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Erosion behaviour of raw bentonites under compacted and confined conditions: relevance of smectite content and clay/water interactions

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Abstract

The quantification of colloid erosion from compacted bentonite barrier, in a high-level waste repository, is considered especially relevant because erosion may compromise its performance and because eroded colloids may contribute to radionuclide transport.

The erosion behaviour of different raw bentonites, compacted at high density, was analysed in a confined system under favourable chemical conditions. A complete physical and geochemical characterisation of clays was carried out to overall relate clay physico-chemical characteristics and structure to their erosion behaviour.

The mass eroded under compacted and confined conditions were in all cases lower than those obtained under free-dispersed conditions; indicating that compacted and confined conditions were limiting erosion. Maximum erosion was below a 1% of the initial mass.

Results clearly showed that clay erosion under compacted state was hindered for those bentonites with high content of bivalent cations in exchangeable positions ((Ca+ Na) > 90 %), low smectite content (Sm. < 70 wt. %) and high tetrahedral charge ($|\tau| > 0.1$ *e*/h.u.c.). In addition, it was demonstrated that, at high solid to liquid ratios, dissolution of salts present in the clay and cation exchange reactions decrease the extent of erosion.

Keywords: Bentonite, erosion, smectite, colloids, radioactive waste, clay/water interactions