In general, a conclusion can be drawn that all suggested criteria of rock failure have their own application range for solving the problems of strength, stability and bearing capacity of saturated soils and rocks. Meanwhile, these ranges should be defined in the course of further research and experiments.

The obtained results include modifications of the known Mohr-Coulomb, Bieniawski, Hoek-Brown and Shashenko failure criteria determining rock strength with due regard to excessive pore fluid pressure. The critical height of the vertical slope and active and passive stresses of saturated and unsaturated rocks are compared. The given results enable natural generalization for rocks in which there is some pore gas under excessive pressure.

The scientific novelty of the research includes modifications of the Mohr-Coulomb, Bieniawskii, Hoek-Brown and Shashenko failure criteria enabling consideration of impacts of excessive pore fluid pressure on rock strength and stability.

Practical significance of the research involves predicting the failure of rock in mine workings composed of water-bearing strata and support structures.

UDC 691.544

S.I. SAKHNO, PhD (Engineering), Associate Professor
L.A. YANOVA, PhD (Engineering), Associate Professor
O.V. PISCHIKOVA, PhD (Engineering), Associate Professor,
Kryvyi Rih National University, Ukraine

APPLICATION OF SINTERING DUST FOR THE INCREASE OF CEMENT DURABILITY

Annual emissions of ferriferous dust in the atmosphere of the Kryvyi Rig region are approximately 400 thousand tons. The greater amount of dust is retained in dust cleaning devices of the enterprises of mining complex. Its return in a technological process is a necessary and ineffective measure. The search of ways of her rational use continues, therefore.

The possible use of these wastes in the production of building materials have been taken into consideration. It was offered to use pulverulent ferriferous wastes for the increase of activity of cements. We have carried out researches into the use of electrostatic precipitator dust of sintering production as an activator of cement hardening.

Studies have demonstrated changes in the size of dust particles and their magnetization at various stages of purification. The dust taken from the cyclone has an average particle diameter d_{mid} = $8.55 \cdot 10^{-6}$ m, the proportion of magnetized particles in it is n = 16.2 % with an average magnetic moment I_{mid} = 0.108·103 A·m. The same dust, but taken from the 1st electrostatic precipitator has the following indicators: d_{mid}=$6{,}3 \cdot 10^{-6}$ m, n=19,2 %, I_{mid}=$0{,}199 \cdot 10^{3}$ A·m, and from the 3rd electrostatic precipitator d_{mid}=$5{,}39 \cdot 10^{-6}$ m, n=30,5 %, I_{mid}=$1{,}3 \cdot 10^{3}$ A·m.

Studies have revealed the possibility to use dust of sintering electrostatic precipitators as an activator of cement hardening due to the effect of chemically induced dynamic nuclear polarization (CIDNP). In the laboratory, binders consisting of a mixture of slag Portland cement and dust of electrostatic precipitators in various proportions were investigated. The amount of dust in various experiments varied from 0,1 to 5 %. In the process of research, considerable attention was paid to the study of tribochemical and catalytic phenomena arising from the interaction of dust with a hardening binder.

Experiments have shown that the greatest increase in the strength of the binder, up to 80%, is observed with the introduction of dust in an amount of from 1.5 to 2%. The increase in strength largely depends on the magnetization of the particles. Dust from the third filter is able to increase the activity of the binder in ~~by~~ 1.8 times, while from the first filter no more than 20%.

Electron microscopic, X-ray diffraction and thermogravimetric studies have shown that an increase in the strength of cement stone with electrostatic dust is associated with an increase in the degree of hydration of cement and active mineral additives. Wherein, the microstructure of the cement stone is more dense and fine-grained, the degree of binding of hydrated lime by active mineral additives increases.

A mathematical model of the effect of electrostatic precipitator dust on the activity of the binder has been developed.