UNIVERSITY OF BELGRADE
TECHNICAL FACULTY IN BOR
CHAMBER OF COMMERCE AND
INDUSTRY OF SERBIA

PROCEEDINGS

XIII International MINERAL PROCESSING and RECYCLING CONFERENCE

Editors:
Grozdanka Bogdanović
Milan Trumić

Belgrade, Serbia, 8 – 10 May 2019

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INVESTIGATION OF THE FLOTATION PARAMETERS FOR THE ORE FROM THE ''CEROVO-C2'' DEPOSIT – CEMENTATION ZONE

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ABSTRACT – The part of the results, obtained during the technological investigations of the ore from the deposit ''Cerovo-C2'' deposit - Cementation zone, are presented in this paper. Investigations were undertaken at different flotation conditions (three collectors and grinding fineness) in order to define possibility and optimal conditions for processing the ore from this deposit. Obtained results indicate the possibility for producing the copper concentrate with the commercial quality. Best results were obtained with the collector Flomin C4132 and grinding fineness of 80 % below 0.074 mm, where the copper content in the rough concentrate was 4.64 % and the copper recovery was 81.74 %..

Key words: flotation, collectors, grinding fineness, copper recovery.

INTRODUCTION

The copper deposit "Kraku Bugaresku-Cementation" belongs to the basic type of porphyry deposits, as well as subgroups of deposits that are characterized by secondary sulphide enrichment (cementation subtype).

Based on the concentration degree of the mineral composition and the mutual relations of individual elements in the deposit, a certain vertical zonality is observed. From the surface of the terrain to the depth can be distinguished: the oxidation zone, the cementation zone or the secondary sulphide enrichment and the primary zone.

Below the level of groundwater, a secondary sulphide enrichment zone (a zone of cementation) is created. The zone of cementation is characterized by processes which are reflected in the delivery of components and somewhat more pronounced caolinization, relative to hypogenic mineralization. The thickness of this zone is predominantly about 30 meters. For this zone, it is characteristic partly, rather than completely, converting chalcopyrite into coveline and chalcocite. The depth intervals of the zones are conditioned by the locally present tectonics.

In the deposit Cerovo C2 dominant minerals are sulphide copper minerals with

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the tolerant presence of the oxide fractions from the aspect of their processing in flotation concentration.

Laboratory technological investigations were carried out in order to examine the possibilities of processing this type of ore by the mean of flotation concentration. Investigations were carried out at different grinding fineness and different flotation reagents in order to define the possibilities and optimal conditions for processing the ore from this deposit.

EXPERIMENTAL

Characteristics of ore sample

Ore samples from the deposit Cerovo C2 derives from the boreholes and were taken during the investigating activities. Samples were grinded and homogenized in order to obtain composite sample.

Moisture content in the composite sample was 3.5 %.

Chemical composition of composite sample is given in Table 1.

Table 1. Chemical composition of ore sample

Content							
Cu_{uk}	**Cu_s**	**Cu_{ox}**	**S**	**Fe**	**Au**	**Ag**	**Pt**
%					**ppm**	**ppm**	**ppm**
0.265	0.233	0.032	2.90	2.35	0.03	1.10	15.0
SiO_2	**Al_2O_3**	**CaO**	**MgO**	**Fe_2O_3**	**K_2O**	**Na_2O**	**TiO_2**
%							
61.86	18.62	1.08	2.04	3.36	3.24	0.41	0.17

* Ignition Lost - I.L.= 5.98 %

X-ray diffraction was used to determine the phase composition. The XRD patterns were obtained using a PW 1710 automated diffractometer (Philips) using a Cu tube operated at 40 kV and 30 mA. The instrument was equipped with a diffracted beam curved graphite monochromator and a Xe-filled proportional counter. All the XRD measurements were performed at room temperature in a stationary sample holder. The presence of minerals pyrite, chalcopyrite, digenite, coveline, chalcocite, digenite, coveline, luzonite, sphalerite, galenite, molibdenite, native gold, rutile, magnetite, Cu-oxsides, gangue minerals are determined in samples [1].

Cu-oxides are: Cu- limonite, azurite i malachite. Gangue minerals are: quartz and silicates.

Technological conditions

Laboratory technological testing the conditions of flotation concentration included a change of relevant technological parameters [2]:

- Tests were carried out through three series of experiments of rough flotation,
- Each series consisted of three experiments:

  I series - three different collectors with grinding fineness 60.0 % - 0.074 mm,

II series - three different collectors with grinding fineness 70.0% - 0.074 mm,
III series - three different collectors with grinding fineness 80.0 % - 0.074 mm.

- pH value of the pulp was 10.5 in each experiment,
- Pulp density during grinding in all experiments was 60% solid phase,
- Pulp density during flotation in all experiments was 25% solid phase,
- D-250 was used as a frother in all experiments with recommended consumption by the manufacturer.

In all experiments, the conditioning time was 10 minutes; the time of rough flotation was 20 minutes. Collectors were added in three doses, one dose in conditioning and two doses in rough flotation.

Consumption of individual collectors by series of experiments is given in Table 2.

Table 2. Consumption of collectors

Series of experiments	Grinding fineness	Consumption of collectors [g/t dry ore]		
		PEX	MX5193+PEX	C4132
I	60.0 % -0.074 mm	70.0	10.0+10.0	11.0
II	70.0 % -0.074 mm	70.0	10.0+10.0	11.0
III	80.0 % -0.074 mm	70.0	10.0+10.0	11.0

RESULTS AND DISCUSSION

The dependence of the total copper content in the rough concentrate, for all investigated collectors, on the grinding fineness is graphically presented at Figure 1. The diagram shows that the total copper content in the rough concentrate increases with the growth of the grinding fineness for all investigated collectors.

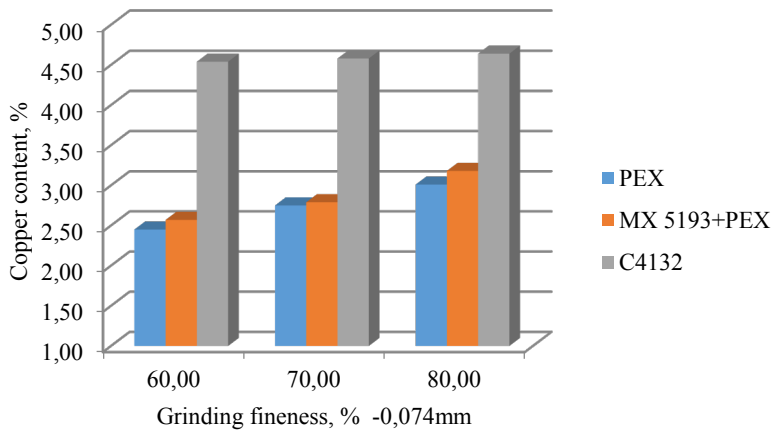

Figure 1. Influence of the grinding finenness on the total copper content in the rough concentrate

The smallest copper content, for all grinding fineness, was achieved using the Potassium Ethyl xanthate (PEX) collector, while the highest content of total copper (4.64 %) for grinding fineness 80 % - 0.074 mm was in experiments in which Flomin C4132 was used as a collector.

The copper recovery in the rough concentrate, for all investigated collectors, on the grinding fineness is numerically given in Table 3 and graphically presented at Figure 2.

From the presented results it can be noted that the copper recovery in the rough concentrate increases with the growth of the grinding fineness for all investigated collectors.

Table 3. The copper recovery in the rough concentrate

Series of experiments	Grinding fineness	Copper recovery, %		
		PEX	MX5193+PEX	C4132
I	60.0 % -0.074 mm	73.91	79.05	74.55
II	70.0 % -0.074 mm	77.07	80.89	76.43
III	80.0 % -0.074 mm	83.77	84.19	81.74

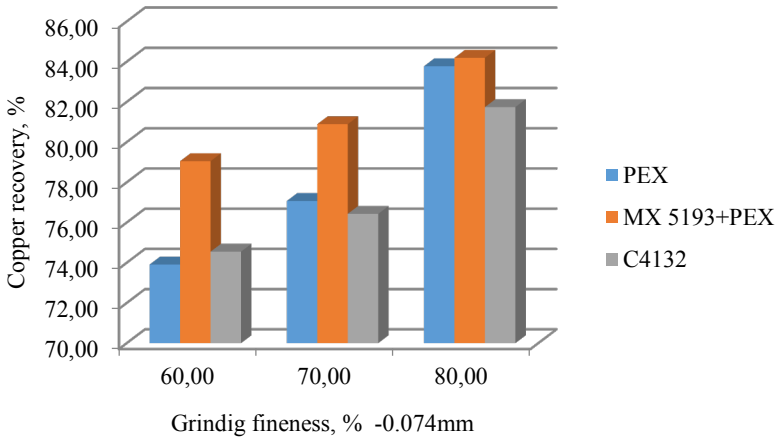

Figure 2. Influence of the grinding finenness on the copper recovery in the rough concentrate

Obtained values of the copper recovery are satisfying, specially from the point of view that this investigation present only preliminary tests. This results can be used as the guideline for the further, more detailed flotation concentration investigations, that should result in the process optimization. Additionally, the presence of the oxide particles are the one that also limited the copper recovery by the flotation concentration process. Therefore, the expactations concerning the copper recovery cannot be the same like in a case of processing the pure sulphide ore.

The higher values of copper recovery in the rough concentrate obtained when applying the PEX as a collector and the combination of the MX 5193 and PEX collectors relative to the tests in which the Flomin C4132 collector is used are explained by the large mass fraction of the rough concentrate.

By the usage of the much more selective collector Flomin C4132, the presence of a limiting factor for the application of xanthates, such as pyrite and sludge particles, is completely eliminated [3]. This collector is designed to collect only copper particles and in this case gives the best results, especially if we take in account all the related parameters: mass fraction of the rough concentrate, the content of the copper in the rough concentrate (~ 4.5 % Cu), copper recovery in the rough concentrate (74 - 82 % Cu), but also and the applied dosage of the collector.

Consumption of collector Flomin C4132 is much lower compared to the other used collectors.

Additionally, Flomin C4132 also has froth properties, and its usage also reduces the dosage of the froth.

CONCLUSION

Investigations of the copper minerals flotation, under different conditions, that were undertaken, show some differences in the effects of their application.

The results of the experiments indicate that the copper content and copper recovery of the rough concentrate increase with the growth of the grinding fineness. In some cases, significant differences in flotation effects for different grinding fineness were observed and these differences range from 0.2 to 1 % for the total copper content and 4 to 10 % for the copper recovery in the rough concentrate. Therefore, it can be concluded that by increasing the grinding fineness and the degree of raw material liberation, increase the probability of successful hydrophobization of mineral grains [4]. By increasing the specific surface area of the raw material, more favorable conditions for the flotation process are achieved and technological indicators of this process are improved.

For the range of these investigations, the most favorable technological results were achieved for 80 % of the class 0.074 mm.

The results of testing the flotation procedure for the concentration of copper minerals from the Cerovo C2 cementation zone samples unambiguously indicate the possibility of applying this technological operation for the successful valorization of copper minerals from the ore.

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