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A software for metal balance of the selective flotation

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Abstract: *In this paper we present the software for metal balance of the selective flotation, specially made for SASA lead and zinc mine in Makedonska Kamenica, Republic of Macedonia. With small changes, it can be applied in other mines and for other metals or nonmetals. The software is Microsoft Access database and it is split into two files: one that contains the tables and one that contains the queries, forms, reports, macros, modules, and shortcuts to data access pages. This way, users who need to access the data can customize their own forms, reports, pages, and other objects while maintaining a single source of data on the network.*

KEY WORDS: METAL BALANCE, SELECTIVE FLOTATION.

1. Introduction

The SASA lead and zinc mine is located on the southeast slopes of the Osogovo mountain, 12km from Makedonska Kamenica, in northeast part of Republic of Macedonia. The mine didn't work for several years, but now it is privatized and restarted. After privatizing, the technological process is changed from bulk to selective flotation.

Processes of grinding and classification are performed in two parallel identical sections with overall capacity of 75t/h and flotation is performed in only one section. This changes request a development of new software for metal balance. For more information on SASA mine see (Orovcanov, D. et al. 1997).

2. The theory behind the software

Flotation process, originally patented in 1906, permitted the mining of low-grade and complex ore bodies which would have otherwise been regarded as uneconomic. The success in the selective flotation concentration process as the most important, and in industrial conditions the most common step in the flotation concentration of typical lead - zinc ores, is first of all seen, in obtaining qualitative selective lead and zinc concentrations adequate for further metallurgical treatment with high metal recovery in the concentrations.

For our software we use several data. We use feed mass Q and results obtained after

chemical analysis of concentration products. Their labels are presented in Table 1.

Parameters used in formulas and obtained from chemical analysis *Table 1.*

	Pb (%)	Zn (%)
Feed	Fp	Fz
Pb concentrate	PCp	PCz
Zn concentrate	ZCp	ZCz
Tailing	Tp	Tz

Also we use this labels:

M_{PC} - mass quota of Pb concentrate;
M_{ZC} - mass quota of Zn concentrate;
M_T - mass quota of tailing.

From presented data and labels we can obtain formulas (1) for mass quotas of Pb concentrate, Zn concentrate and tailing ((Wills, B. A. 1988) and (Krstev, B. 2002)):

$$M_{PC} = Q\frac{(Fp-Tp)(ZCz-Tz)-(ZCp-Tp)(Fz-Tz)}{(PCp-Tp)(ZCz-Tz)-(ZCp-Tp)(PCz-Tz)}$$

$$M_{ZC} = Q\frac{(PCp-Tp)(Fz-Tz)-(Fp-Tp)(PCz-Tz)}{(PCp-Tp)(ZCz-Tz)-(ZCp-Tp)(PCz-Tz)}$$

$$M_T = Q - M_{PC} - M_{ZC} \qquad (1)$$

We use formulas (2) and (3) for recovery of Pb and Zn in Pb concentrate and Zn concentrate.

$$R_{PC_p} = M_{PC}\cdot\frac{PCp}{Fp} \quad R_{ZC_p} = M_{ZC}\cdot\frac{ZCp}{Fp} \qquad (2)$$

$$R_{PC_z} = M_{PC}\cdot\frac{PCz}{Fz} \quad R_{ZC_z} = M_{ZC}\cdot\frac{ZCz}{Fz} \qquad (3)$$

3. How program works

The software is Microsoft Access database and it is split into two files: *rudnik_v4_be.mdb* that contains the tables and *MetalBalance.mdb* that contains the queries, forms, reports, macros, modules, and shortcuts to data access pages. This way, users who need to access the data can customize their own forms, reports, pages, and other objects while maintaining a single source of data on the network. The program is starting with the second file, and than the main program window, witch is switchboard form, occur (Figure 1).

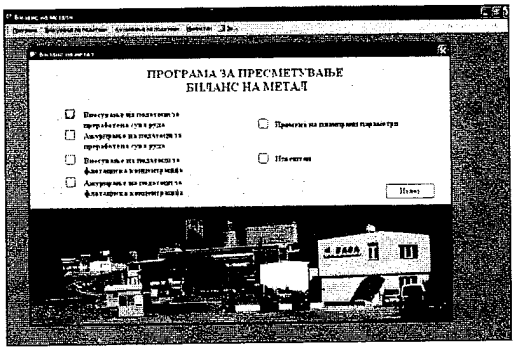


Figure 1. Main program window

Program command can be activated in two manners: from main menu or with buttons from main program window. Main Manu consists of: *Programa* (Main program window), *Vnesuvanje na podatoci* (Data entering), *Azuriranje na podatoci* (Data modifying), *Izvestai* (Reports) and *Za* (About).

3.1. Data entering and modifying

Data entering is divided in two parts. First part is data entering for feed ore (Menu: *Vnesuvanje na podatoci* → *Melenje i klasiranje* or Main program window: *Vnesuvanje na podatoci za prerabotena suva ruda*) and form on Figure 2 occurs. Data are consist of number of section (1 or 2), number of working shift (1, 2 or 3), date, working hours and mass of feed ore in tones.

The second is data entering for flotation (Menu: *Vnesuvanje na podatoci* → *Flotaciska koncentracija* or Main program window: *Vnesuvanje na podatoci za flotaciska koncentracija*), for witch we use form on

Figure 3. Data are working shift an chemical analysis (Table 1).

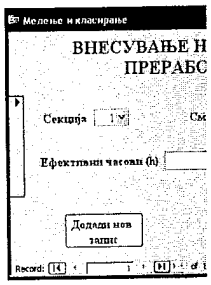
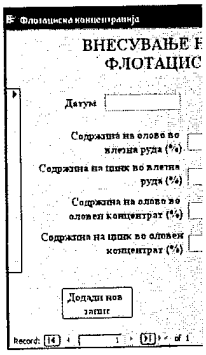


Figure 2. Data



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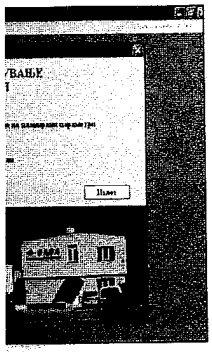

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Figure 3. Data are consist of date, number of working shift and results obtained after chemical analysis of concentration products (Table 1).

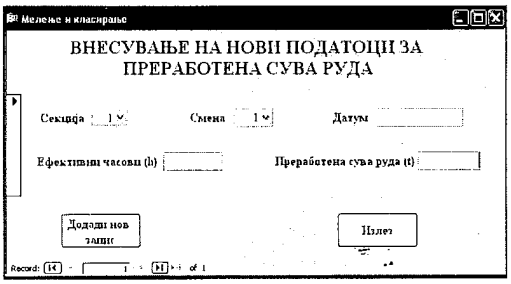

Figure 2. Data entering form for feed ore

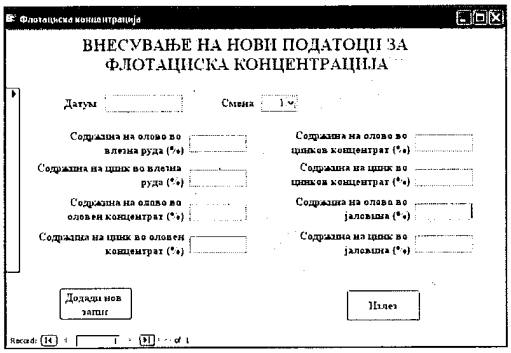

Figure 3. Data entering form for flotation

Data modifying is performed in similar forms. Data modifying form for feed ore is accessed from menu - *Azuriranje na podatoci* → *Melenje i klasiranje* or from the button *Azuriranje na podatoci za prerabotena suva ruda* in main program window. First you must specify section, working shift and date. Data modifying form for flotation is accessed from menu - *Azuriranje na podatoci* → *Flotaciska koncentracija* or from the button *Azuriranje na podatoci za flotaciska koncentracija* in main program window, with first specifying working shift and date.

The software for metal balance of the selective flotation also give planning possibility. Planning form is opened from the menu - *Azuriranje na podatoci* → *Promena na planirani parametri* or with the button *Promena na planirani parametri* and consists of month planning parameters (Figure 4).

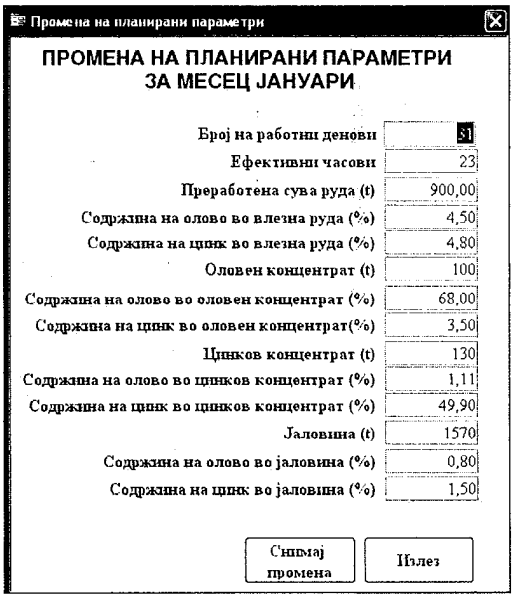

Figure 4. Planning form

3.2. Reports

Main purpose of this software is to free people from comprehensive and tiresome calculations and work for writing reports. This program offer four kind of reports (Menu: *Izvestai* or Main program window: *Izvestai*). The first report is List of data entered for feed ore in some time interval (*Lista na vneseni podatoci za prerabotena suva ruda*), see Figure 5.

Листа на внесени податоци за преработена сува руда

Ден	Секција	Смена	Ефективни часови (h)	Преработена сува руда (t)
02.04.2000				
	1			
		1	8	240,00
		2	8	240,00
		3	8	240,00
	2			
		1	7	230,00
		2	8	250,00
		3	7	230,00
03.04.2000				
	2			
		3	8	250,00

Figure 5. List of data entered for feed ore in some time interval

The second report is List of data entered for flotation in some time interval (*Lista na vneseni podatoci za flotaciska koncentracija*), see Figure 6. The time interval is determined by first and final date.

Daily report (*Dneven izvestaj*) is the third in line and it offers daily obtained data for technological parameters for grinding and classification and for flotation. This includes mass quotas of Pb concentrate, Zn concentrate and tailing; mass quotas of Pb and Zn in tailing and Pb and Zn concentrate; and Pb and Zn recovery in Pb concentrate and Zn concentrate. Data are presented by working shifts, summary, cumulatively and like percentage with planning values. Planning values are also presented (Figure 7).

Листа на внесени податоци за флотациска концентрација

Ден	Смена	Содржина на олово во влезна руда	Содржина на цинк во влезна руда	Содржина на олово во оловен концентрат	Содржина на цинк во оловен концентрат	Содржина на олово во цинков концентрат	Содржина на цинк во цинков концентрат	Содржина на олово во јаловина	Содржина на цинк во јаловина
02.08.2006									
	1	6,00	6,60	65,10	6,80	1,40	49,00	0,70	1,10
	2	6,10	5,90	75,10	4,80	1,60	52,30	1,00	0,70
	3	3,90	3,70	62,80	7,10	3,00	44,70	0,50	0,60
03.08.2006									
	1	4,80	4,50	73,60	3,10	3,10	44,20	0,80	0,40
	2	4,70	4,80	74,10	2,70	2,80	48,10	1,60	0,60
	3	4,60	4,80	68,20	4,10	2,90	47,50	2,50	1,30
04.08.2006									
	1	4,60	4,90	71,70	3,50	1,90	47,50	0,80	1,20
	2	4,30	4,60	63,80	5,20	0,80	51,70	0,40	0,90
	3	4,40	5,40	72,30	3,10	0,20	49,70	1,00	2,50
05.08.2006									
	1	3,50	3,90	70,30	3,60	1,70	45,30	0,80	1,00
	2	4,20	4,10	68,40	3,10	2,60	49,20	1,10	0,50
	3	4,10	4,40	59,30	5,60	0,30	46,40	0,80	2,70
06.08.2006									
	1	4,20	4,50	60,50	5,00	0,40	51,60	0,30	0,70
	2	4,20	4,50	75,60	2,30	0,90	48,50	0,40	0,60
	3	3,80	3,70	73,90	3,00	2,30	43,80	0,80	1,30
07.08.2006									
	1	5,20	5,90	62,30	5,00	1,00	45,20	0,60	0,70
	2	6,20	7,60	64,50	2,10	0,70	50,60	0,80	1,00
	3	4,80	5,60	71,20	5,30	1,90	52,10	1,30	1,60
08.08.2006									
	1	5,80	6,20	67,80	5,50	0,70	50,50	0,40	0,70
	2	4,70	5,50	65,20	4,80	0,20	51,90	0,50	0,40

Страна 1од2

Figure 6 List of data entered for flotation in some time interval

РУДНИК ЗА ОЛОВО И ЦИНК "САСА" Македонска Каменица

ДНЕВЕН ИЗВЕШТАЈ

ОД ПОГОН ФЛОТАЦИЈА ЗА ОСТВАРУВАЊЕ НА ПЛАНОТ

Датум 10.08.2006

Ред. број	Технолошки параметри за мелење и класирање		I секција Смена I	II	III	Дневно	Кумул.	II секција Смена I	II	III	Дневно	Кумул.	I+II секција кумулативно Планирано	Остварено	%
1	Ефективни часови	(h)	8	8	8	24	216	8	8	8	24	216	45	48	106,67
2	Преработена сува руда	(t)	360	360	360	1080	9232	325	350	327	1002	8497	1800	2092	115,67
3	Просечен часовен капацитет	(t/h)	45	45	45	45	42,74	40,62	43,75	40,88	41,75	39,34	40	43,39	108,45

Ред. број	Технолошки параметри за флотациска концентрација		Смена I	II	III	Остварено	Планирано	%	Кумулативно
1	Преработена сува руда	(t)	685	710	687	2092	1800	115,67	17729
2	Содржина на Pb	(%)	4,4	6,3	6,9	5,87	4,5	130,44	4,87
3	Содржина на Zn	(%)	4,5	6,8	7,5	6,27	4,8	130,62	6,23
4	Pb метал во руда	(t)	30,14	44,73	47,4	122,27	81	150,95	860,26
5	Zn метал во руда	(t)	30,82	49,28	51,52	130,62	86,4	151,18	927,36
6	Добиен Pb концентрат	(t)	32,89	48,09	57,4	138,38	100	138,38	1053,48
7	Содржина на Pb	(%)	77,2	79,6	72	75,88	68	111,59	68,44
8	Содржина на Zn	(%)	3,4	1,9	5,7	3,83	3,5	109,43	4,47
9	Pb метал во Pb концентрат	(t)	25,30	38,28	41,33	105	68	154,41	721,05
10	Zn метал во Pb концентрат	(t)	1,12	0,91	3,27	5,3	3,5	151,43	47,16
11	Добиен Zn концентрат	(t)	56,56	82,83	80,04	218,43	130	168,02	1522,85
12	Содржина на Pb	(%)	2,1	1,5	2,1	1,87	1,11	168,47	1,52
13	Содржина на Zn	(%)	48,1	46,7	49,3	48,01	49,9	96,21	48,32
14	Pb метал во Zn концентрат	(t)	1,17	1,24	1,68	4,09	1,44	284,03	23,09
15	Zn метал во Zn концентрат	(t)	26,72	38,68	39,46	104,86	64,87	161,65	736,92
16	Јаловина	(t)	596,6	579,1	549,6	1725,19	1570	109,89	15152,67
17	Содржина на Pb	(%)	0,6	0,9	0,8	0,76	0,8	95	0,79
18	Содржина на Zn	(%)	0,5	1,5	1,6	1,19	1,5	79,33	0,95
19	Pb метал во јаловина	(t)	3,58	5,21	4,4	13,19	12,56	105,02	119,13
20	Zn метал во јаловина	(t)	2,98	8,69	8,79	20,46	23,56	86,98	144,3
21	Искористување на Pb во PbK	(%)	84,24	65,58	87,19	85,88	83,95	102,3	80,53
22	Искористување на Zn во PbK	(%)	3,63	1,88	6,35	4,06	4,05	100,25	5,09
23	Искористување на Pb во ZnK	(%)	3,88	2,77	3,54	3,35	1,79	188,2	2,67
24	Искористување на Zn во ZnK	(%)	86,7	80,12	76,69	80,28	75,08	106,93	79,36
25	Вкупно искористување на Pb	(%)	88,12	88,36	90,73	89,23	85,73	104,08	86,2
26	Вкупно искористување на Zn	(%)	90,33	82	92,94	84,34	79,13	106,58	84,45

Податоците ги подготвил

Figure 7. Daily report

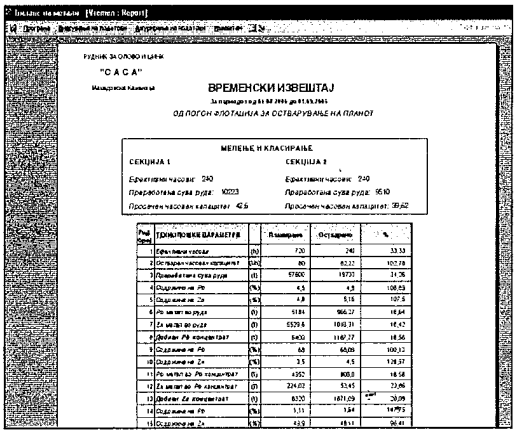

Figure 8. Time report

The fourth report is time report (*Vremenski izvestaj*) and it presents the same data from daily report but for given time interval, which is entered by first and final data (Figure 8). In this way yearly, half yearly, monthly and quarterly report can be produced. Results in this report are given summary.

4. Conclusion

In this paper we present the software for metal balance of the selective flotation, specially made for SASA lead and zinc mine in Makedonska Kamenica, Republic of Macedonia. With small changes, it can be applied in other mines and for other metals or nonmetals. Main purpose of this software is to free people from comprehensive and tiresome calculations and work for writing reports.

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