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Influence of Thermal History on the Undrained Shear Strength of the Bentonite-Sand Mixture

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Abstract : Densely compacted bentonite or bentonite–sand mixture has been identified as a suitable buffer in the deep geological repository (DGR) for the safe disposal of high-level nuclear waste (HLW) due to its favourable physicochemical and hydro-mechanical properties. The addition of sand to the bentonite enhances the thermal conductivity and compaction properties and reduces the drying shrinkage of the buffer material. The buffer material may undergo cyclic wetting and drying upon ingress of groundwater from the surrounding rock mass and from evaporation due to high temperature (50–210 °C) derived from the waste canister. The cycles of changes in temperature may result in thermal history, and the hydro-mechanical properties of the buffer material may be affected. This paper examines the influence of thermal history on the undrained shear strength of bentonite and bentonite-sand mixture. Bentonite from Rajasthan state and sand from the Assam state of India are used in this study. The undrained shear strength values are obtained by conducting unconfined compressive strength (UCS) tests on cylindrical specimens (dry densities 1.30 and 1.5 Mg/m3) of bentonite and bentonite-sand mixture consisting of 30 % bentonite+ 70 % sand. The specimens are preheated at temperatures varying from 50-150 °C for one, two and four hours in hot air oven. The results indicate that the undrained shear strength is increased by the thermal history of the buffer material. The specimens of bentonite-sand mixture exhibited more increase in strength compared to the pure bentonite specimens. This indicates that the sand content of the mixture plays a vital role in taking the thermal stresses of the bentonite buffer in DGR conditions.

Keywords : bentonite, deep geological repository, thermal history, undrained shear strength
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