Application of X-ray absorption method for an estimation of magnesite ore separation into tailings and concentrates

INTRODUCTION

Magnesite is a mineral, magnesium carbonate $MgCO_3$. The composition is close to the theoretical one. Of the impurities, Fe is the most important; Mn, Ca are less important.

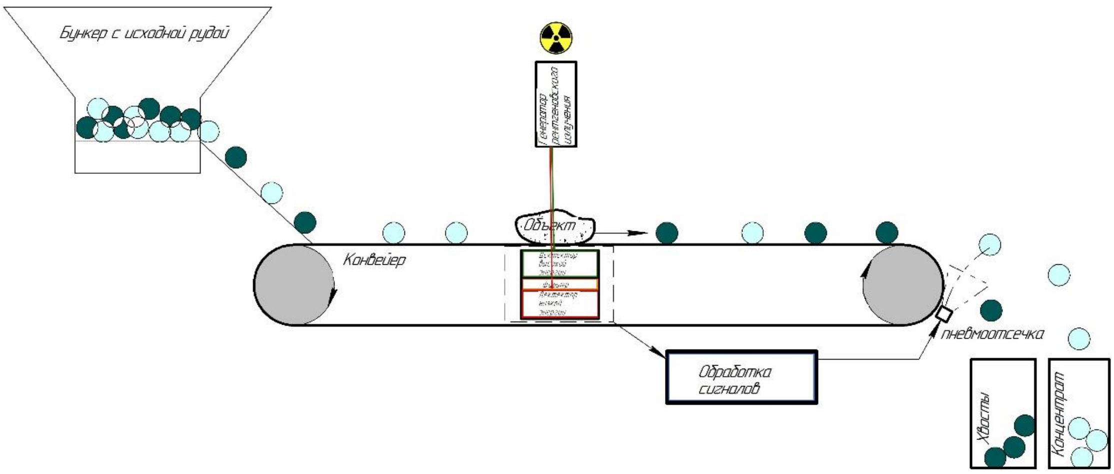
Magnesite is used for production of refractories, cement, electrical insulators, metallic magnesium (alloying additive in metallurgy); in paper, sugar and rubber production. Magnesite mineral raw materials are widely used in the chemical industry and in the production of fertilizers.

Porcelain-like aggregates of magnesite are used as ornamental stone.

METHODS AND PRINCIPLES

The search for an effective method of raw mineral concentration is an important strategic task for the development of mining companies. A special place among the methods used for preconcentration is occupied by a group of information methods. Among them the most widespread are X-ray absorption for primary concentration of mineral ores. For this purpose, X-ray absorption separation or X-Ray Transmission method (XRT method) is used with high efficiency.

This method does not require special preparation of raw materials in the form of washing operations and cleaning the surface of rocks from dirt, dust, sludge films. X-ray absorption method is a penetrating method, and allows to recognize hidden mineralization in the rock.



General principle of operation of the X-ray absorption sorting

In general, the principle of operation of the X-ray absorption method can be presented as follows: the higher the atomic number of the elements that make up minerals and rocks, the smaller the number of X-rays will pass through this material. The amount of attenuation of X-ray intensity by the material depends on the atomic number of the object substance, the thickness of the piece and the energy of X-ray quanta.

STUDY

Bourevestnik carried out works on assessment of enrichability of magnesite ores of Khalilovskoye deposit by X-ray absorption method. According to the results of the research high efficiency of the developed MD separation feature was established.

The principle of registration and estimation at X-ray absorption analysis consists in that the passed X-ray radiation through pieces of minerals and rocks on a scintillation detector is registered. The detector converts the energy of the X-rays that have passed through the pieces of ore into current pulses, which are amplified and recorded by a recording system. The obtained results are digitized, converted into graphic form in the form of raster graphic images and processed by the software of the automated control system according to a special algorithm developed in Bourevestnik. Then they are compared with the values of the specified separation threshold, after which the ratio of the area of the useful component to the total area of the ore piece in the X-ray image was analyzed and calculated.

The object of the study was a sample of 72 samples of magnesite ore (Fig. 1) from four packages (No. 1 (tailings)-185 g (+5), No. 2 (concentrate for separation)-62 g (+5), No. 3 (mixture)-375 g (-3.25+2), No. 4 (concentrate) - 77 g (+5)). (+5)) Sample material: fine, fine-medium-grained samples are weathering crusts on ultramafic rocks actively serpentinized, gray, white, gray-white, yellowish, brown, lilac-yellow color, amorphous-crystalline with irregular zonal-sectorial distribution of color. Samples are represented by dolomite or in mixture with anhydrite, with dolomites and dolomitized limestones, also breinnerite, gelmagnesite, ferruginous magnesite, mesaitite spar, nickel magnesite, siderite, manganosiderite and quartz.

RESULTS AND DISCUSSIONS

To estimate the X-ray absorption intensity of magnesite ore, a comparative analysis of representative samples of "tailings" and "concentrates" of 3 mm in size at 40 kV, the results are presented in Figure 2 and the calculation of the magnesite ore contrast index as the ratio of the absorption intensity of "concentrates" to the absorption intensity of "tailings" was carried out.

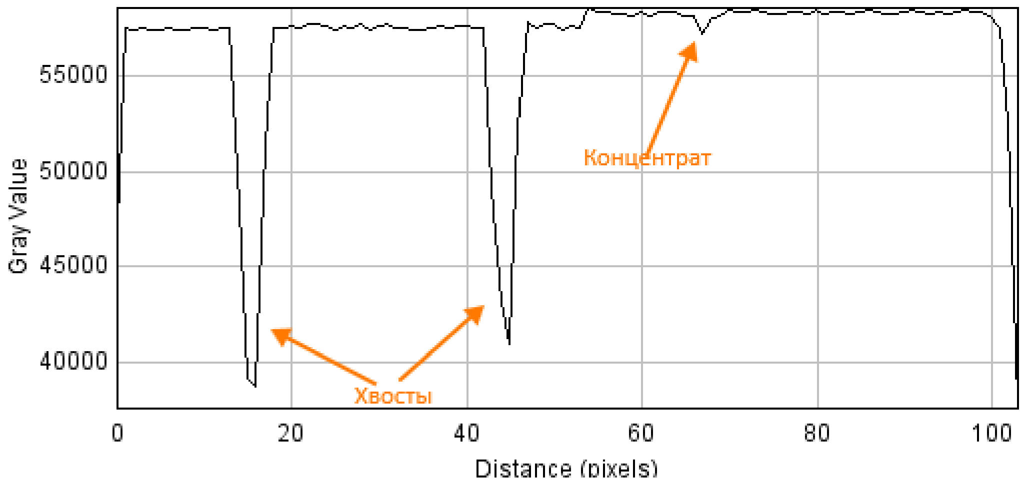
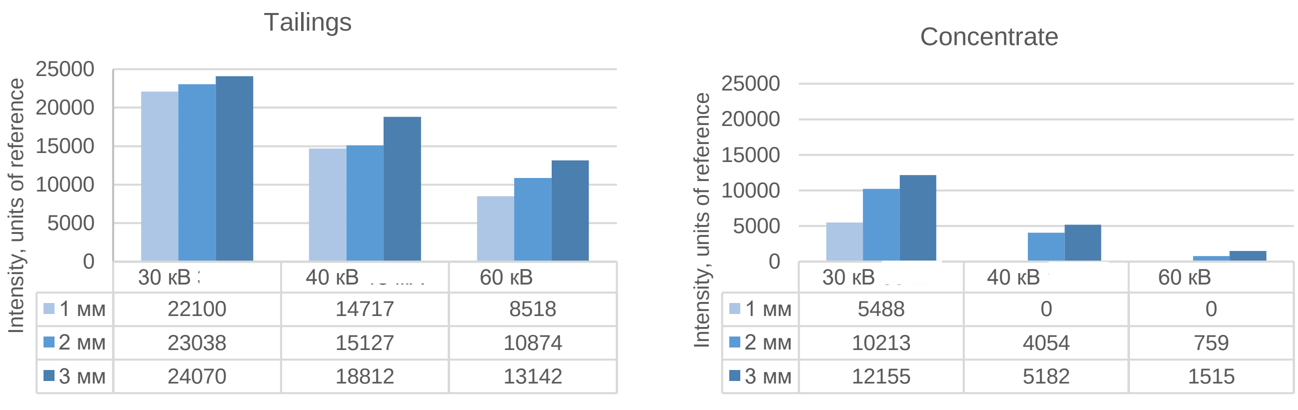


Figure 2 – X-ray absorption intensity of magnesite ore samples

Comparative analysis of X-ray absorption intensity of magnesite ore samples in "tailings" and "concentrates" with sizes of 1 mm, 2 mm, 3 mm at 30 kV; 40 kV, 60 kV is presented in Figure 3.



а б

Figure 3 - X-ray absorption intensity of magnesite samples:

а – tailings; б – concentrate

In order to preliminarily evaluate the sign of separation, 40 samples of magnesite ores with different mineral inclusions and host rocks were selected, with the highest and lowest absorption capacity on the surface (Fig. 4).

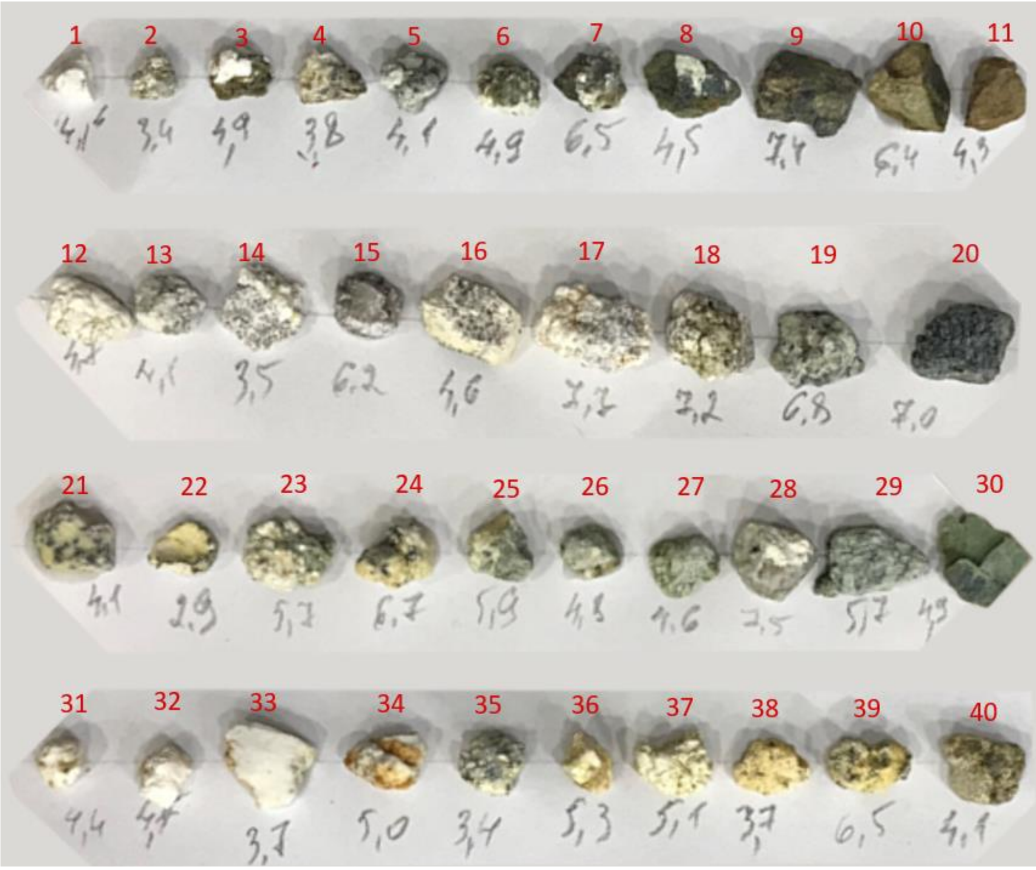


Figure 4 - Sample selection

For all sample specimens (Fig. 4) tests were carried out according to the methodology and algorithm MD1 and MD2, developed in Bourevestnik, which include combined analysis - X-ray absorption method and laser triangulation method.

CONCLUSIONS

In order to develop the sign of separation MD1 and MD2 according to the method and algorithm of Bourevestnik, representative samples were selected to identify inclusions of minerals and host rocks with the highest (representing the host rock) and the lowest (with minerals on the surface of the piece) X-ray absorption capacity, giving a different radiographic picture.

Using these samples according to the methodology and algorithm MD1 and MD2, developed in Bourevestnik, the possibility of separation of samples was evaluated:

- X-ray absorption imaging of fractionated samples of magnesite ore was carried out, which showed high contrast of "concentrate" samples Kl/x = 1.02-1.28, K'x/k = 0.06-0.51, the values of which depend on the mode of operation at X-ray absorption method of sorting.
- The analysis of available software and methodological support on the parameter of separation feature MD1 and MD2 was carried out. It was found that the value of the separation attribute parameter of RAM, at which the separation into concentrate and tailings occurs, was at MD1 - 25.4

and at MD2 - 0.3 on the sample, which will allow to obtain from 88% to 93% of the magnesite ore concentrate. Both separation attributes show high efficiency for the indirect separation method, which is the X-ray absorption method.

Thus, taking into account the obtained results of magnesite ore research, the X-ray absorption method of separation realized on the mineral separator RGS-6A with the capacity up to 160 t/h with the possibility of loading ore pieces from 10 to 100 mm, produced by Bourevestnik, allows to significantly increase the recovery rates of the useful component at the stage of preliminary enrichment of the initial ore due to its inclusion in the technological process chain.