SUMMARY

Changes of selected physico-chemical properties of bentonites under the heat and saline treatment were examined considering their possible use as an engineered barrier (buffer, backfill) in the nuclear waste repository.

Two sets of materials were used in the experiment – the international standard of Na bentonite (MX 80) from Wyoming (USA) and Ca/Mg bentonite from the Rokle deposit (Czech Republic). The aim of this study is to determine effects of the heat and saline treatment on selected physico-chemical properties (cation exchange capacity, swell index) and to identify the transformation processes occuring in the bentonite and compare obtained results to the MX 80 standard.

Four sets of samples were used in the experiment. Each set contained nine samples (Rokle bulk and MX 80). The samples were treated for two months for 6–8 hours a day, one set at 40 °C, second at 60 °C, third at 90 °C and the last set at 120 °C. Saline environment was simulated by 30 wt. % NaCl solution. After two months the cation exchange capacity (CEC) of monovalent and divalent cations, swell indexes (SI) were determined. Structural changes in the bentonite were identified using X-ray diffraction (oriented and glycolated samples).

A significant decrease in CEC and SI values was observed after heat treatment. Samples in high saline environment showed more rapid decrease of CEC and SI (even at the lowest temperature, 40 °C).

The three main transformation processes (illitization, beidellitization and kaolinization) changing the significant amount of smectites in the bentonite were identified. Kaolinization was recorded in the MX 80 bentonite sample heated to 40 °C, 60 °C, 90 °C 120 °C, while illitization processes appeared in the saline environment at all temperatures.

Transformation processes in Rokle bentonite samples did not show such a uniform character. Kaolinization appeared with temperature rise (60 °C – 90 °C). However, at the highest temperature (120 °C) illitization was observed.

In the saline environment illitization, beidellitization and kaolinization occured.

Each of these transformation processes negatively affected the ability of ion exchange (Ro bulk samples – a decrease from 74.0 mmol/100 g to 62.5 mmol/100 g, Ro bulk + NaCl – a significant decrease from 65.4 mmol/100g to 41.9 mmol/100 g, MX 80 samples – a decrease from 90.6 mmol/100 g to 77.5 mmol/100 g, MX 80 + NaCl – a significant decrease from 84.0 mmol/100 g to 66.2 mmol/100 g) as well as their swelling ability (Ro bulk samples – a significant decrease from 2.24 to 1.9, Ro bulk + NaCl – decrease from 2.22 to 1.9, MX 80 – decrease from 9.0 to 6.1 and MX 80 + NaCl – from 8.9 to 6.1).

Initial values of CEC and SI are significantly higher in MX 80 bentonite than in bentonite from the Rokle deposit. However, the decreasing trends recorded for the Rokle bentonite after heat/saline treatment are very similar to the Na-bentonite standard.

The experimental results have revealed, that Rokle bentonite can be a suitable material, which may be used as an engineered barrier in the nuclear waste repository.