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DEVELOPMENT OF A METHODOLOGY FOR CALCULATING A SUFFICIENT AMOUNT OF REAGENT-COLLECTOR FOR FLOTATION ENRICHMENT OF ASH SLAG WASTE

РОЗРОБКА МЕТОДИКИ РОЗРАХУНКУ ДОСТАТНЬОЇ КІЛЬКОСТІ РЕАГЕНТУ-ЗБИРАЧА ДЛЯ ФЛОТАЦІЙНОГО ЗБАГАЧЕННЯ ЗОЛОШЛАКОВИХ ВІДХОДІВ

Hlukhoveria M.R.
PhD student, National Technical University "Dnipro polytechnic", Dnipro, Ukraine

Глуховеря М.Р.
аспірант, Національний технічний університет «Дніпровська політехніка», м. Дніпро, Україна

Mladetskyi I.K.
DSc (Engineering), Professor, National Technical University "Dnipro polytechnic", Dnipro, Ukraine

Младецький І.К.
д.т.н., професор, Національний технічний університет «Дніпровська політехніка», м. Дніпро, Україна

Introduction. In the current conditions of development of the world economy, extraction and processing of minerals is of great importance. In connection with the depletion of deposits rich in the content of a valuable mineral component, more and more attention is paid to the processing of accumulated industrial waste. In this regard, we will consider fly ash, which is formed during the burning of coal fuel in the furnaces of thermal power plants (TPP) and consists of mechanical underburning and mineral impurities. Mechanical underburning is the unburned parts of coal in the form of semi-coke, acute-angled, less than 200 microns in size. At some TPPs of Ukraine, the content of unburned fuel particles in fly ash increases from 10 to 25%. Extraction of these parts makes it possible to obtain secondary fuel, which can be suitable for re-burning at thermal power plants or find other applications in industry [1].

In a number of works [1, 2] the possibility of extraction of coal concentrate from fly ash by the flotation method was investigated. Studies have confirmed the possibility of using foam flotation to obtain coal concentrate from TEC fly ash. The obtained coal concentrates had an ash content of 34 to 52%. The output of the foam product ranges from 5 to 20% of the total mass, this indicator depends primarily on the amount of mechanical underfire contained in the ash. It is worth paying attention to the fact that the authors of the above-mentioned works use surface-active substances (SAS) such as kerosene, diesel fuel, they are also called reagents-collectors. Collector dosages were chosen largely intuitively in unreasonable amounts, sometimes reaching 7 l/t.

Main part. It is known that in the flotation process, small dosages of reagents initially improve the process of extraction of useful minerals, then when the consumption of reagents exceeds a certain value, the process deteriorates. A change in the consumption of reagents by several tens of grams after reaching the extremum significantly affects the enrichment indicators of the flotation process.

It is possible to choose the optimal consumption of collector reagents by conducting many tests, but then in each new case it is necessary to conduct such tests, so it is interesting to search for theoretical research in this direction. In this, based on known laboratory studies, we will try to develop a theoretical model for determining the optimal dosages of the reagent-collector for TPP ash removal.

Separation of this mass is supposed to be carried out with the help of flotation. It is known that this process requires the use of various additives that help stabilize the pulp in all its states in the floatation machine.

Additives are called scavenging reagents or surface-active substances (surfactants). In places of depressions surface of particle, the reagent-collector accumulates in thicker layers, then the reagent is distributed over the entire surface, forming a continuous layer of the reagent. This is the best combination of surfactant and solid mass. Then the excess surfactant begins to isolate the separating properties of the particles and the separation deteriorates. Let’s try to reveal these provisions.

Let us assume that the particles of the fuel mass in the ash have surface irregularities with different frequency of protrusions and different amplitude. Thus, the surface change function of a particle is a random nonstationary function because it depends on the particle size: Large particles have higher amplitudes of surface change, and small particles have small amplitudes. Observations have shown that the general regularity of changes in the particle surface function has not yet been established. In general, we can judge this function by (Fig. 1), taken under a microscope.

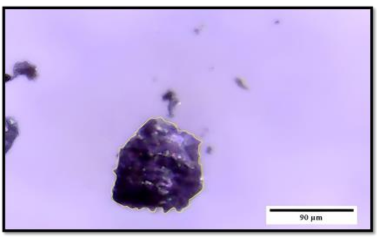

Fig. 1. Change in the surface of coal extracted from ash TPP removal

Particles of a solid product after some grinding have a free surface of an irregular shape, which resembles a random function in any cross-section of the particle. Above the line of the average value we have projections, and below it – depressions. Let's take the largest protrusion as the value that characterizes the size of the particle $d_ч$, and the smallest depression as the value that characterizes the continuous solid phase $d_ч - \Delta$. Expression (1) was obtained for determining the content of cavities in relation to the volume of the particle:

$$f_П = 1 - \left(1 - \frac{1}{n}\right)^3 \cdot k = 1 - \left(1 - \frac{1}{n}\right)^3 \cdot \frac{n}{n-1} \qquad (1)$$

where *k* – is the part of the volume that is filled with a solid phase;

$$n \cdot \Delta = d_ч \qquad (2)$$

where Δ – is the difference between the size of the protrusion and depression of the particle surface; *n* – is the amount that fit in the size of the particle.

When $n \to 0$, then $f_П \to 1$, the entire particle is a volume including voids. When $n \to \infty$ (there are no cavities), then $f_П \to 0$. For example, a particle represents a continuous surface.

Conclusions. A large amount of surface-active substance (surfactant) leads to the fact that the substance envelops the particles of the useful mineral and rock to such an extent that they gradually lose their properties of the substance and take on the properties of the surfactant, which ultimately leads to the extraction in concentrates of the rock particles. At the same time, surfactants should only enhance the surface properties of particles, but not obscure their separating properties.

It follows from this that any raw material that is planned to be enriched by the flotation method must be examined under a microscope, the surface of the particles should be studied in detail, and as a result, it is possible to determine the consumption of the reagent-collector, which will be optimal for a specific raw material, without conducting preliminary laboratory tests.

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