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Edited by

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Igor Miljanović, Ivana Simović

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ACADEMY OF ENGINEERING SCIENCES OF SERBIA
UNIVERSITY OF BELGRADE

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Foreword

Practically, all human societies depend on the availability and use of mined products. Mining and mineral processing has played a vital part in the history and economy of the Balkans.

In the world, mineral processing was an art till the 1920s, when it started to become a science. The achievements of fundamental science enabled the explanation of phenomena in the processes of mineral processing, or they started from fundamental science to come to an appropriate solution in mineral processing. In many respects mineral processing becomes fundamental science.

Balkan countries have more or less rapidly accepted innovations in the field of mining and mineral processing.

Generations of professionals from Balkan trained on the tradition of mining schools, afterward universities, (Schemnitz established 1702, Jachimov 1716, Banska Štiavnica 1725, Jekatarinburg 1730, L' Ecole Polytechnique 1794 in Paris, Politehnika in Prague, and certainly the most famous Bergakademie Freiberg founded in 1765, and much later, universities in the United States and Soviet Union) contributed to today's level of development of mineral processing, and contributed to the quality of studies of mineral processing, both in the world, and so in the Balkans.

After the Second World War in the Balkans a large number of universities, faculty, institutes and laboratories of mining industry with special departments for mineral processing were opened. In many Balkan countries remarkable impact on development of mineral processing had Russian and American schools.

A great number of researchers and specialists in Balkan area were occupied for more decades by the research in mineral processing. The goal of this research was establishment of concentration process in industry, capacity enlargement, optimization of processes, increase the energy efficiency of processes and devices, introduction or construction of new machines. Based on those activities, Balkan mining has been evolving and continuously operates up to nowadays. As a result, in the Balkan countries appeared a significant number of successful researchers in the field of mineral processing. They founded the first Balkan mineral processing Committee (1973), and then the Balkan Academy of Mineral Technology.

Balkan Congress on Mineral Processing is beening held for 40 years. Participation in the work of the Committee of the Balkan mineral processing is a strong link between the development of the science and profession with global trends, and it provides the possibility of establishing direct contacts between researchers, designers, equipment manufacturers and investors from the region and around the world. It has already become tradition to hold every second year an international event, "Balkan Mineral Processing Congress," in which participate, not only Balkan experts, than experts from the whole world.

Maintenance XVI Balkan Congress on Mineral Processing in Belgrade from 16 to 21 June 2015 is held under the auspices of the Ministry of Mines and Energy of Serbia, with the financial assistance of the Ministry of Republic of Serbia. Incomparably greater financial support Congress had from sponsors who strongly support the mineral processing industry all over the world.

Prof. dr Nadežda Ćalić

The XVI BMPC Chair

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RECOVERY OF COPPER, GOLD AND SILVER FROM ORE DEPOSIT TENKA 3 IN DEPENDENCE ON GRINDING FINENESS

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Abstract: The results shown in this paper represent a part of technological testings performed to evaluate the possibility of copper and precious metals valorization from ore deposit Tenka 3. Concentration of useful minerals was achieved through flotation method including rougher and scavenger circuits. During the experimental procedure AEROPHINE 3418A Promoter (phosphine-based collector) and AERO 5500 Promoter (ethoxycarbonyl thiourea based collector) were used for the hydrophobization of mineral surfaces. pH value of flotation pulp was 10.5 in every experiment. Grinding fineness varied from 56% to 65% of class –0.074 mm. The highest recoveries of copper and precious metals are obtained at grinding fineness of 60% –0.074 mm, while the highest grades are obtained at grinding fineness of 56% –0.074 mm.
Key words: flotation, grinding fineness, copper concentrate

INTRODUCTION

Polymetallic-gold deposit Tenka is located in the far northern part of Northern Area of copper deposit Majdanpek. It comprises the area of irregular trapezoid form, whose strike is N-S, longer side about 650 m, while shorter side ranges from 150 - 250 m. Polymetallic sulphide mineralization is spatially limited to the western part of ore mineralized zone. Deposit Tenka consists of several ore bodies of complex morphology among which dominant are ore veins, columns, lenses and nest-form ore bodies. Control factor of their position consists of tectonized zones of contact of volcanic rocks of Upper Cretaceous with structures of Jurassic age. In more strongly tectonized zones (breccias) along which movement of ore bearing fluids have been easier, there has occurred formation of smaller ore bodies of irregular morphology of stockwerk-impregnation ore mineralization type. Polymetallic, as well as Cu-pyrite ore mineralization has been deposited in scarned limestones, tectonic breccias and partly in andesites. The area around massive-sulphide mineralization is filled with stockwerk-impregnation and vein form mineralization with occurrences of barren limestone inclusions. Massive-sulphide mineralization is regularly found in limestones, when the boundary towards surrounding rocks is sharp and in tectonic breccias when it is in combination with smaller veins and veinlets. In andesites, most frequently occur veinlets, more rarely veins. In brecciated limestones, mineralization has been deposited in existing cavities and fractures, cementing limestone fragments. Observed from economical pint of view, of special interest are the following ore bodies: Tenka-1, northern ore body; Tenka-2, southern ore body and Tenka-3, which makes the eastern part of productive zone. These ore bodies are different in morphological characteristics, partly in mineralogical characteristics and contents of useful components [1].

Ore body Tenka 3 is formed in tectonized zones of contact between limestones of Starica and Upper-Cretaceous volcanites and partly in limestones, i.e. hydrothermally altered andesites. In terms of mineral composition, ore body Tenka 3 is agglomerate composed of massive pyrite bodies (pyrite content is 60-90%), magnetite ore bodies in skarns and copper vein-impregnated mineralization in andesites [1,2].

The aim of this work was to determine the optimal conditions (in terms of the grinding fineness) which provide the best recovery of useful components (Cu, Ag, Au) in flotation concentrate. The sample from ore body Tenka 3, used in this testing, contained a high amount of pyrite besides the relatively high content of useful components. Structural and textural properties, clay content, mineralogical composition, degree of intergrowth of useful and gangue minerals are similar in the tested sample as in the ore body Tenka 3 [3].

EXPERIMENTAL PROCEDURE

Raw materials

The starting sample, which was used during this study, was formed by mixing three samples from different locations of ore body Tenka 3 (locations 1, 2, and 3). Chemical composition of the composite sample is shown in Table 1.

Qualitative mineralogical analysis was performed by the polarizing microscope with reflected light in the air. According to this analysis the sample contain the following major minerals: pyrite, chalcopyrite, limonite, quartz, silicates and carbonates. *Pyrite* is the most abundant sulfide mineral. It consisted mainly of coarse crystalline "spongy" aggregates, which are made of small, rounded pyrite grains (recrystallization). Pyrite minerals regularly include the relics of copper minerals (chalcopyrite). The aggregates of pyrite are cataclased and cemented by quartz. *Chalcopyrite* is the main copper mineral which is mostly occurred in the form of free grains. A small amounts of *tetrahedrite* are also observed. Figure 1 shows pyrite and chalcopyrite grains, Figure 2 presents a grain of tetrahedrite, found in the observed sample.

Table 1, Chemical composition of the composite sample from the Tenka 3 deposit

Metal	Pb, %	Zn, %	Cu, %	Cu_{sulf}, %
Content	0.073	0.016	0.473	0.453
Metal	**Cu_{ox}, %**	**S, %**	**Au, g/t**	**Ag, g/t**
Content	0.021	21.853	0.520	5.567

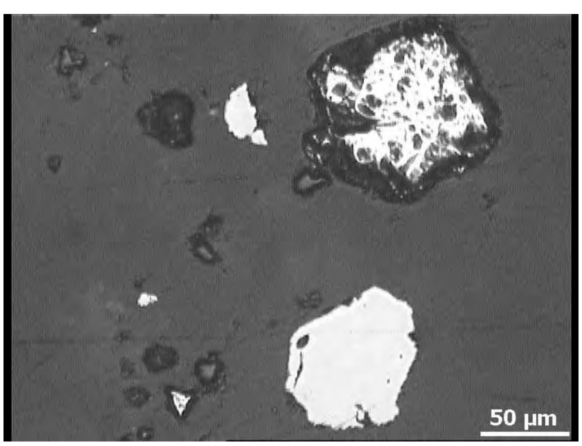

Figure 1, Mineral grains of pyrite and chalcopyrite

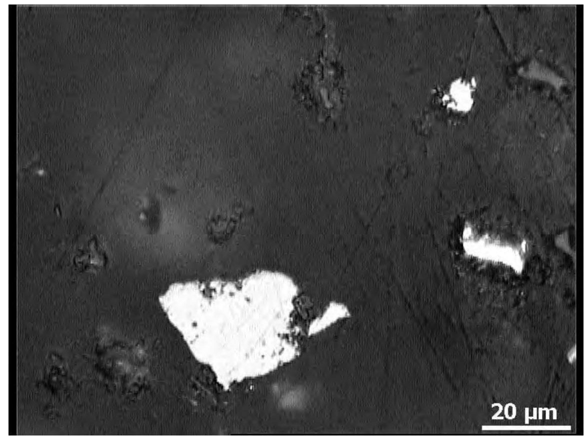

Figure 2, Mineral grain of tetrahedrite

Test procedure

Laboratory testing of copper minerals flotation was performed according to the following conditions:

- Pulp density in grinding circuit was 70% of solid phase, during the whole experimental procedure.
- Grinding fineness of feed material entering a flotation circuit varied as follows: 56%, 60% and 65% of class –0,074+0 mm – from the first to the third experiment, respectively.
- Flotation pulp density was 30% of solid phase in all experiments.
- pH value of flotation pulp was 10.5 during the whole experimental procedure.
- AEROPHINE 3418A Promoter (phosphine-based reagent) and AERO 5500 Promoter (ethoxycarbonyl thiourea based reagent) were applied as the collectors. Mass ratio of these collectors was 3418A : A5500 = 50 : 50%. Overal consumption of the collectors was 50 g/t in all experiments. The collector dose is based on the content of sulphide minerals including very high amount of pyrite (over 30%) in the ore.
- AEROFROTH 76A was used as a frother in all experiments, with the dosage recommended by the manufacturer.

RESULTS AND DISCUSSION

The results of laboratory testing are presented in Tables 2, 3, and 4.

Table 2, The results of laboratory testing obtained in experiment 1 (56% –0,074+0 mm)

Product	M, %	Cu, %	S, %	Au, g/t	Ag, g/t	R_{Cu}, %	R_S, %	R_{Au}, %	R_{Ag}, %
F*	100.00	0.47	21.8	0.520	5.567	100.00	100.00	100.00	100.00
RC_{Cu}	10.45	3.18	24.6	2.170	14.800	70.70	11.79	43.61	27.78
SC_{Cu}	3.25	0.54	19.1	1.800	12.200	3.73	2.85	11.25	7.12
T	86.30	0.14	21.6	0.272	4.200	25.57	85.36	45.14	65.10

Table 3, The results of laboratory testing obtained in experiment 2 (60% –0,074+0 mm)

Product	M, %	Cu, %	S, %	Au, g/t	Ag, g/t	R_{Cu}, %	R_S, %	R_{Au}, %	R_{Ag}, %
F	100.00	0.47	21.8	0.520	5.567	100.00	100.00	100.00	100.00
RC_{Cu}	15.02	2.45	29.6	1.900	10.300	78.30	20.39	54.88	27.79
SC_{Cu}	3.53	0.57	26.3	0.900	8.400	4.28	4.26	6.12	5.33
T	81.45	0.10	20.2	0.249	4.571	17.42	75.35	39.00	66.88

Table 4 - The results of laboratory testing obtained in experiment 3 (65% –0,074+0 mm)

Product	M, %	Cu, %	S, %	Au, g/t	Ag, g/t	R_{Cu}, %	R_S, %	R_{Au}, %	R_{Ag}, %
F	100.00	0.47	21.8	0.520	5.567	100.00	100.00	100.00	100.00
RC_{Cu}	13.65	2.66	31.9	2.054	10.551	77.34	19.96	53.92	25.87
SC_{Cu}	3.28	0.59	21.8	1.164	11.015	4.13	3.28	7.34	6.49
T	83.07	0.10	20.1	0.242	4.533	18.53	76.76	38.74	67.64

**F – feed, RC_{Cu} – rougher copper concentrate, SC_{Cu} – scavenger copper concentrate, T – tailings*

Figures 3 and 4 show the dependence of metal recovery in the rougher and scavenger copper concentrate on the grinding fineness, respectively. Likewise, Figures 5 and 6 present the dependence of metal content in the rougher and scavenger copper concentrate on the grinding fineness, respectively.

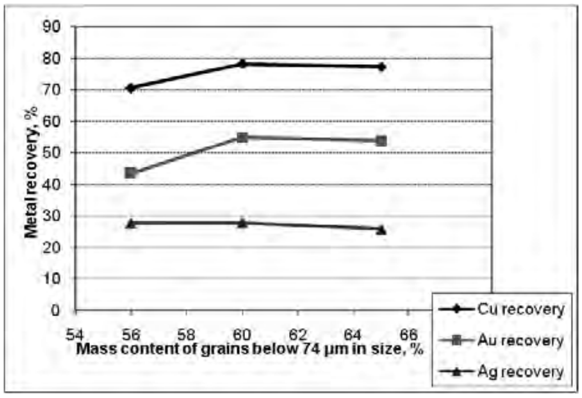

Figure 3, Metal recovery in the rougher copper concentrate

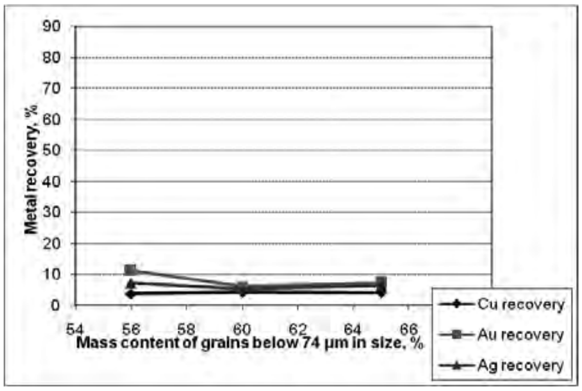

Figure 4, Metal recovery in the scavenger copper concentrate

As it can be seen from Tables 2 – 4, the highest contents of copper (3.18 % Cu), gold (2,170 g/t Au) and silver (14,800 g/t Ag) in the rougher concentrate were achieved in the first experiment (where the grinding fineness was 56% –0,074+0 mm). On the other hand, the highest recoveries of copper and precious metals are obtained at grinding fineness of 60%

–0.074+0 mm. However, the general conclusion is that the best results (in terms of both – metal content and recovery) are obtained in the third experiment.

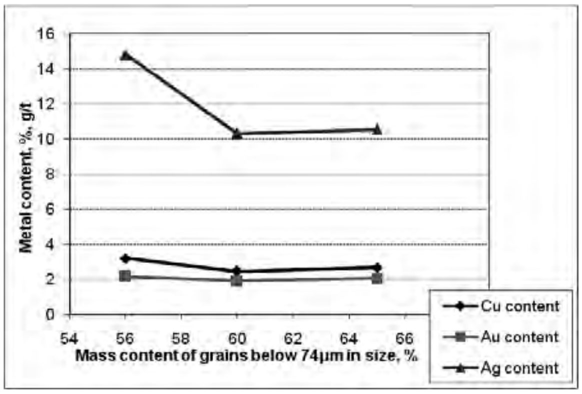

Figure 4 - Metal content in the rougher copper concentrate

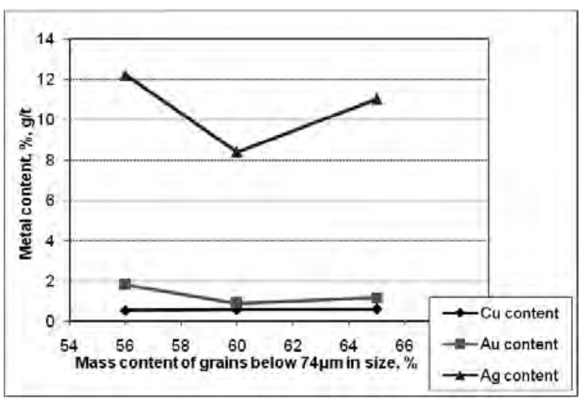

Figure 4 - Metal content in the scavenger copper concentrate

It is interesting to point at very close values of silver contents in rougher and scavenger concentrate of each experiment. This could indicate the silver is mostly incorporated in pyrite grains that (usually) rather pass into concentrate after certain time of flotation.

The trend of linear dependence between technological results and grinding fineness is not clearly observed (Figures 3 – 6).

CONCLUSION

The aim of presented study was to find the relationship between grinding fineness and technological results obtained by copper flotation. Laboratory testing have included the rougher and scavenger flotation circuits of copper from ore body Tenka 3. It is shown that the highest recoveries of metals are obtained at grinding fineness of 60% –0.074 mm, while the highest grades are obtained at grinding fineness of 56% –0.074 mm. The trend of linear dependence between technological results and grinding fineness is not observed.

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References

www.reservoirminerals.com/files/Analyst_Tour_Book_Bor_2013.pdf

Vujić, S., Grujić, M., Salatić, D., Radivojević S., Jelenković, R., 2005. Rudnik bakra Majdanpek, razvoj, stanje, budućnost, Rudarsko-geološki fakultet, Beograd, 167 p. (In Serbian)

V. Milošević et al., 2011. Izveštaj – Istraživanja za izbor optimalnih parametara tehnološkog procesa za dobijanje najpovoljnijeg iskorišćenja i kvaliteta koncentrata bakra iz uzorka Tenka 3 – Severni revir, arhiva ITNMS, Beograd, 63 p. (In Serbian)