Zoran Vaduvesković, Daniel Kržanović*, Nenad Vušović***

CONVERSION OF FLOTATION PROCESSING USING THE HEAP LEACHING METHOD IN THE MINE CEMENTACIJA – KRAKU BUGARESKU IN THE COPPER MINE BOR***

Abstract

RTB Bor is planning to expand the capacity of mining and processing at the Cementacija Kraku Bugaresku site from the current 2.5 million tons per year to 5.5 million. The current processing technology - the classic flotation of the entire excavated ore, without the separation of oxide and sulfide ores, due to the low copper recovery from oxide ore, has achieved the modest financial results. This article discusses an alternative method of copper obtaining using the hydrometallurgical heap leaching and SX/EW extraction method from leach solutions, in terms of economics, i.e. comparative analysis of cash flow and discounted cash flow for both cases (scenarios). The analysis is performed in a software for strategic planning and design in mining - Whittle Fx, with the input techno-economic data for both cases [7].

Due to the frequent breakdowns and causing the accidental situations on the current infrastructure installations of the processing plants, pipeline for pulp-hydro transport from the site to the flotation plant, in conclusion, to emphasize the comparative advantages of hydrometallurgical processing are emphasized in the conclusion not only in terms of the economy but also the environmental protection. In the world, the world's largest copper producers have a tendency to make, besides copper is necessary and valuable metal, also the "green" metal.

Keywords: *heap leaching, hydrometallurgy, oxide ore, sulfide ore, long-term dynamics of production, cash flow, discounted cash flow*

1 INTRODUCTION

The deposit Cementacija Kraku Bugaresku has begun the exploitation in 1990 by the investment works in stripping the deposit at the site Cementacija 1. The name of the ore body and complex of ore bodies consisting of Cementacija 1, 2, 3 and 4 talks about the nature of these ore bodies. It is a cementation zone of secondary enrichment with about 40% of oxide ore, mostly at levels near the surface, which is relatively poor to the flotation process. Flotation copper re-

covery from the ore has shown in the previous work a slightly higher level than 50%. Combining the processing methods - flotation of sulfide ore with maximum 10% of oxide (considered not have a negative effect on the recovery coefficient in the flotation) will achieve a significantly better economic effects [1], but the problem is in the possibility of selective excavation and separation of the aforementioned types of ore - sulphide and oxide.

* *Mining and Metallurgy Institute Bor, Zeleni bulevar 35, Srbija*

** *Technical Faculty Bor, University in Belgrade, Vojske Jugoslavije 12, 19210 Bor, Serbia*

*** *This work is within the Projects of technological development TR33038 "Improving Technology of Exploitation and Processing of Copper Ore with Monitoring the Living and Working Environment in the RTB Bor Group" and TR34004 "The New Production Line for Copper Production by Solvent Extraction of Mine Water", funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia*

2 DESCRIPTION OF THE PROBLEM

The major problem is in fact that the flotation processing on the deposit is only to the level of pulp obtaining, i.e. grinding and then concentration, and then the pulp is transported by hydrotransport for further processing in the Flotation Plant Veliki Krivelj. In addition to the increased costs of flotation process, this processing method is also very unfavorable from the aspect of environmental protection due to the frequent accidents on the pipeline and consequences for the environment. (The last one happened in mid-April 2014).

As with the opening of mine, the manner and type of processing were influenced by a lobby for "environmental protection". The decision on the processing method was so made without the expert analyses, not taking into account the nature of the deposit (content over 40% of oxide ore). According to the leaching method, not only due to its potential impact on the environment, but without a detailed knowledge of these matters, an animosity was created even to mention the acid, or cyanide, which are, by their nature, toxic. During the current exploitation a part of deposit, it was proved that the adopted and applied method does not give good economic effects, but also is a major polluter of the environment.

One example of the total conversion of pyrometallurgical process - flotation method of concentration and classical smelting of concentrate with electrolytic anode dissociation, hydrometallurgical process, i.e. heap leaching in combination with the "in situ" leaching assisted by bacterial leaching was applied to the mine Morenci of the Phelps Dodge company, Arizona [7] in early 2001. The existing facilities for concentration were put into a "stand by" condition while the smelter was previously relocated to a place Chino, Mexico.

In addition to this example, where the daily processing is about 75,000 tons of ore (about 360,000 tons of copper a year), the examples of total conversion of pyrometallurgical process are in Cerro Verde, (1993 - 15,000 t/d), Zaldivar (1992 - 20,000 t/d) in Peru, and Kuebrada Blanca (1,993 to 17,300 t/d) in Chile, and many other mines.

The benefits are multiple, the significant energy savings through reducing the total cost of production per tone of copper, whose purity is 99.99%, to the "clear sky" or environmental protection. It is also a way that the activities of copper exploitation and production leave behind them waste as less as possible.

3 COMPARATIVE ANALYSIS OF THE ECONOMIC EFFICIENCY OF CLASSICAL METHOD AND LEACHING METHOD WITH SX/EW EXTRACTION MODE

The analysis was carried out based on the literature techno-economic data for the "heap leaching" method and hydrometallurgical extraction process SX/EW, but bearing in mind the specificity of the cementation deposit Kraku Bugaresku both from the aspect of ore mineralogy in the deposit and the possibility of using this method, and from the aspect of a comparative cost data in relation to the classical processing method for which the relevant (known) data were used.

The following Table presents the techno-economic data with which the analysis was carried out in software for strategic planning in mining, Whittle Fx, whose working principle is based on the Lerch Grossmann algorithm.

Table 1 *Input techno-economic parameters of exploitation for the optimization process*

Parameter	Unit	Values
Excavation capacity - excavations	t/year	12 Mt from 3 rd year 17 Mt
Capacity of flotation processing – Sulfide ore with max. 10% oxide	t/year	2.5 Mt from 3 rd year 5.5 Mt
Capacity of heap leaching – Oxide ore with over 10% of oxide content	t/year	2.5 Mt
Copper price	\$/t cathode	5,000.00
Gold price	\$/kg	40,000.00
Silver price	\$/kg	500.00
Excavation costs	\$/t	2,3.
Costs of flotation processing	\$/t	4,00
Processing costs of heap leaching	\$/t ore	1.00
Costs of metallurgical copper treatment	\$/t cathode	450.00
Costs of metallurgical gold treatment	\$/kg	150.00
Costs of metallurgical silver treatment	\$/kg	15.00
Costs of hydrometallurgical processing (SXEW)	\$/t cathode	100.0
Initial capital costs of leaching and SXEW	\$	20,000,000
Total copper recovery (flot,and metallurgy)	%	0.788
Total gold recovery (flot,and metallurgy)	%	0.50
Silver recovery (flot,and metallurgy)	%	0.40
Copper recovery from oxide ore with over 10% of oxide content	%	0.54
Copper recovery by leaching from sulfide ore		0.55
Discount rate	%	10.0

3.1 Scenario 1

The obtained results by Scenario 1, or the current processing process, i.e. total ore undergoes to the flotation, without selective excavation and separation on two types of ore - sulphide and oxide. For this purpose, a block model was modified and the aforementioned types of ore were separated, as well as rock types only theoretical due to the demands in the software, but

essentially the whole ore undergoes to the flotation process (mill). Table below shows the long-term dynamics of excavation with the economic indicators - cash flow, undiscounted and discounted. The analysis was done for the whole process of ore processing, both flotation and metallurgical, with the revenue of cathode copper and precious metals.

Table 2 Long-term dynamics of excavation by Scenario 1, analyzed in the software Whittle Fx

SCENARIO 1 _SHEDULE GRAPPH																
PB: 19, 26,3

Figure 1 Graphical presentation of the long-term dynamics of excavation by Scenario 1 – flotation processing

3.2 Scenario 2

According to the second Scenario, due to the above given facts and plans of RTB Bor Group – Copper Mine Bor, which owns the concerned mine, to increase the capacity of excavation at this site for the flotation

processing to 5,500,000 t, is the use of leaching method for processing of these amounts [7]. The oxide ore with oxide content of up to 10% during leaching was considered with the recovery coefficient of 0.7,

while leaching of sulphide ore was discussed with the recovery coefficient of 0.55 (Table 1.).

The input costs have also included the rehandling costs from the stock pile (0.2 \$/t

ore), and also the estimated investment costs of \$ 20,000,000 for the construction of infrastructure facilities and installations for hydrometallurgical processing method at the start of production (in the first year).

Table 3 Long-term dynamics of excavation by Scenario 2, analyzed in the software Whittle Fx

Push backs: 19, 26, 36			Long Term Schedule -Method Heap Leachig																		
						RSUL tonne					ROXD tonne					cashflow					
			Grade	Grade	Grade	From mine	to	From	TOTAL	From mine	to	From	TOTAL	Open pit	Open pit						
			input	input	input	input LCH1	stockpile	stockpile to	RSULF	input LCH2	stockpile	stockpile to	ROKSD	cashflow	cashflow						
Period	tonne	Waste	Strip	CU	AU	AG	RSUL	SP1 - RSulf	LCH1-RSUL	LCH1	ROXD	SP2-Roxd	LCH2-ROXD	LCH1	\$	\$ disc					
year	tonne	tonne	ratio	%	g/t	g/t	t	t	t	TOTAL t	t	t	t	TOTAL t	\$	\$					
1	7,637,874	9,362,127	1.23	0.1274	0.0329	0.6228	23,404	736,892	0	23,404	3,000,000	3,877,578	0	3,000,000	-26,688,274	-24,262,067					
2	6,729,443	10,270,557	1.53	0.2579	0.06	0.9707	839,606	747,903	736,892	1,576,498	3,000,000	2,141,934	0	3,000,000	-3,444,904	-2,847,028					
3	14,115,539	6,884,461	0.49	0.3268	0.0801	1.0017	4,755,686	2,835,617	744,314	5,500,000	5,500,000	1,024,236	0	5,500,000	53,796,117	40,417,819					
4	13,206,031	7,793,969	0.59	0.2378	0.071	1.0775	4,389,920	859,446	1,110,080	5,500,000	5,500,000	2,456,665	0	5,500,000	20,641,477	14,098,406					
5	18,683,273	2,316,727	0.12	0.2285	0.0724	0.9961	4,102,604	7,296,895	1,397,396	5,500,000	5,500,000	1,783,774	0	5,500,000	19,923,823	12,371,126					
6	15,363,156	5,636,844	0.37	0.19	0.0647	1.0937	2,494,333	2,731,602	3,005,647	5,500,000	5,500,000	4,637,201	0	5,500,000	9,514,108	5,370,466					
7	9,816,632	49,502	0.01	0.1982	0.0603	0.8397	5,500,000	3,365,802	0	5,500,000	695,769	255,061	4,804,231	5,500,000	25,672,382	13,173,991					
8	0	0	0	#DIV/0!	0	0	0	0	5,500,000	5,500,000	0	0	0	5,500,000	55,174,611	25,739,363					
9	0	0	0	#DIV/0!	0	0	0	0	5,500,000	5,500,000	0	0	0	5,500,000	55,174,611	23,399,421					
10	0	0	0	#DIV/0!	0	0	0	0	579,829	579,829	0	0	0	372,218	4,575,773	1,921,174					
	85,551,948	42,314,187	0.49				22,105,573	18,574,157	18,574,158	40,679,731	28,695,769	16,176,449	16,176,449	44,872,218	214,339,724	109,382,671

Figure 2 Graphical presentation of the long-term dynamics and cash flows per years by Scenario 2 – total conversion of flotation process by the leaching method

Figure 3 Pie graph of sulphide and oxide ore participation in the leaching process

4 CONCLUSION

The obtained results by Scenario 2 are with the use of storage technology (stock pile), which serve as a buffer for the planned processing capacity, but also have the option of conducting the leaching time and shortening the period of total exploitation of the planned long-term dynamics. It is important to note that in recent years, when practically the excavation at the open pit was completed, the leaching time and leaching capacity can be adapted to the needs. Therefore, whether the ore from the stock pile will be processed for the time provided for the long-term plan or shorter, depending on the input of particle size distribution of ore, or from the surface of openness of mineral grains and thereby the leaching rate.

It can be seen from the following Figure 3, Tables and Graphs of the comparative analysis results by Scenation 1 or Scenatio 2, as well as from Tables 2 and 3 and Graphs 1 and 2 that:

1. Calculated Cash flow by the second scenario is higher than by the first (by which any capital costs are not included for the capacity expansion);
2. That the exploitation period at the open pit (mining period) by the second scenario is almost half shorter than the first. The extended years of the second scenario is the processing of already excavated ore from the stock pile. It certainly brings savings that can be seen from the comparison with the economy by scenario 1;

- As it was noted in the previous section, the amount of excavated ore could be processed in a shorter time than it was presented in a long term scheduling increasing the time of leaching, i.e. with conducting the size of input ore to the leaching heaps or with selection the degree of crushing fragmentation;

Discounted cash flow in scenario 2 is higher, and among other things, as the leaching operation includes the overall mineralization within the open pit limits, without the use of cutoff grade as a boundary factor of ore and waste materials. Thus, the new processing process produces not only more high purity copper for human use, but also removes the uneconomic waste material from the environment.

Figure 4 Comparative analysis of cash flow Graphics for a wide variety of scenarios, processing and extraction of metals from ore per years

- Heap leaching process, which is in the case here, has much higher level of security in terms of environmental protection than the flotation process;
- Hydro-metallurgical method of copper extraction as opposed to the conventional pyro-metallurgical method eliminates SO_2 and other harmful impurities from the air in the area of the town of Bor, where the Smelting plant is located and its environment. In the considered case the recommendation is the SX/EW process instead of the current classic pyrometallurgy process. The SX/EW plant requires much less capital investments.

- Due to these facts and previous experience with accidental situations to the environmental protection, it is necessary to make an effort in the education of staff, as well as to introduce population with the bad and good aspects of this method for metal obtaining, also with a reduced risk of accidents.

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Zoran Vaduvesković, Daniel Kržanović*, Nenad Vušović***

KONVERZIJA FLOTACIJSKE PRERADE POSTUPKOM LUŽENJA NA GOMILI NA RUDNIKU CEMENTACIJA – KRAKU BUGARESKU U RUDNIKU BAKRA BOR***

Izvod

RTB Bor planira proširenje kapaciteta otkopavanja i prerade na ležištu Cementacija Kraku Bugaresku sa sadašnjih 2,5 miliona tona godišnje, na 5,5 miliona. Postojećom tehnologijom prerade, klasičnim flotiranjem celokupne otkopane rude, bez selektivnog otkopavanja i razdvajanja sulfidne od oksidne, zbog niskog iskorišćenja metala iz rude, postižu se skromni finansijski efekti. Rad razmatra **kompletnu** konverziju sadašnjeg načina eksploatacije, hidrometalurškim dobijanjem bakra luženjem na gomili i SX/EW metodom ekstrakcije iz lužnog rastvora, sa aspekta ekonomije, uporednom analizom novčanog i diskontovanog novčanog toka za oba slučaja (scenarija - sadašnji način flotiranjem i alternativni - luženjem). Analiza je urađena u softveru za strateško planiranje u rudarstvu-Whittle Fx, sa ulaznim tehnoekonomskim podacima za jedan i drugi slučaj [7].

Zbog učestalih havarija i izazivanja akcidentnih situacija na postojećim infrastrukturnim instalacijama postrojenja prerade, cevovodu za hidrotransport pulpe, u zaključku se ističu i komparativne prednosti hidrometalurške prerade ne samo sa aspekta ekonomije nego i zaštite životne sredine. U svetu, kod najvećih svetskih proizvođača bakra, tendencija je da se bakar učini pored skupocenog i "zelenim" metalom.

KLjučne reči: luženje na gomili, hidrometalurgija, oksidna ruda, sulfidna ruda, dugoročna dinamika proizvodnje, novčani tok, diskontovani novčani tok

1. UVOD

Ležište Cementacija Kraku Bugaresku je započelo sa eksploatacijom 1990. godine, investicionim radovima na raskrivanju ležištu, na lokaciji Cementacija 1. Sam naziv rudnog tela i kompleksa rudnih tela koji se sastoji od Cementacije 1, 2, 3 i 4, govori o prirodi ovih rudnih tela. Radi se o cementacionoj zoni sekundarnog obogaćenja, sa oko 40% oksidne rude, najviše na nivoima bližim površini, koja se relativno slabo flotira. Flotacijsko iskorišćenje bakra iz rude je,

pokazalo se u dosadašnjem radu, nivoa nešto većeg od 50%. Kombinacijom metoda prerade - flotiranjem sulfidne rude sa maksimalno 10% oksidne (smatra se da se pri tome ne utiče negativno na koeficijent iskorišćenja u flotaciji) postigli bi se znatno bolji ekonomski efekti [1], međutim problem je u mogućnostima selektivnog otkopavanja i izdvajanju pomenutih tipova rude – sulfidne i oksidne.

* Institut za rudarstvo i metalurgiju Bor, Zeleni bulevar 35, Srbija

** Tehnički fakultet Bor, Univerziteta u Beogradu, Vojske Jugoslavije 12, 19210 Bor, Srbija

*** Članak je u sklopu projekata tehnološkog razvoja TR 33038 "Usavršavanje tehnologija eksploatacije i prerade rude bakra sa monitoringom životne i radne sredine u RTB Bor Grupa" i TR 34004 "Nova proizvodna linija za dobijanje bakra solventnom ekstrakcijom rudničkih voda", koji su finansirani od strane Ministarstva prosvete, nauke i tehnološkog razvoja Republike Srbije

2. OPIS PROBLEMATIKE

Veliki problem je i što je na samom ležištu flotacijska prerada samo do nivoa dobijanja *pulpe*, tj. mlevenja i nakon toga zgušnjavanja, a zatim se hidrottransportom pulpa transportuje na dalju preradu u flotaciju Veliki Krivelj. Osim povećanih troškova flotiranja, ovakav način prerade je vrlo nepovoljan i sa aspekta zaštite životne sredine zbog čestih akcidenata na cevovodu i posledica po okolinu. (Poslednji takav desio se polovinom aprila 2014. godine).

Kao i prilikom otvaranja rudnika, na način i vrstu prerade veliki uticaj je imao lobi za "zaštitu životne sredine" Odluka o metodi prerade je tako donešena bez stručnih analiza, ne vodeći računa o prirodi ležišta (sadržaj preko 40% oksidne rude). Prema metodi luženja, ne samo zbog njenog eventualnog uticaja na životnu sredinu, ali bez detaljnog poznavanja ove problematike, stvoren je animozitet čak zbog same pomene kiseline, odnosno cijanida koji su, po svojoj prirodi, otrovni. Tokom dosadašnje eksploatacije dela ležišta, pokazalo se da usvojena i primenjena metoda ne samo da ne daje dobre ekonomske efekte, nego je i veliki zagađivač okoline.

Jedan od primera totalne konverzije piro-metalurškog procesa – flotacijske metode koncentracije i klasičnog topljenja koncentrata sa elektrolitičkom disocijacijom anode, hidrometalurškim procesom tj. luženjem na gomili u kombinaciji sa "*in situ*" luženjem potpomognutim bakterijskim luženjem, primenjen je na rudniku, *Morenci* kompanije *Phelps Dodge*, Arizona [7], početkom 2001. godine. Postojeći objekti za koncentraciju su stavljeni u stanje "*stand by*", dok je topionica prethodno izmeštena u mesto Chino, u Meksiku.

Osim ovog primera, gde se dnevno prerađuje oko 75.000 t rude (oko 360.000 t bakra godišnje), primeri totalne konverzije piro-metalurškog procesa su još u Cerro Verde (1993 - 15.000 t/d), Zaldivar (1992 - ~ 20.000 t/d) u Peru-u, i Kuebrada Blanka (1993 - 17.300 t/d) u Čileu, i mnogi drugi rudnici.

Koristi su višestruke, od značajne uštede energije, preko smanjenja ukupnih troškova proizvodnje po toni bakra, čija je čistoća 99,99%, do "*čistog neba*" odnosno zaštite životne sredine. To je takođe način da aktivnosti eksploatacije i dobijanja bakra, iza sebe ostavljaju što manje otpada.

3. UPOREDNA ANALIZA EKONOMSKE EFIKASNOSTI KLASIČNE METODE I METODE LUŽENJA SA SX/EW NAČINOM EKSTRAKCIJE

Analiza je sprovedena na bazi literaturnih tehnoeconomičkih podataka za metodu "Heap Leaching" i hidrometalurški proces ekstrakcije SX/EW, ali imajući u vidu specifičnosti ležišta cementacija Krakua Bugaresku, kako sa aspekta mineralogije rude u ležištu i mogućnosti primene ove metode, tako i sa aspekta uporednih troškovnih podataka u odnosu na klasičan način prerade, za koji su korišćeni relevantni (poznati) podaci.

U sledećoj tabeli prikazani su tehnoeconomički podaci sa kojima je analiza urađena u softveru za strateško planiranje u rudarstvu, Whittle Fx, čiji je princip rada na osnovu Lerch Grossmann algoritma.

Tabela 1. *Ulazni tehnoekonomske parametri eksploatacije za proces optimizacije (in put)*

Parametar	Jedinica	Vrednosti
Kapacitet otkopavanja - iskopine	t/god	12 Mt od 3. godine 17 Mt
Kapacitet flotacijske prerade - Sulfidna ruda sa max. 10% oksidne	t/god	2,5 Mt od 3. godine 5,5 Mt
Kapacitet luženja na gomili – Oksidna ruda sa preko 10% sadržajem oksida	t/god	2.5 Mt
Cena bakra	\$/tkatode	5,000.00
Cena zlata	\$/kg	40,000.00
Cena srebra	\$/kg	500.00
Troškovi otkopavanja	\$/t	2,3.
Troškovi flotacijske prerade	\$/t	4,00
Troškovi prerade luženjem na gomili	\$/t rude	1.00
Troškovi metalurške prerade bakra	\$/t katode	450.00
Troškovi metalurške prerade zlata	\$/kg	150.00
Troškovi metalurške prerade srebra	\$/kg	15.00
Troškovi hidrometalurške prerade (SXEW)	\$/t katode	100.0
Inicijalni kapitalni troškovi luženja i SXEW	\$	20,000,000
Ukupno iskorišćenje bakra (flot i metal)	%	0,788
Ukupno iskorišćenje zlata (flot i metal)	%	0,50
Iskorišćenje srebra (flot i metal)	%	0,40
Iskorišćenje bakra iz oksidne rude sa preko 10% sadržajem oksida	%	0,54
Iskorišćenje bakra luženjem iz sulfidnih ruda		0,55
Diskontna stopa	%	10.0

3.1. Scenario 1

Dobijeni rezultati po scenariju 1, odnosno postupkom kojim se sada vrši prerada, a to je da ukupna ruda ide na flotiranje, bez selektivnog otkopavanja i razdvajanja na dva tipa rude – sulfidnu i oksidnu. Za ove potrebe je modifikovan blok model i izvršeno razdvajanje pomenutih vrsta rude, kao tipova stena (Rock Types), samo teoretski zbog zahteva u softveru, ali suštinski celo-

kupna ruda ide na process flotiranja (MILL). U narednoj tabeli je prikazana dugoročna dinamika otkopavanja sa ekonomskim pokazateljima - novčanim tokom, nediskontovanim i diskontovanim. Analiza je urađena za ceo process prerade rude, kako flotacijskog, tako i metalurškog, sa prihodom od katodnog bakra i plemenitih metala.

Tabela 2. Dugoročna dinamika otkopavanja po scenariju 1, analizirana u softveru Whittle Fx

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Sl. 1. Grafički prikaz dugoročne dinamike otkopavanja po Scenariju 1 – flotacija prerada

3.2. Scenario 2

Prema drugom scenariju, zbog navedenih činjenica i planova RTB Bor Grupe – Rudnika Bakra Bor u čijem je vlasništvu predmetni rudnik, o povećanju kapaciteta otkopavanja na ovom lokalitetu za flota-

cijsku preradu na 5.500.000 t, jeste da se te količine prerade luženjem [7]. Oksidna ruda sa sadržajem oksida do 10% prilikom luženja razmatrana je sa jednim koeficijentom iskorišćenja (0,7), dok je luženje sulfidne

rude razmatrano sa koeficijentom iskorišćenja od 0,55 (Tabela 1.).

U ulazne troškove uračunati su i *re-handling* troškovi sa skladišta (0,2 \$/t rude), a uzeti su u obzir i procenjeni

investicioni troškovi od 20.000.000 \$ za izgradnju infrastrukturnih objekata i instalacija za hidrometaluršku metodu prerade, i to na samom startu proizvodnje (u prvoj godini).

Tabela 3. Dugoročna dinamika otkopavanja po scenariju 2, analizirana u softveru Whittle Fx

Push backs: 19, 26, 36			Long Term Shedule -Method Heap Leachig

Sl. 3. Pie grafik učešća sulfidne i oksidne rude u procesu luženja

ZAKLJUČAK

Dobijeni rezultati po Scenariju 2 su sa tehnologijom korišćenja skladišta (Stock pile), koji služe kao bafer za planirani kapacitet prerade, ali stoji i mogućnost dirigovanja vremenom luženja i skraćenjem perioda ukupne eksploatacije predviđenog dugoročnom dinamikom. Bitno je napomenuti i da se u poslednjim godinama, kada je praktično otkopavanje na kopu završeno može vreme luženja, time i kapacitet luženja prilagoditi potrebama. Dakle, da li će se ruda sa skladišta prerađivati za vreme predviđeno dugoročnim planom ili kraće, zavisi od ulaznog granulometrijskog sastava rude, odnosno od površine otvorenosti mineralnih zrna i time brzine izluživanja.

Na sledećoj slici 4 – *Tabela i dijagram uporednih rezultata analize po jednom i drugom scenariju*, kao i iz Tabela 2 i 3, odnosno grafika 1 i 2, vidi se:

1. Sračunati Cash flow po drugom scenariju je veći nego po prvom (po kome nisu uračunati nikakvi investicioni troškovi za povećanje kapaciteta);
2. Da je vek eksploatacije na kopu (otkopavanja) po drugom scenariju upola kraći nego po prvom. Preostalih godina po drugom scenariju je prerada sa već otkopanom rudom – rudom sa skladišta. To svakako donosi uštede koje se vide iz upoređenja sa ekonomijom po scenariju 1.

3. Kao što je u prethodnom poglavlju napomenuto, otkopana ruda se može prerađivati i kraćem vremenu nego što je predstavljeno u dugoročnoj dinamici, smanjujući potrebno vreme izluživanja po osnovu veličine ulazne granulacije rudena gomile za luženje, odnosno izborom stepena drobljenja;

Diskontovani novčani tok po scenariju 2. je veći pored ostalog, izbog toga što se procesom luženja zahvata celokupna mineralizacija u granicama kopa, bez korišćenja graničnog sadržaja kao faktora razgraničenja rude i jalovine. Dakle, novi proces prerade stvara ne samo više bakra visoke čistoće za ljudsku upotrebu, već takođe uklanja neekonomični otpad iz životne sredine.

Sl. 4. Grafik uporedne analize novčanih tokova za različite scenarije prerade i ekstrakcije metala iz rude, po godinama

4. Proces luženja na gomili, o kome se ovde radi, je sa mnogo većim stepenom sigurnosti sa aspekta zaštite životne sredine nego što je process flotiranja;
5. Prerada ove rude za razliku od klasične prerade topljenjem, eliminiše SO_2 i druge štetne primese iz vazduha na području topionice, odnosno grada Bora i okoline. Ovde se umesto klasičnog pirometalurškog procesa, primenjuje SX/EW process. Postrojenje zahteva mnogo i manja kapitalna ulaganja.
6. Zbog navedenih činjenica, i dosadašnjih iskustava saakcedentnim situacijama po zaštitu životne sredine,

potrebno je uložiti napor kako u edukaciju kadrova, tako i u upoznavanje stanovništva sa lošim i dobrim stranama ovakve metode dobijanja metala, takođe sa smanjenim rizikom od akcidenata.

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