

Characteristics of soil of “Józefka” deposit overlay, Kielce District

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The aim of this article is to describe and characterize the properties of the overburden overlying rocks of “Józefka” mine, with an attempt to demonstrate a dependence of diversified mineral composition on geotechnical characteristics of the tested material. The article presents previously obtained unpublished data necessary for the evaluation of the physical characteristics of the overlying rocks. The research was conducted in the mining area of the “Józefka” mine, located in Górno – ca. 10 km eastwards from Kielce. Dolomite and calcareous rocks, estimated to be Givetian in age (Czarnocki 1938), are exploited in the mine. The obtained material is used as road aggregate. The deposit is located in the southern part of the Świętokrzyskie Mountains, in the so-called Kielce zone being a part of Małopolska Province Massif (Stupnicka 1997). Silty soils occur there as pockets and interbeds. An attempt to describe them precisely has not been undertaken as yet.

Three samples with intact structure and natural moisture were collected during field work. The deposit investigations were carried out at two stages: 1) mineralogical and petrographic, and 2) geotechnical.

At the first stage, the analysis included optical microscopy of thin sections, X-ray diffractometry and thermal differential analysis DTA. Clay fraction (below 2 μm) was separated by settling in water. Oriented specimens, glioled and heated to 550°C were analyzed. The rock contains up to 70 wt% of detrital quartz.

The second stage of the research programme was conducted in accordance with the engineering practice and standards (PKN-CEN ISO/TS 17892-2:2009).

Basic physical parameters were established:

- natural moisture – w_n [%],
- bulk density – ρ [g/cm^3],
- density – ρ_s [g/cm^3],
- granulometric composition,
- plasticity – w_p [%] and liquidity limits – w_L [%],
- swelling index – p [%].

The results of the mineralogical and petrographical tests revealed that kaolinite is the main fraction of clay minerals in all three samples.

The content of clay fraction was determined with the use of two methods:

- water separation – 50 g of material was prepared; the clay material in sample 1 constitutes 55% of the whole material, in sample 2–40%, and in sample 3–39%;
- areometric – 35g of material was prepared; the results show that the proportions of the clay material amount to: sample 1–48%, sample 2–33%, sample 3–29%.

The concurrence of results of both methods is evident. The maximum difference of clay fraction content was 10%. It indicates the difference in selecting equally representative samples.

During the geotechnical determination the tested soil was classified as: sample 1 – clay (Cl), sample 2 – sandy clay (saCl), sample 3 – silty sandy clay (sasiCl) (PN-EN ISO 14688-2:2006).

Moreover the following physical properties of the samples were determined:

- sample 1: $w_n = 22.34\%$, $w_p = 22.16\%$, $w_L = 40.5\%$, $p = 15.42\%$, $\rho = 2.01 \text{ g/cm}^3$, $\rho_s = 2.68 \text{ g/cm}^3$;
- sample 2: $w_n = 22.97\%$, $w_p = 23.47\%$, $w_L = 52\%$, $p = 11.97\%$, $\rho = 2.04 \text{ g/cm}^3$, $\rho_s = 2.66 \text{ g/cm}^3$;
- sample 3: $w_n = 20.21\%$, $w_p = 21.3\%$, $w_L = 43\%$, $p = 21.5\%$, $\rho = 2.05 \text{ g/cm}^3$, $\rho_s = 2.68 \text{ g/cm}^3$.

Sample 3 was classified as highly swelling, which confirms a significant content of smectite in the mineral composition. Other samples were classified as medium swelling, correspondingly sample 1: 15.42%, and sample 2: 11.97% (Niedzielski 1993). The lowest value of bulk density of sample 1 indicates increased content of clay fraction. This is confirmed by the mineralogical and petrographical tests.

Soils present in "Józefka" deposit overburden may be used as an addition to vegetable fertilizers.

Their use will increase sorption of cations and water in soil. This material should be mined in a selective way due to its variability.

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