SUMMARY

One of the applications of fly ash is using it in landfill mineral sealing layers. Mineral sealing layers ensure a reduction in the negative impact of waste on the environment. Their main function is to prevent ground and groundwater contamination caused by leakage. The thesis that fly ash with bentonite addition is an appropriate material for building landfill sealing layers, comparable to sandy clay (saCl), has been formulated in view of the fact that fly ash is a material which alone or after some improvement can achieve parameters required for sealing layers.

The aim of the dissertation was to determine the characteristics of compressibility, hydraulic conductivity and tensile and shearing strength of fly ash mixes with varying percentages of bentonite content compared to sandy clay with standardized parameters.

The aim of the doctoral thesis was achieved by conducting analyses and laboratory tests of compacted coal fly ash and fly ash mixtures with bentonite content of 5, 10 and 15% in the dry weight of the sample. Laboratory tests on sandy clay were also conducted.

The chemical composition and physical properties such as: grain size distribution, specific density, specific surface area and compactibility of the tested materials were determined. Laboratory tests of shearing and tensile strength, compressibility and hydraulic conductivity of fly ash and fly ash-bentonite mixtures were conducted. In order to determine the effect of bentonite addition on the structure of the samples, X-ray computed microtomography scans were performed. The obtained test results for fly ash and fly ash-bentonite mixtures were compared to the test results for sandy clay.

Bentonite addition affects the physical and mechanical parameters of fly ash. Bentonite has an impact on the tensile strength of fly ash tested by the indirect (Brazilian test) or direct method (tearing). The highest values of tensile strength were obtained for the samples with 10 and 15% bentonite content. It was observed that curing time of the samples has an influence on their tensile strength, the value of which generally increased along with an increase in the curing time period.

The addition of bentonite resulted in the decrease in the value of vertical strain of the fly ash-bentonite samples. The lowest value of vertical deformation was obtained for mixtures FA+15%B and FA+10%B. The influence of the moisture content during compaction on the vertical deformation of fly ash and fly ash-bentonite mixtures was confirmed.

Bentonite addition reduces the value of hydraulic conductivity of fly ash. Hydraulic conductivity decreases along with an increase in the water content of compacted fly ash

and fly ash-bentonite samples. The lowest values of hydraulic conductivity were obtained for sandy clay, which was caused by a higher value of specific surface area of clay relative to fly ash-bentonite mixtures.

It was found that samples which are not fully saturated have lower hydraulic conductivity values, but this cannot be treated as a characteristic of the flow of water in a sample. Hydraulic conductivity tests of fly ash and fly ash with bentonite addition should be conducted on fully saturated samples. When determining the compressibility of fly ash and fly ash-bentonite mixtures it should be noted whether the samples were saturated. The value of Skempton's parameter B or the degree of saturation S_r should be given.

Bentonite addition doesn't have a negative influence on fly ash strength characteristics. The best laboratory test results were obtained for fly ash with 10% bentonite addition. Its tensile strength value did not decrease at varying curing times. The mixture with 10% bentonite content displayed a lower value of vertical strain than sandy clay.

Fly ash mix with 15% bentonite content displays hydraulic conductivity $k \leq 1{,}0 \cdot 10^{-9}$ m/s, which is required for sealing layers. Fly ash and fly ash-bentonite mixtures with lower bentonite content obtained values of $k \leq 1{,}0 \cdot 10^{-7}$ m/s. The tensile strength of fly ash-bentonite mixtures is comparable to or higher than that of sandy clay.