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Healing of compacted bentonite block joints permeated by synthetic underground water

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High-level radioactively waste (HLW) is probably disposed in underground repository, where compacted bentonite blocks' joints play as potential "hydraulic defects" and compromise the integrity of bentonite barrier. In the repository, the healing of the joints may be affected by the salinity of underground water and the constrained swelling condition. This work used the mixture of bentonite pellets and powders at a 7:3 mass ratio to seal the joints and the healing of the joints after permeation was evaluated by the evolutions of hydraulic conductivity and thermal conductivity. During the permeation, the swelling of the bentonite barrier was constrained by a steel permeating cell to simulate the constraint of wall rock, and synthetic underground water was used as permeating liquids to investigate the effect of salinity of underground water. Distilled water was used to permeate as a control. After permeation, the configuration of bentonite aggregates was illustrated by scanning electron microscope (SEM). Comparing to integrated block permeated by distilled water, less reduction of hydraulic conductivity was observed on bentonite pellet-powder sealed joints, and the hydraulic conductivity of the joint was about 3*10ˆ-12 m/s, which is sufficient to intercept radionuclide. The synthetic underground water with 5 g/L NaCl and Na2SO4 mixtures as permeating liquid, however, resulted in about a 10-fold hydraulic conductivity increase of the joints. The thermal conductivity of the joints was similar to the block after permeated by distilled water, while it was relatively lower than the block after permeated by synthetic underground water. This phenomenon indicates that the salinity underground water compromises the healing and the low-permeability of bentonite barrier, which is consistent with the results of permeation. Additionally, bentonite tended to flocculation after permeated by synthetic underground water as illustrated by SEM images. This flocculation of bentonite increased the hydraulic conductivity of the joints and compromised the safety of the repository. In further research, the side effects of underground water to bentonite barrier need be underlined.