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Study of the non-ferrous metal ores preparation characteristic features and technological requirements for the quality of ores supplied to the dressing plants

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ABSTRACT: The efficiency of the processing plants largely depends on the quality of the processed raw materials. To obtain the maximum extraction of useful components during the enrichment of ore raw materials, the constancy of its composition over time is required, at least during the shift. This article discusses the characteristic features of the dressability of non-ferrous metal ores and the technological requirements for the quality of ores supplied to the dressing plants.

KEY WORDS: Non-ferrous metal ores, complexity of raw materials, low content of non-ferrous metals in ores, the complexity and variability of the material composition of ores, difficult mining and geological conditions, fine dispersed connection of valuable components.

I.INTRODUCTION

Non-ferrous metal ores have a number of characteristic features that determine not only the choice of technology for their processing and enrichment, but also the technology of field development. The main ones include the following: the complexity of raw materials, low content of non-ferrous metals in ores, the complexity and variability of the material composition of ores, complex mining and geological conditions in the depths of ore deposits, a fine dispersed connection of valuable components with the host rocks and among themselves.

II. SIGNIFICANCE OF THE SYSTEM

High rates of ore processing can be obtained only if their quality is fully consistent with the applied technological enrichment regime. In conditions of frequent changes in the chemical and mineralogical composition of the processed raw materials or delays in information about them, the concentrators are not able to quickly change the mode of ore processing. Meanwhile, at many processing plants, one can observe how during the shift the concentration of metals changes several times or the number of refractory varieties in the ore supplied to flotation increases.
Measures for averaging the quality of ore and beneficiation products, ensuring the stabilization of the technological process at a relative level and the efficient operation of automation systems, make it possible to increase the productivity of the plant (by 5–8%), metal recovery (by 0.5–5.0%) and reduce consumption reagents (by 10-15%).

III. LITERATURE SURVEY

Let's consider this set of characteristic features.
1. The complexity of raw materials. In non-ferrous metal ores, along with the basic metals (copper, lead, zinc, nickel, cobalt, molybdenum, tungsten, bismuth), there are gold, silver, cadmium, indium, selenium, tellurium, rhenium, thallium, gallium, rare earths, sulfur , barite, fluorite, quartz and other elements and minerals. The bulk (80–85%) of non-ferrous metals in ores is represented by sulfide minerals. Precious metals and impurities are present in ores mainly in the form of isomorphic impurities and finely dispersed inclusions in the minerals of the main and accompanying useful components, such as, for example, molybdenite, barite, pyrite, etc. Non-sulfide minerals are represented by

oxides, silicates, carbonates, phosphates and others rock minerals in their various proportions. The existing level of technology for processing and enrichment of non-ferrous metal ores makes it possible to establish practically waste-free production, but the possibility of organizing it in practice also depends on economic, geographical, departmental and other factors operating in the region.

2. Low content of non-ferrous metals in ores. The average copper content in porphyry copper ores abroad is currently about 0.9%, in cuprous sandstones - 2%, in copper-pyrite ores - 1.4%. Within the same limits, the average contents of lead, nickel and zinc vary. The content of accompanying metals is usually estimated in hundredths and thousandths of a percent.

According to the content of metals, ores are conventionally divided into rich, poor and off-balance (non-industrial), the boundaries between which are determined by the state of technology and processing technology, economic interests and the needs of the state in the production of metals. The constant growth in the production and consumption of basic non-ferrous metals (copper, lead, zinc, nickel) is accompanied by a continuous decrease in their content in the processed ores. For example, the average copper content in copper ores in the United States over the past 90 years has decreased 10 times and is currently about 0.3%.

3. The complexity and variability of the material composition of ores. Ores of non-ferrous metals are very diverse and variable in chemical and mineral composition, the nature of dissemination and textural-structural features, oxidation degree, strength, crushing, grindability, and washability. With an increase in the degree of oxidation of ores, their dressability deteriorates. Reasons: the increasing complexity of the mineral composition of the ores; surface oxidation; activation and mutual activation of available sulfides; variety and worse floatability (in comparison with sulfides) of oxidized minerals; close connection of oxidized minerals of non-ferrous metals with minerals of waste rock and among themselves; a sharp increase in the content of ocher-clayey sludge, soluble salts in ores and the inconstancy of the material composition of ores.

Various combinations of ore properties create a wide variety of their types and varieties, differing in important technological properties in relation to the processes of crushing, grinding, enrichment, etc. Therefore, technological types and grades of ores at each processing plant are determined based on the results of specially conducted technological tests.

4. Difficult mining and geological conditions of occurrence in the depths of ore deposits. Deposits of non-ferrous metals are usually distinguished by relatively small reserves, a particular complexity of the morphology of ore bodies, very strong ores and host rocks, which predetermine a great labor intensity in their development. The variety of structures and textures observed in this case is accompanied by abrupt changes in the physical and mechanical properties of the ore. The development of deposits is complicated by the need to deliver ores by technological grades. Industrial types of ores are distinguished by the content of the main and accompanying components, as well as by the form of ore bodies and genesis.

5. Fine dispersed connection of valuable components with the host rocks and with each other. The different nature of the mineralization of the processed ores requires the development of a more advanced technology for ore preparation, the use of more complex stage-by-stage enrichment schemes. The optimal final and intermediate (in stages) grinding size is selected based on the dependence of the concentration indices on the grinding size of the ore. Conventionally, large (45–55%, that is –0.074 mm), medium (55–85%) and fine (over 85%) grinding are distinguished.

IV. METHODOLOGY

The main characteristics of the material composition of non-ferrous metal ores, which determine the technical and economic indicators of concentration, include:

- content of valuable components;
- mineral composition;
- the nature of dissemination and accretion of minerals;
- the presence of isomorphic impurities in them;
- secondary changes in minerals due to oxidation, weathering and mutual activations.

Content of valuable components. Ore is a mixture of valuable components, each of which can be used in the national economy. The degree of extraction of each of them into separate concentrates depends on its content in the ore. All other things being equal, recovery increases with an increase in the content of this component in the ore. This is usually due to the fact that the content of its non-recoverable part in the ore is more or less the same, and with an increase in the total content of the floated component, the share of its recoverable part increases. However, when processing various types of ores at a factory, such a relationship may not exist, if it turns out that in ores with a higher content of the extractable component, it is represented by hard-to-float or non-extractable minerals, and in ores with a low content of this component, by easily-floatable mineral varieties.

Mineral composition. The technological parameters for the extraction of each component from the ore and the quality of the obtained concentrates depend on the mineral composition of the ore, firstly, because each metal or element can be represented by different minerals with different flotation capacity. For example, copper in ores can be represented by easily floatable sulfide minerals (chalcopyrite, bornite, chalcocite and covellite); much worse floating oxidized minerals (malachite, azurite, cuprite) and practically unrecoverable chrysocolla and copper aluminosilicates during flotation. Different groups of mineral forms require different reagent regimes, and with their joint presence it is difficult to provide optimal conditions for the flotation of all minerals. Therefore, the technological scheme usually provides for a separate flotation recovery, for example, first sulfide, then oxidized minerals. A change in the ratio of mineral forms towards an increase in the difficult-to-float differences of the extracted component leads to a decrease in its extraction into concentrate.

Secondly, the possibility of selective (selective) flotation depends on the degree of closeness of the physicochemical properties of the separated mineral components and the difficulty of its implementation increases when minerals with the same anion or cation are separated. For example, while the flotation separation of sulfide minerals from non-sulfide minerals is usually a simple operation, the separation of sulfides is much more difficult. Difficulties in selective flotation of minerals with the same cation or anion are also due to the fact that different mineral forms of the same metal or element have different properties. If, for example, the separation of galena from chalcopyrite proceeds rather easily, then its separation from chalcocite requires special conditions.

Thirdly, selective flotation will be complicated in the presence of readily floatable aluminosilicates in the ores, a high content of slime minerals and rocks with a high absorptive capacity in relation to flotation reagents. For example, flotation recovery of oxidized lead minerals from heavily destroyed ores becomes practically impossible if they contain manganese oxides and hydroxides. Effective depression of flotation active silicates, which sharply reduce the content of the recoverable component in the concentrate, is also a difficult task.

Influence of the genesis of ores. The conditions for the formation of minerals (genesis) determine their structure, the nature of crystallization, isomorphism, the rate and degree of oxidation, and the electronic properties of minerals. For example, sulfide ores resulting from the crystallization of molten magmas or the precipitation of sulfide minerals from hot aqueous solutions are distinguished by their density, coarse crystalline structure, and have no pores. Oxidized ores formed during the oxidation and leaching of sulfide ores are usually characterized by a fine-crystalline structure and a large number of pores filled with ocher-clay material. When grinding such ores, ocher-clay material forms a significant amount of the so-called "primary" sludge, which has a detrimental effect on flotation.

Genesis determines the content of isomorphic impurities in minerals. A wide change in the content of isomorphic, for example, iron in zinc blende, pentlandite, molybdenum in scheelite, manganese in tungsten, has a significant effect on the necessary conditions for the activation and depression of isomorphic varieties of the mineral. Isomorphism is the main reason for the presence in ores of easily- and difficult-to-float varieties of one total mineral. The study of their influence on the floatability of sulfide minerals showed that a change in the concentration of electrons in the surface layer of minerals does not require a change in the previously established ratios of the concentrations of reagents in the boundary conditions of mineral flotation, but can significantly affect the maximum possible extraction of minerals into concentrate. The reason for this is the violation of the conditions for the formation of dixanthogenide on the surface at a high concentration of electrons or, conversely, holes in the surface layer of the mineral. It is possible to increase the extraction of a mineral at a high concentration of electrons, for example, by using oxidizing reagents, and at a high concentration of holes - by using reducing reagents, which reduce their concentration in the surface layer to the optimum.

Secondary changes in minerals. Both ore minerals and minerals of host rocks can be subjected to secondary alterations. The most important changes in gangue minerals are associated with silicification, coalization, chloritization, and sericitization of their surface. Kaolinization and sericitization are the main processes of alteration of feldspars; chloritization is most characteristic of iron-magnesian minerals. In the process of secondary changes, there is a unification of the surface properties of various rock minerals with an increase in the overall degree of their hydrophobicity and the formation of a large mass of easily floatable sericite-chlorite slimes, even with relatively coarse grinding. As a result, the difficulties of depression of waste rock, prevention of harmful influence of sludge and obtaining rich concentrates increase.

Secondary changes in ore, for example, sulfide minerals, are mainly associated with their oxidation and mutual activation. Oxidation of sulfides in the oxidation zone of a deposit or in the process of mining, transportation, crushing and grinding of ore leads to the formation of more polar compounds on their surface than sulfides themselves. When interacting with a collector, loose hydrophobic sludge is formed on such surfaces, which impedes the flotation of sulfide grains. The best results in this case are obtained by preliminary sulfidization of the oxidized surface of sulfide minerals.

The greatest difficulties in selective flotation can be caused by the mutual activation of minerals both in the deposit itself and in the process of preparing the ore for flotation. It is especially difficult to select sulfide ores from secondary beneficiation zones, when the surface of almost all sulfides of iron, zinc, lead is covered with films of secondary copper sulfides. In this case, the floatability of all minerals becomes the same. With a limited development of activating films on the surface, minerals can be separated only after very fine grinding or only after removing the films with appropriate solvents.

The involvement of increasingly poor and refractory ores into operation leads to an increase in the volume of mining operations. High-performance development systems and equipment of large unit capacity, used in order to reduce the cost of production, cause an increase in dilution, an even greater deterioration in the quality of a mineral, an increase in difficulties in the concentration conversion and a sharp drop in technological, economic indicators of concentration and the complexity of the use of raw materials. The tight connection between the mining and processing cycles ensures that the maximum overall efficiency of the mining and processing complex is obtained only if the following mandatory conditions for the quality of ores supplied for processing are met:

-the maximum possible removal of rock from lumpy and crushed rock mass in order to reduce useless energy, capital and operating costs for crushing, grinding and enrichment, to ensure a more complete disclosure of mineral aggregates and thereby improve the quality of concentrates, the extraction of valuable components in them and the complexity of the use of raw materials ;

- separate mining and processing of technologically incompatible ore grades. Co-processing of different in material composition (for example, the ratio of the contents of valuable components and their mineral forms, the nature of the host rocks, textural and structural features, etc.) ore grades leads to a sharp drop in technological and technical and economic indicators of concentration. Most of the mining and processing enterprises process ores of two or three grades, some 8-10 (Sartori in Italy, Sullivan in Canada, etc.). The results of studying the structure of domestic deposits also showed that in most (including Khandiza, Uch-Kulach, Belousov, Salair and other mines), technological ore grades are quite clearly separated in space and can be mined separately in terms of mining capabilities. Separate mining and processing of technological grades of ores makes it possible to dramatically increase the enrichment indicators, the complexity of the use of raw materials, including the extraction of precious metals: gold and silver - from copper, copper-zinc and polymetallic ores (for example, Mirgalimsay, Ridder-Sokolny deposits), platinum and platinoids - from copper-nickel ores;

- the constancy of the contents of valuable components, harmful impurities and physical and mechanical properties, close to the design indicators of each technological grade of ore, for which the developed technology of complex processing and concentration is intended, in order to obtain the maximum possible technological and technical and economic indicators.

V. CONCLUSION

Fulfillment of the listed conditions for the quality of ores supplied for processing can be achieved through the interaction of geologists, miners and concentrators. The essence of such interaction is the study of the technological properties of ore still in the depths, the formation of technological flows of ore, homogeneous in composition, the separation in the flow, batch modes and at the separation complex (preconcentration operations) of dump large-lump tailings, ensuring an optimal scheme for the disintegration of ore with minimization of energy consumption in the blasting - crushing - grinding (self-grinding) and obtaining a given granulometric composition of the material at the exit from grinding.

Thus, the conformity of the quality of the ore planned for processing, which is optimal for the selected ore preparation and concentration schemes and is actually supplied for processing, is ensured by a preliminary technological study of the deposit's ores, as a result of which its technological mapping, long-term planning and operational management of the ore quality in the mining and transport process, mine and factory ore homogenization should be carried out.

REFERENCES

[1]. Adamov E.V. Basics of design of concentration plants. Textbook. M. 2012.647 p.
[2]. Avdokhin V.M. Fundamentals of mineral processing. Vol. 2.M. 2014.310 p.
[3]. Bocharov V.A., Ignatkina V.A., Abryutin D.V. Technology of processing gold-bearing raw materials. Textbook. MISIS 2011.328 p.

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[4]. G. G. Chuyanov. Mineral processing technology. Tutorial. Yekaterinburg-2007.
[5]. Abramov A.A. Technology of concentration of non-ferrous metal ores. M., Nedra, 2002.217 p.
[6]. Handbook of ore dressing. M., Nedra, 2001.315 p.
[7]. M. A. Eigeles. Enrichment of non-metallic minerals. Literature on building materials. M., 2000. 234 p.
[8]. Akbarov T.G., Toshtemirov U.T., Nurkhanov Kh., Khojakulov A. Recommended Support Structures For Excavations In Difficult Mining And Geological Conditions. IJARSET. "International Journal of Advanced Research in Science, Engineering and Technology" Vol. 7, Issue 2, February 2020. Pp. 12798-12802.
[9]. Mutalova M.A., Khasanov A.A., Melnikova T.E.,Ibragimov I.S.Development of Technology for Producing Tungsten Product with WO_3 Content Not Lower than 40% from Technogenic Waste SIE«Almalyk MMC».IJARSET.International Journal of AdvancedResearch in Science, Engineering and Technology, Vol. 6, Issue 12 , December 2019. Pp. 12334-12338.
[10]. Mutalova M.A., Khasanov A.A., Masidikov E.M. "Extraction of a Tungsten-Containing Product from the Left Tails of the Ingichin Factory" International Journal of Advanced Research in Science, Engineering and Technology Vol. 7, Issue 5, May 2020, pp. 13850-13856.

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