparison, Na-bentonite showed d-spacing expansions of 17.6% and 19.6% when in contact with RP and CSC Cu, respectively. No changes in the chemical and mineral compositions of the Ca- and Na-bentonite blocks were observed. Ca-bentonite exhibited a tighter structure than MX-80 under KURT conditions. The presence of either green copper corrosion products or cuprite on bentonite did not have any notable effect on the porewater chemistry.

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