ABSTRACT

The Cypriot deposits of bentonite, Phiti, Statos and Pedakomo are located in an autochthon sediment zone, which represents sediments during the marine regression in the period Upper Cretaceous - Pleistocene (67 Ma to 0.0117 Ma). The goal of this thesis is to suggest potential applications of bentonite, through the study of mineralogical composition and analysis of selected properties (chemical, physical and mechanical).

The mineralogical study of Cypriot bentonite using X-ray diffraction analysis has proven the existence of clay mineral belonging to the group of smectite (montmorillonite), as well as the existence of minority illite and kaolinite. From non-clay minerals, the majority of the samples contained zeolite (clinoptilolite), quartz, feldspar and in some samples calcite. The semiquantitative representation of crystalline phases, found during the mineralogical study, was calculated through the chemical analysis. The calculations suggest that Cypriot bentonite is composed of 47 - 58 % smectite, 3 - 19 % kaolinite, 3 - 11 % illite, 3 - 10 % clinoptilonite, 8 - 17 % quartz and 2 - 5 % feldspar.

From the physicochemical properties, the cation exchange capacity and specific surface area were studied. The values of cation exchange capacity fluctuate in a range 15.8 – 64.3 meq/100g for individual monovalent and bivalent cations. The specific surface area was calculated from the adsorption isotherms of CO_2 (micropores) and N_2 (mesopores and part of macropores). The calculated specific surface of micropores (defined as pores with a radius up to 2 nm) ranging from 42.43 – 67.72 m^2/g correlates closely with the smectite composition. The specific surface area of mesopores and the part of macropores, interpreted using the BET method, ranges between 62.92 and 92.19 m^2/g which are values that too correlate with the smectite content.

From the physical and physical-mechanical properties, grain size distribution, moisture content, consistency limits, swelling ability, compressibility, and permeability were studied. The results from the grain size distribution indicate that the clay fraction ranges between 30-77 %; 5 out of 6 analyzed samples can therefore be classified as clay, and 1 out of 6 as sandy clay. The moisture of the analyzed samples of Cypriot bentonite lies within the range of 7 - 17 % and in general correlates with the smectite content.

Volume changes caused by the interaction of water and bentonite have been evaluated based on swelling determination. In combination with time, some Cypriot bentonites have the ability to completely swell during one day, with a maximum deformation of approximately 1.8 mm. On the other hand, some Cypriot bentonites had yet to stabilize even after five (and in some cases seven) days. The majority of these bentonites also had a small volume deformation of approximately 0.2 – 0.6 mm. Furthermore, the compressibility was calculated by straining the samples with a weight equal to 20000 - 1280000 Pa. During the compressibility analysis it was discovered, that samples with moisture around 15 % were more compressible than samples with moisture of 10 % or less (due to smaller pores) and 20 % or more (due to larger osmotic pressure). The smallest changes were 0,00035 mm, whereas the biggest changes were around 0.4 mm. From the gained data permeability was calculated, which was found in the range between $2.01 \cdot 10^{-9}$ and $7.97 \cdot 10^{-11}$ m/s at pressure of 270 kPa. As regards the permeability, the majority of studied samples were impermeable at low strain and highly impermeable at high strain.