Abstract

The work involved in the thesis is mainly focused on the Czech bentonite which is originally from Cerny vrch deposit (north western region of the Czech Republic). The compacted bentonites are prepared from the industry provided bentonite powder with an initial water content around 10%. Dry densities from 1.27 to 2 g/cm^3 were used for laboratory testing, specifically 1.27, 1.60 and 1.90 g/cm^3 were used for water retention measurements, microstructures and fractal pore analysis. Dry densities of 1.25 to 1.95 g/cm^3 were used for mechanical tests such as one dimensional swelling strain and oedometer load-unload tests. The vapor equilibrium method was used to impose the suction on samples ranging from 3.29 MPa to 286.7 MPa. Mercury intrusion porosimetry (MIP) and environmental scanning electron microscope (ESEM) were utilized for the microstructure analysis. The water retention measurements were performed at 20, 40, 60 and 80 °C respectively, results show that the increasing of temperature can decrease the water retention capacity. The influence of compaction and suction on microstructure was compared and studied. MIP tests were performed on the samples which were equilibrated at suction of 3.29, 38 and 286.7 MPa on wetting path of both low and high dry densities. The samples equilibrated at suction of 286.7 MPa on wetting path were firstly observed in ESEM chamber with different magnification, then followed by wetting and drying path performed in the chamber with increasing and decreasing relative humidity. The changes in aggregates and macropores were recorded. The pore families (macropores and micropores) recognized by the MIP results were consistent with the ESEM observation. Moreover, the influence of dry density and suction on the microstructure was studied by fractal analysis with different methods. Fractal analysis confirmed the pore families definition by MIP pore size distribution curve. The mechanical study of compacted bentonite showed a unique relationship between (aggregate) dry density and effective stress. The proposed equations for predicting swelling pressure were developed based on the diffuse double layer (DDL) theory, which was proved to be applicable in both sodium and calcium bentonites. The prediction of swelling pressure of Czech bentonite was presented and discussed.