THE EFFICIENCES AND SELECTIVITY INDEXES – THE POSSIBILITY OF LEAD PRESENTATION AND APPLICATION OF USEFUL PROGRAMMES

D.Krstev, A. Krstev, B. Krstev, Z. Gocev J. Zivanovik, V. Jovanovski

Goce Delcev University, Faculty of Natural&Technical Sciences, Mineral Processing Department, 2000 Stip, The Republic of Macedonia

boris.krstev@ugd.edu.mk

ABSTRACT. *The presentation and comparative analysis and the tabular and figurative shown of the techno indicators of the concentration, techno efficiency and economic efficiency for the treated ores in mineral processing technologies lead/zinc-galena/sphalerite ores in Sasa mine in the Republic of Macedonia, their correlation and other characteristics using descriptive statistics of experimental/industrial results with Microsoft Excel 2010. The presentation of the selectivity indexes for poly metallic lead and zinc bearing ores from domestic deposits as an appropriate way for technological indication..*

KEY WORDS: selectivity, indexes, efficiency, economic, technical

1. INTRODUCTION

For practical and industrial results from flotation of the useful minerals it's possible to consider either for the process kinetic or for selectivity of the obtained products purity. These are specially related for the poly component (mineral) raw materials. For the process characterization are proposed coefficients, well known as selectivity indexes. For examples, as the result of the by floating of the copper-zinc ores we'll produce copper concentrate with recovery of 90% and zinc concentrate with recovery of 85%. According to the Mitrofanov, the selectivity index will be:

$$\eta = \varepsilon_1 + \varepsilon_2 = 90 + 85 = 175\%$$

The mentioned selectivity index may be changed depending to the techno – economic efficiency. Beloglazov had proposed the following equation for process selectivity index determination:

$$\eta = \frac{\log\frac{1}{1-\varepsilon 1}}{\log\frac{1}{1-\varepsilon 2}} = \frac{\log\frac{1}{1-0.9}}{\log\frac{1}{1-0.85}} = 1.21$$

Where ε_1 and ε_2 are recoveries for copper minerals and zinc minerals in concentrate.

As the result of the by floating of the lead-zinc ores we'll produce lead concentrate with recovery of 93% and zinc concentrate with recovery of 87%. According to the Mitrofanov, the selectivity index will be:

$$\eta = \varepsilon_1 + \varepsilon_2 = 93 + 87 = 180\%$$

The mentioned selectivity index may be changed depending to the techno – economic efficiency. Equation for process selectivity index determination:

$$\eta = \frac{\log\frac{1}{1-\varepsilon 1}}{\log\frac{1}{1-\varepsilon 2}} = \frac{\log\frac{1}{1-0.93}}{\log\frac{1}{1-0.87}} = 1.30$$

The mentioned process selectivity index primary has had technological character because it's necessary to solve every concrete case depending of the floated material characterization and the demands for the product enriching, depending of the flotation plant conditions etc.

The investigations by means of **Microsoft Excel 2010** are carried out in the real environment and real conditions using the data for concentration methods (flotation concentration) for and lead and zinc galena-sphalerite ores (Sasa-Macedonia). The technological indicators and data are processed in 2^2 or 2^3 plan of experiments according to the appropriate equations for metal recovery $I = \frac{k}{r}x\frac{(r-j)}{(k-j)}x$ *100=* $K_o x M_k$ where are *k, r, j*, $K_o=k/r, M_k=\frac{(r-j)}{(k-j)}x$ *100,* are contents of the useful metals (lead and zinc) and concentration degree or mass recovery. The optimum results are obtained after minimization of the metal contentce in waste *j*. The less loss of the useful metal in obtained and produced final products, its bigger recovery or extraction of the useful metal in the useful and market component.

2. Results and discussion

On the basis of the statistical analysis which are carried out in the real industrial processes in the flotation plants in galena-sphaleriote mines in Sasa mine, and processing of the data for the annual reports it's worked out Excel program according to the SEVOP (Sequential EVOP) and calculated processing with optimization techniques, the evaluation of the real process or condition, processing for techno-economic indicators and appropriate efficiencies for these real conditions.

The investigations by means of **Microsoft Excel 2010** are carried out in the real environment and real conditions using the data for concentration methods (flotation concentration) for lead and zinc galena-sphalerite ores (Sasa-Macedonia) for the other indicators very important for the mineral processing showing.

The techno and economic data for TE or EE (techno and economic efficiency) are processed in using the equations for EE or TE: $EE = I[1 - \frac{k_n}{k}]$ or $TE = Ix\frac{(k-r)}{[k(100-r)]}$ x 100, where *k, r,* are contents of useful metals (lead or zinc) in concentrates and ores, while k_n is a ratio of the smelter costs and prize of the produced useful metal expressed in *$/ton metal.*

Table 1. Results show of Sasa concentration 2010/2011

2010, Months	Galena concentrate		Sphalerite concentrate		η_M
	Pb%	Zn%	Pb%	Zn%	
Januar	76,2	2,7	1,3	50,1	126.3
February	77,5	2,8	1,5	51,2	128.8
Marth	76,5	3,0	1,3	50,8	127.3
April	76,5	3,2	1,0	50,0	126.5
May	74,5	3,0	1,1	49,5	124.0
June	72,5	2,8	0,8	51,0	123.5
July	74,0	2,6	0,8	50,8	124.8
August	73,5	2,8	1,0	51,0	124.5
September	74,5	3,0	1,1	51,5	126.0
October	75,5	2,9	1,3	51,2	126.7
November	75,0	2,6	1,1	50,7	125.7
December	75,5	2,3	1,0	51,0	126.5

Table 2. Results show of Sasa concentration 2011/2012

2011, Months	Galena concentrate		Sphalerite concentrate		η_M
	Pb%	Zn%	Pb%	Zn%	
Januar	76,2	2,7	1,3	50,5	126.7
February	77,5	2,8	1,5	51,4	128.9
Marth	76,5	3,0	1,3	50,5	127.0
April	76,5	3,2	1,0	50,3	126.8
May	74,5	3,0	1,1	49,5	124.0
June	72,5	2,8	0,8	51,3	123.8
July	74,1	2,6	0,8	50,8	124.9
August	73,8	2,8	1,0	51,0	124.8
Septemb	74,5	3,0	1,1	51,5	126.0
October	75,3	2,9	1,3	51,2	126.5
Novembe	75,2	2,6	1,1	50,7	125.9
Decembe	75,5	2,3	1,0	51,3	126.8

The optimum results for techno efficiency TE are obtained after minimization of the below express in the equations of the techno efficiency TE and maximization of the metal recovery of the produced concentrate directed in the smelting process, as showing on the table shown. The optimum results for economic efficiency are obtained by means of minimization of the k_n/k (ratio of smelting costs and prize of the produced useful metal and the content of the useful metal in the processed concentrate, and maximization of the metal recovery in the produced concentrate.

Влез	*Параметри*	*Резултати*	*Единици*
Руда	R	750000.0000	(t)
Концентрат	K	35000.0000	(t)
Јаловина	J	715000.0000	(t)
Корисна минерална компонента			
Руда	r	3.8000	(%)
Концентрат	k	80.0000	(%)
Јаловина	j	0.1000	(%)
Зависно од рудата	m	86.6000	(%)
Масено искористување			
Концентрат	Mк	4.6308	
Јаловина	Mj	95.3692	
Искористување			
Концентрат	Ik	97.4903	
Јаловина	Ij	2.5088	
Коефициент на скратување	kc	21.4286	
Коефициент на концентрација	ko	21.0526	
Ефикасност на концентрација	E	97.1212	
Техничка ефикасност	TE	96.5275	
Економска ефикасност	EE	96.6779	
Трошоци	kn	0.6667	$/t
Трошоци за топење	S	1000.0000	$/t
Цена на металот	P	1500.0000	$/t
Искористување	I	97.4903	
Идеално масено искористување	Mo	4.3880	

Figure 2. The comparison-example of techno-economic efficiency for Pb ore

CONCLUSION

The selectivity indexes (Mitrofanov or Beloglazov), the comparative analysis and the tabular and figurative shown of the techno indicators of the concentration, techno efficiency and economic efficiency for the treated ores in mineral processing technologies for lead/zinc-galena/sphalerite ores in Sasa mine in the Republic of Macedonia, using Microsoft Excel 2010, are the appropriate and good manner for presentation, description and explination of the mentioned characteristics and processes.

References

[1]. Grujic, M., (1989) “Mathematical Modeling in Mineral Processing”. SME Meeting Las Vegas;

[2]. Gupta A., Yan D.S.,(2010) Mineral Processing Design and Operation – An Introduction, Elsevier, Radarweg 29, PO Box 211, Amsterdam, The Netherlands

[3]. Kawatra S. K., Eisele T. C., Welgui H. J.,(2004), Optimization of Comminution Circuit Through put and Product Size Distribution by Simulation and Control., MTU, Michgan, USA, 2004;

[4]. Napier-Munn, T. J., Morrell, S., Morrison, R. D., and Kojovic, T., (1996). *Mineral comminution circuits: their operation and optimization.* JKMRC.

[5]. Renner, V. G., and Cohen, H. E.,(1978), Measurement and interpretation of size distribution of particles within a hydrocyclone, *Trans. IMM.*, Sec. C, 87,139;