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# Modern Condition of Hard-to-Processing Ores in The Republic of Kazakhstan

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ABSTRACT: Kazakhstan takes up one of the leading places in the world by reserves of useful minerals. Problems of processing of hard-to-processing ores arise all over the world. Today in Kazakhstan easy-to-processing ores are practically mined as a result of intensive exploitation of mineral resources. The main extracting ores are hard-to-processing ores which are characterised by low content of useful components, increasing of a part of oxidized forms, high content of soluble minerals, increasing of a part of line- and emulsive patching ores. In the paper results of technological-mineralogical investigations of deposits and their parts are presented.

## 1 INTRODUCTION

Specific nature of processing of hard-to-processing ores of Kazakhstan is in a fact that for full extraction of useful component a thorough study of composition, character of mineral associations of minerals, crystals' size, in-depth technological-mineralogical study is necessary. Especial attention must be paid to investigations of technological compatibility of ores from different parts of a deposit.

There are 37 preparation plants in Kazakhstan, and practically all of them are faces with the problem of hard-to-processing ores processing, especially preparation plants of the Eastern Kazakhstan where complex mixed ores are processed.

For complex and rational using of mineral resources it is necessary to create optimal technology of processing of mineral raw materials which will take into account not only problems of processing stage but also problems of mining operations when forming ore-flows which arc transported to preparation plants.

## 2 DETAILS OF THE STUDY

Mineral processing is the final stage of mineral raw materials working. Products are received when ore processing comes to metallurgical treatment, where they are smelted or are dissolved. The main purpose of processing is receiving of market product complying with standards of metallurgical stage.

The main result of purposeful technological-mineralogical studying of ores from different parts. zones and levels of any deposit is forming of a map of washability for its parts. Systematic technological-mineralogical sampling will allow bringing to light such parts of deposits and such types of ores, which may be effectively processed by modern methods and also the others, which need modernization of existing or creating new technologies. In-depth technological-mineralogical analysis of all zones and parts of deposits will at the same time allow bringing to light to the reasons of bad washability of particular ores and define the most effective, priority directions of investigations.

As an example studying Akzhal deposit may be considered. Ore ledge of Akzhal deposit is divided into more than 60 separate fragments ore bodies or parts. In previous works, ores of Akzhal deposit are subdivided into two types: mixed and sulphide.

Mixed ores include up to 70% minerals of zones of oxidation and on the whole are located at a depth of 20-30 m. These are hard-to-processing varieties of ores, and now they are worked out in a high degree, but losses of lead and zinc during processing, which add up to 10% and 16.5% correspondingly, arc evidence of their ingress into a process today.

Sulphide ores are the main at the deposit. 5 genetic varieties may be separated out of these ores, but their technological-mineralogical characteristic properties and distinctions are not studied. They are distinguished from each other by varieties of sphalerite and differences in aggregating rock minerals: in the first case it is thin growing together with carbonates, in the second case it is close growing together with calcite and in the third case - emulsive patching by chalcopyrite. All these varieties are

hard-lo-process. There are more favorable ores to process, where large-crystal sphalerite and large-sized galena are predominated, but there is secondary covellile and it negatively effects on selection of lead and zinc.

At the deposit different structural-textural ores are fixed:

Table I Content of elements in ores, ore tailings and concentrates

| Product name | Content, mas. % | | | | | | |
|---|---|---|---|---|---|---|---|
| | Zn | Pb | Cd | Ag г/т | S | $SiO_2$ | CaO |
| 1. Ore sample | 3.3 | 0.13 | 0.02 | | 2.13 | 5.03 | 40.4 |
| 2. Ore sample | 4.0 | 0.15 | 0.032 | | 2.8 | 8.6 | 38.3 |
| 3. Ore sample | 5.06 | 0.18 | 0.038 | | 3.57 | 8.6 | 35.2 |
| 4. Ore tailings | 0.26 | 0.015 | 0.002 | | 0.62 | 4.97 | 45.1 |
| 5. Ore tailings | 0.26 | 0.014 | 0.002 | | 0.73 | 8.3 | 41.9 |
| 6. Ore tailings | 0.25 | 0.023 | 0.002 | | 0.59 | 6.6 | 44.0 |
| 7. Pb – concentrate | 4.9 | 59.9 | | 380 | | | |
| 8. Pb – concentrate | 4.7 | 56.9 | | 350 | | | |
| 9. Pb – concentrate | 4.3 | 67.9 | | 324 | | | |
| 10. Zn – concentrate | 51.7 | 1.05 | 0.41 | 48 | | | |
| 11. Zn – concentrate | 50.6 | 0.68 | 0.42 | 49.5 | | | |
| 12. Zn – concentrate | 53.9 | 0.86 | 0.41 | 62 | | | |

massivc - continuos aggregates of sphalerite, galena and other sulphides;

banded - alternating of stripes of sphalerite, galena and carbonates;

patched - patches of sulphides in limestone;

brecciated - fragments of limestone cemented by sulphides and calcite;

emulsive - structures of disintegration of solid solutions.

In Table 1 data are presented of content of elements in ores, ore tailings, and concentrates. They also are evidences of differences in washability of processed ores; variations are substantial both in contents of extracting metals (zinc, lead, cadmium, silver) and also in contents of elements and compounds, characterizing share of sulphide varieties (sulphur) and in quality of influencing rocks - CaO, Si(X

All these ores need particular technological-mineralogical studying which will allow systemizing them by washability and separating into technologically compatible groups.

Forming of ore-Hows, arriving to preparation plant, is carried out today without taking account of washability and technological-mineralogical properties of ores of different parts of the deposit. Ore extracting is carried out with due account of ease of carrying out of stripping operations of this or those parts of the main ledge of the deposit. Mining is carried out by method of complete extraction and ore arrives to preparation plant in arbitrarily mixed condition.

For a more detailed study the open cast was divided into 6 typical parts, distinguishing from each other by technological-mineralogical properties of ores, where representing samples were taken.

Mineralogical studying of the first testing samples showed, that useful minerals are; sphalerite, galena is present in insignificant quantities and in insulated grains - pyrite and chalcopyrile. The most typical textures are non-uniform-patched, rarer veinlet-palched and banded and very rarely densely patched. Dimension of sphalerite grains arc from thousandth parts of mm up to 3-5 mm, grains of 0.1-0.3 mm prevail: dimensions of galena grains - from thousandth parts of mm up to 0.1 mm. Limestones, which are in different degree marblcizcd, cataclastized. quartzed and harytized, present enclosing rocks, rare marble and diabasic porphyrite are present. Calcite, dolomite, quartz, baryte, feldspar, seriate, dark-colour minerals (in the decreasing order) pyroxene, amphibole, epidote, chlorite and garnet present rock-forming minerals.

All samples have characteristic technological-mineralogical distinctions and include different enclosing rocks and minerals, which effect on technological process and quality of producing concentrate.

Ores of different sorts from different zones by washability are mixed, and ore mixture is arrived to preparation plant. This negatively influences on final indexes of the process. That is why today results are not limiting for these types of ores. Upgrading the quality of concentrate and final indexes is possible when detail and in-depth studying of effect of every type of ore in their mixture.

Interconnection of such functioning subsystems as open cast and preparation plant will allow studying them as an integrated system with required qual-

ity characteristics, ensuring technological compatibility of ores, arriving to processing. Influence of technological-mineralogical factor on processing must be taken into account al a stage of timely work with geological reserves.

For increasing of fullness of useful components extraction, it is necessary to systematize ores by washability, and this requires forming technological-mineralogical map of washability of ores from different parts and levels within limits of open-pit field. Such map using will allow stabilizing homogeneity of mineral raw materials, when forming of ore-flows, arriving to preparation plant, regulating their movement and substantially increasing technical-economic indexes of preparation plants.

## 3 CONCLUSION

High priority of these investigations is based on a fact that at preparation plants ore quality is taken into account mainly by metal content, and this is not enough for representation of true ores washability. Ore-flows forming on this base cause substantial metal losses during processing.

High technological-mineralogical distinction ol ores from different parts is typical for Ak/hal deposit. Advance study and systcmization of ores, forming of technological-mineralogical map of washability will allow forming of ore-flows, ensuring optimization of schemes of ores from different parts of deposit, which are compatible by technological properties, stabilization of homogeneity of mineral raw materials arriving to preparation plant. This will allow increasing the technological indexes of metals extraction into concentrate by 3-5%, improving quality of concentrate and increasing complex utilization of mineral raw materials.