EFFECT OF THERMAL WINNING ON BENEFICIATION OF FERRUGINOUS QUARTZITES


The traditional method of working ore deposits by drilling and blasting has a number of well-known drawbacks (it is labor-intensive and dangerous, large-scale blasts cause seismic effects, and the explosion products contaminate the environment). It excludes the possibility of organizing flow-type technologies of preparation and extraction owing to the need for successive operations of drilling, charging, detonation, ventilation, and supplementary breaking up of oversize fragments after large-scale blasts.

Attempts to design a cutter-loader for working hard ores have so far been unsuccessful owing to the inadequate life of the cutting tools.

At present, a broad search is being made for new methods of breaking hard rocks. Some of these methods are based on thermal action, which is known to reduce the hardness of ores. Their original properties are altered, and this must be taken into account in subsequent technological treatments – in particular, beneficiation.

In our opinion, the most promising methods of winning hard ore are the electothermomechanical (ETM) and gas–jet (GJ) techniques.

At the Problems Laboratory of the Moscow Mining Institute, in collaboration with the Central Laboratory of the Lebedinskii Mining and Processing Combine (GOK), research has been going on into the influence of thermal winning on the beneficiation of ferruginous quartzites. For this purpose, at the Lebedinskii Mining and Processing Combine we selected representative samples from large oversize fragments of various types of ores. First, ore was cut mechanically with hammer and chisel; then, from the same oversize ore fragments, ore was cut by the ETM method with infrared radiators. The specific power of each radiator was 5–6 W/cm². After 3–5 min the ore started to separate in the form of scales. On further heating, cracks appeared and the ore split in the planes of the beds. But it did not break up spontaneously. It was necessary to break it down by gently tapping with the chisel. This separated slabs in layers 10–50 mm thick. At the surface of the radiator the temperature was 950–1000°C, and at the surface of the ore, 280–370°C. The distance between the radiator and the face ranged from 30 to 60 mm on account of the irregularity of the face.
An ore sample from gas-jet winning was taken near the mouth of the expanded borehole by the thermal method. The expansion was effected with the aid of a kerosene-compressed air gas jet fed to the burner at a pressure of 7-8 atm. Broken ore in the form of scales, 0-3 mm thick and 0-30 mm in diameter, was thrown out by the gas jet from the surface of the bench.

The weight of each sample was 40-50 kg. From the original sample we chose specimens for mineralogical analysis. The designation of the type of ore was used as a basis for describing the thin sections. The chemical phase analysis of the samples of ferruginous quartzites is listed in Table 1.

The contents of total and magnetite iron in the samples cut by the electrothermal method are higher than in those cut mechanically, on account of conversion of part of the hematite to magnetite in the micaceous hematite and alkali-amphibole quartzite varieties.

The samples were prepared for testing by screening into +5 mm and -5-mm classes. The +5-mm and was crushed in a DShch 60 x 100 jaw breaker. The -5-mm ore material was mixed and divided into three parts — experimental, screen analysis, and duplicate control. A sample of -5-mm quartzite was also ground in a 40 ML-A ball mill. The charges were: spheres, 40%, ore, 10%, and water, 10% of the volume of the mill. The grinding time was taken as 120 min according to the previously established technology for obtaining end product for beneficiation of the class 70% - 0.044 mm with a mineral grain exposure factor of at least 0.99. After grinding, the ore was dried and a screen analysis made; the results are listed in Table 2.

The samples won by the electrothermomechanical method were crushed and ground somewhat less heavily; however, no appreciable differences were observed.