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First Shrinkage Parameters of Slovak Bentonites Considered for Engineered Barriers in the Geological Repository for Radioactive Waste and Spent Nuclear Fuel

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In a previous research for the deep geological repository of radioactive waste and spent nuclear fuel, the swelling potential of bentonites from Slovak deposits was evaluated by indicative parameters (Atterberg liquid limit) and by swelling pressure tests (Adamcova et al., 2009). The noticed absence of data on shrinkage behaviour initiated a pilot research of bentonite shrinkage parameters in Slovakia (within the project VEGA 1/0828/13 granted by the Slovak Ministry of Education). Comparison of Slovak, Austrian, German and British Standards for shrinkage test methods showed that Slovak Technical Standards (STN) pertain to undisturbed soil samples, where shrinkage depends not only on the current moisture, but also on the grain size distribution and porosity. Shrinkage limit ws (%) and relative linear shrinkage Ls (%) determined according to the foreign technical standards are independent from those properties, because sample preparation brings all soils to equal starting conditions: sieved to grain size below 0.5 mm, water added to reach moisture w near the liquid limit wL, suspension smeared without bubbles into standard moulds. Applied Austrian ONORM B 4411: 2009 offers three test procedures for ws. First, ws was determined by manifold measuring of the sample weight and volume during drying. Calculation followed from the moisture vs. relative volume plot with a linear trend line. Results were compared to data from the other two methods. Highest Ls (up to 32.5% of the initial length) was observed in bentonite J250 from the Jelsovy Potok deposit, the best Slovak bentonite because of its swelling potential and excellent sorption properties for radionuclides (Galambos et al., 2009; Galambos et al, 2010a; Galambos et al, 2010b; Galambos et al., 2011). Reaching of the shrinkage limit (ws = 11%) was indicated also by a color change from light brownish grey (2,5Y 6/2) to light grey (2,5Y 7/1 - Munsell Soil-Color Charts, 2009). Because ws is lower than the equilibrium moisture of the bentonite J250 under room conditions, which is 14%, bentonite blocks might shrink and gaps between them open due to high temperature around the containers with radioactive waste and spent nuclear fuel in the geological repository, until water from the host rock mass intrudes and bentonite swells. Results indicated the necessity of further shrinkage tests, this time on bentonite powder compacted to high-density segments. Methods described in STN 72 1019 were recommended as relevant for the assessment of their total shrinkage.

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