

THE WORLD MODERN MINERAL PROCESSING TRENDS IN THE RECONSTRUCTION OF SASA LEAD-ZINC CONCENTRATOR – M. KAMENICA, R. OF MACEDONIA

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ABSTRACT:

The Sasa lead-zinc mine, with increasing annual production and ore processing capacity of 0,92M tones, given in the "Business plan for restarting" (according to the program and the planned total investments from US \$ 26,4M, for the modernization of the mine and the reconstruction of the concentrator), foresees a production of the largest quantities of concentrates with lead metals in Europe.

According to the planed reconstruction of the concentrator of the Sasa Mine, foresees the following world modern processing trends:

- A.- Primary crushing and SAG-Mill grinding process, replacing the existing primary, secondary and tertiary crushing process;*
- B.- One parallel stage ball mill grinding process, replacing the existing two serial stages rod mill and ball mills grinding process;*
- C.- Alternative Flow-sheet for a selective lead and zinc, selective lead - collective lead-zinc, and collective lead- zinc flotation (neded for ISP-imperial smelting process);*
- D.- Regrinding process, additional grinding ;*
- E.- PSM-control, ISA-analysis and sampling systems, pH-control with auto process distribution of the lime milk and flotation reagents;*
- F.- Pressure filtration process for the selective lead, selective zinc or collective lead-zinc concentrate.*

INTRODUCTION

The restarting of the Sasa Mine (after its insolvency from the 12 th February, 2003), foresees a modernization of the mine and reconstruction of the concentrator for ashived annual capacity of a 0,92M t ore, with production:

- *Selective lead concentrate and zinc concentrate;*
- *Selective lead concentrate-collective lead-zinc concentrate; and*
- *collective lead-zinc concentrate.*

This comes as a result of the fact that by parallel restarting of the metallurgical processing capacity MHK Zletovo-Veles over ISP (*Imperial Smelting Process*), so that there will be a possibility for new processing of collective lead-zinc concentrates in R. of Macedonia.

That is to say, this is the way to enable Sasa Mine to produce the max. needed quantity of collective lead-zinc concentrate, as well as production of selective lead concentrate suitable for export.

History of Sasa lead-zinc mining and ore processing

The I-st phase of the development of the Sasa Mine, with the concentrator plant (1-st section and the flow-sheet selective lead and zinc flotation), capacity 270.000 t ore/year, was put into operation in 1965.

The II-nd phase of the development of the Sasa Mine, began in 1974, i.e. the reconstruction speaking about increasing the capacity to 550.000 t ore/year (taking also the construction of the brand new 2-nd section, according to the flow-sheet selective lead and zinc flotation).

The introduction of the flow-sheet collective lead-zinc flotation lasted three years, starting from 1979.

Speaking about the definite introduction of the flow-sheet collective lead-zinc flotation, basically was established that :

- the direct galena and sphalerite flotation has to be done conditionally separated and gradually;

- on the start of the rougher flotation a vast part of the free galena should be separated, before increasing of the pH-value and sphalerite activation;
- the comprehension that pH-value >10,5 is not suitable for the galena, while pH-value <10,5 is suitable for it, because the increased pyrit content has been shown as not good for the quality of the collective lead-zinc concentrate; and
- that in a short time of cleaning of the basic collective lead-zinc concentrate this problem has been solved, because the gained quality over 58% (Pb-Zn), was absolutely satisfying.

According to these undertaken measures, as well as to some other (which could not be mentioned here because of the place shortage), led to a conclusion that the introduction of the collective lead-zinc flotation in the concentrator of the Sasa Mine, is possible and completely justified.

Not less because of the fact that the first transported quantities of the collective lead-zinc

concentrate has completely satisfied the conditions of the proceedings ISP-process in the metallurgical plant MHK Zletovo.

After these positive conclusions in 1985 has been moved towards realisation of the III-rd phase of the development of the Sasa Mine, towards increasing of the capacity to 650.000 t ore/year.

With this phase a new tertiary crushing with screening (in closed circle) was introduced, as well as reconstruction of the 2-nd stage of the ore grinding process with two steps of the classification process, as it is shown in Figure 1.

In this phase also on the 2-nd stage flotation was introduced a new flow-sheet selective lead- collective lead and zinc flotation, as well as reconstruction of the 1-st section with flow-sheet collective lead-zinc flotation.

Starting from 1985, this reconstruction with the III-rd phase of the development of the Sasa Mine, was retained over 18 years, i.e. till the insolvency of the Sasa Mine from the 12 th February, 2003.

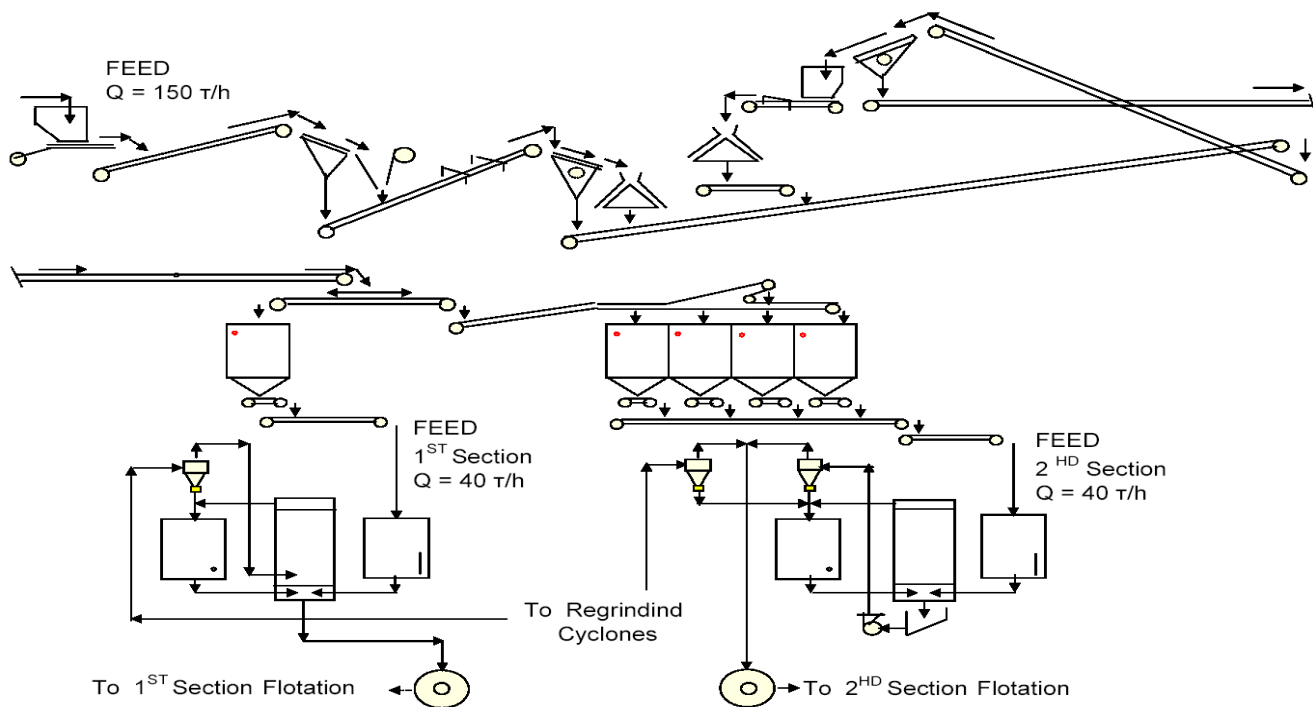


Figure 1. Flow-sheet of the last IIIrd phase of the development of the crushing and grinding process of the Concentrator Sasa.

CARACTERISTIC FOR RESTATING OF THE MINE AND THE CONCENTRATOR SASA

In 2005, with completed "Business plan for restarting the Sasa Mine", it is foreseen (according to the program and the planned total investments from US \$ 26,4M, for the mine and the reconstruction of the concentrator), production of the largest quantities of concentrates with lead metals in Europe.

Here 5 principle frames or selected processing operations are taken into consideration, which are

effective for the project, modernisation of the mine, as well as for the preparation of the ore.

1.- Ore exploitation reserves;

Ore exploitation reserves, when entering the flotation are more than 10M t. ore, and they are planned to be exploited only from the mining district Svinja River (from the existing three mining districts).

2.- Capacity of ore exploitation with transport;

The capacity of the ore exploitation with transport is planned to be annually 0.92M t.

The ore exploitation in the ledge is planned to be carried from above till the bottom, while the transport is planned to be carried out by lorries, leaving the existing with shaft hauling and locomotive transport.

3.- Primary crushing with open stockpile to 3.500 t;

Primary crushing of the ore to be done, with a level of reduction for crush in 1-1.5 and capacity to 350 t/hour, and then to store the ore in an opened bunker, with capacity to 3.500 t, leaving the permanent primary, secondary, and tertiary crushing.

4.- SAG-Mill grinding process with capacity to 125 t/h;

Involving the SAG-mill ore grinding is estimated as a basic condition, together with the existing mills for reaching the planned capacity to 125 t/hour.

In other words, in this way with the existing ball mills and reconstruction of the mills with rods in balls, i. e. with the involving of one stage of ore grinding retains the existing structural building for grinding and flotation plant.

5.- Flotation with regrinding process;

Including the alternative flow-sheet, together with a new regrinding mill for the flotation middleproducts.

CARACTERISTIC OF THE ORE AND THE MINE MINERALS

The ore that is planned to be exploited is characterized with three chief textural types such as compact ore (most represented type), banded ore

(modified type of compact ore), and impregnated ore (least represented type).

The basic ore minerals are galena, sphalerite, pyrite, and the subsidiary pyrrhotine, magnesite, hematite, ceruzite, chalcopryrite, smithsonite, argentite and others.

Non-ore mineral-sag minerals are quartz, calcite, chlorite, epidotic etc.

The ore mineral association is complex, the galena minerals appear very rarely as free beads, when they are 10 to 270 μm, i.e. the sphalerite can reach a size of even 350 μm.

Average metal content in the ore feet flotation, are planned to be :

Pb.....	4,60 % ;	Cu.....	0,30 % ;
Zn.....	4,40 % ;	Fe.....	8,28 % ;
Ag.....	28,04 g/t ;	As.....	0,05 % ;
Bi.....	0,005% ;	Cd.....	0,05 % ;

RECONSTRUCTION OF THE CONCENTRATOR

The concentrator is planned to be reconstructed as soon as the following world modern mineral processing trends are involved:

A.- NEW PRIMARY CRUSHING AND SAG-MILL GRINDING PROCESS, REPLACING THE EXISTING PRIMARY, SECONDARY AND TERTIARY CRUSHING WITH SCREENING PROCESS ;

Flow-sheet of the New Primary crushing and SAG-Mill grinding process, and reconstruction of the Ball-Mills grinding process is shown in the Figure 2.

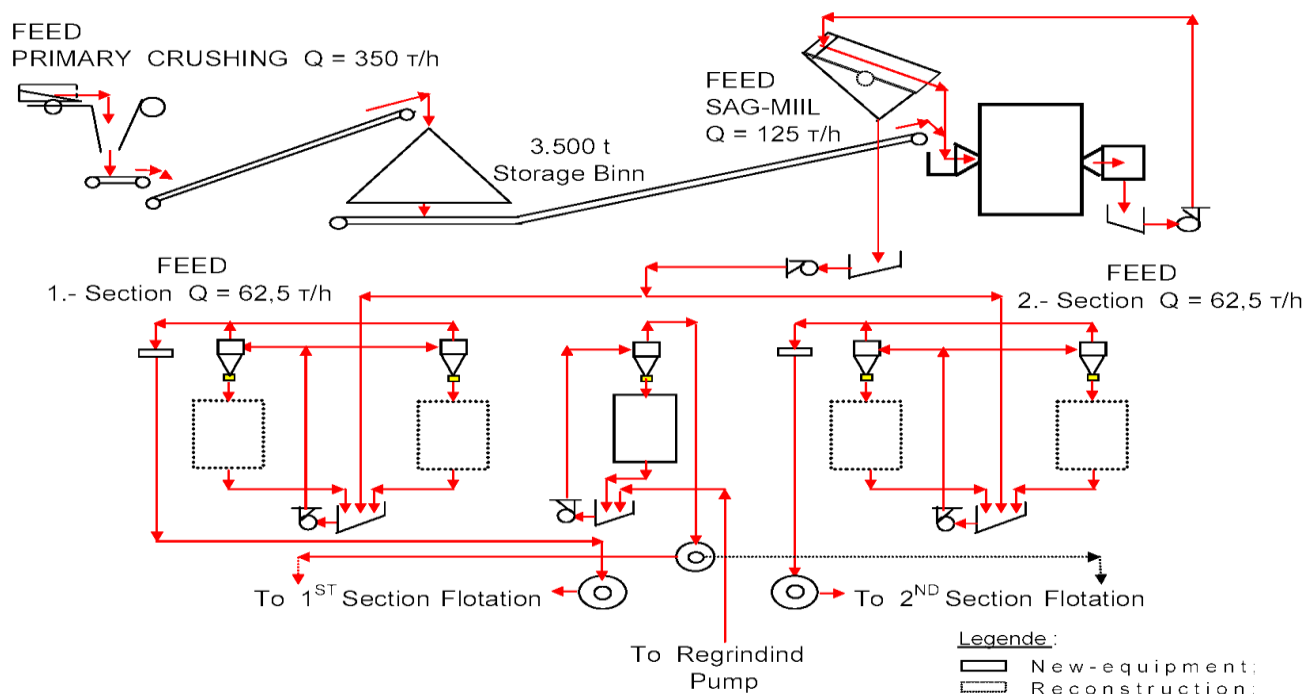


Figure 2. Flow-sheet of the New Primary crushing and SAG-Mill grinding process, and reconstruction of the Ball-Mills grinding process of the Concentrator Sasa.

The New Primary crushing process and SAG-Mill grinding process is estimated to be involved, so as to eliminate the following unfavourable conditions for the existing process:

Mining exploitation;

- the limited ore coarse to max. 350 (400) mm (for increased mining exploitation);
- the limited wet in ore to max. 5,5% water (for increased mining exploitation);
- the limited primary ore bunker space to max. 180 t (for increased mining exploitation);

Ore crushing with screening;

- the limited capacity for the ore coarse crushing 18 (20) mm to 150 t/hour (for increased capacity of the ore processing);
- unfavourable for dust extraction during ore crushing and screening process (for normal maintenance of the crushing with screening plant);

Ore grinding with classification;

- the limited capacity of the ore grinding with classification to 80 t/hour, with the existing mills in two stages with rods and balls (for increased capacity of the ore processing);
- discontinuous conditions (with mill standstill) for dosing the mill rods (for increased capacity of the ore processing);

B.- ONE PARALLEL STAGE BALL MILL GRINDING PROCESS, REPLACING THE EXISTING TWO SERIAL STAGES ROD AND BALL MILL GRINDING PROCESS ;

One parallel stage of the ball mill grinding process is estimated to be involved :

- for reaching the needed capacity of the ore grinding to 125 t/hour, by including the SAG-mill and the existing mills, i.e. by reconstruction of the mills with rods in balls (without expenses for new mills, and construction building);

C.- ALTERNATIVE FLOW-SHEET FOR :

- SELECTIVE LEAD AND ZINC FLOTATION;
- SELECTIVE LEAD - COLLECTIVE LEAD - ZINC FLOTATION; AND
- COLLECTIVE LEAD - ZINC FLOTATION ;

The alternative flow-sheet (selective lead and zinc flotation, selective lead-collective lead-zinc flotation, and collective lead-zinc flotation), is shown on the Figure 3.

Metal balances, which are being planned to be achieved according to this alternative flow-sheet, are shown on the Tables 1, 2, and 3 (assortments and types of concentrate needed for today's market).

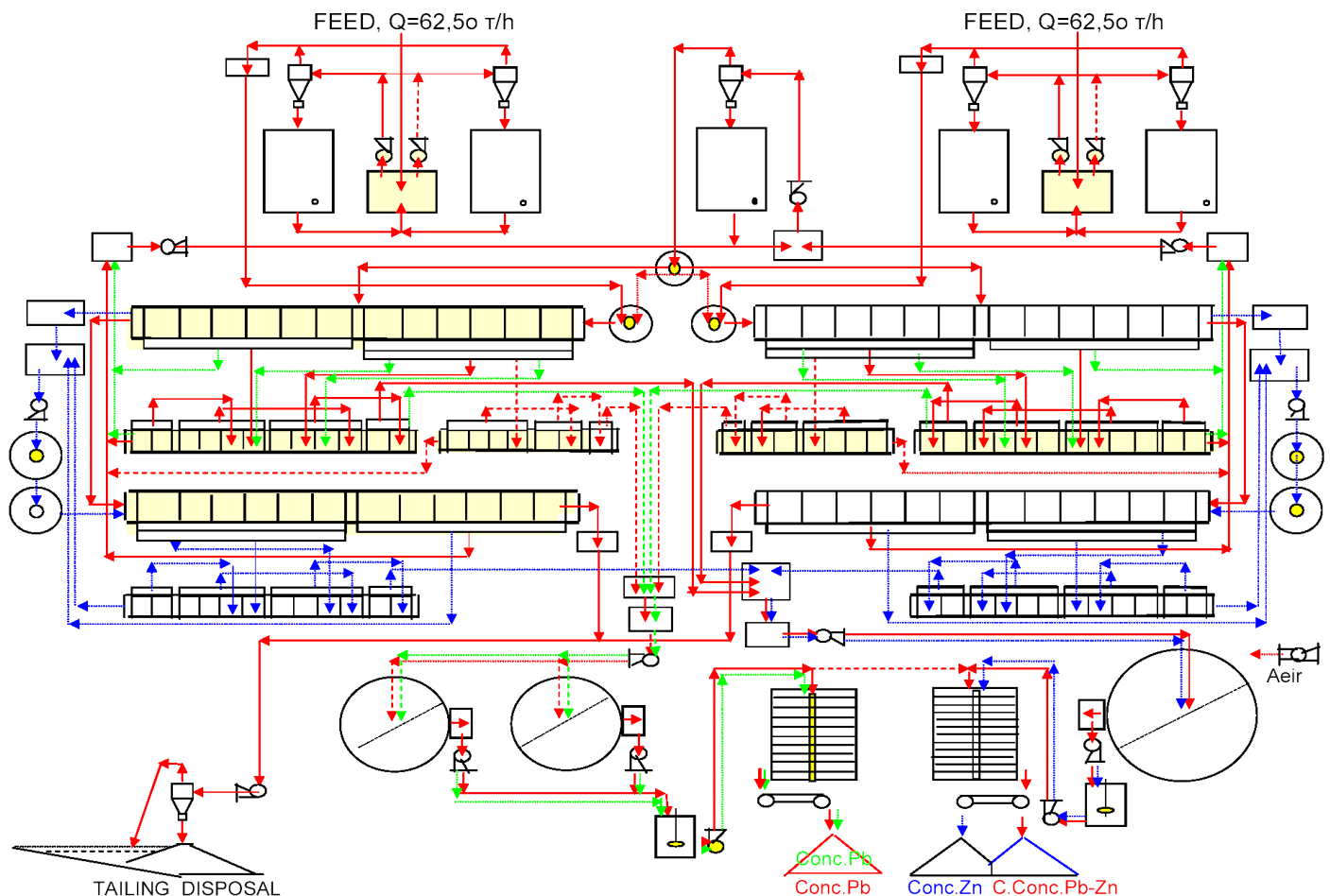


Figure 3. Alternative Flow-sheet for : Selective lead and zinc, Selective lead-collective lead-zinc, and Collective lead-zinc flotation ;

D.- REGRINDING PROCESS, ADDITIONAL GRINDING ;

Selected new regrinding is estimated to be involved, due to the following grounds:

- more effective regrinding of the flotation middleproduct (so as to increase the qualitative tech. results);

E.- PSM-CONTROL, ISA-ANALYSIS AND SAMPLING SYSTEMS, PH-CONTROL WITH AUTO PROCESS DISTRIBUTION OF THE LIME MILK AND FLOTATION REAGENTS ;

PSM - control, is estimated to be involved, so as to carry out the necessary ore grinding control, i.e. the needed opening of the lead and zinc minerals (so as to increase the qualitative tech. results);

ISA - analysis and sampling system is estimated to be involved so as to carry out the necessary content control of the useful metals feed flotation, i.e. the cycles of lead and zinc flotation (so as to increase the qualitative tech. results);

pH - control with auto process distribution of the lime milk and flotation reagents, is estimated to be involved so as to carry out the necessary control at the media regulator of the pulp, i.e., *pH-value* of the lead and zinc mineral flotation, presented in the flow-sheets (so as to increase the qualitative tech. results);

Auto process distribution of the flotation reagents, is estimated to be involved, so as to carry out the necessary dosage control of the flotation reagents needed for lead and zinc flotation (so as to increase the qualitative tech. results);

F.- PRESSURE FILTRATION PROCESS FOR SELECTIVE LEAD, SELECTIVE ZINC OR COLLECTIVE LEAD-ZINC CONCENTRATE.

Pressure filtration process is estimated that beside the existing, a new one is needed for filtration of the lead-zinc concentrate (for decreasing the wet in the concentrates).

Table 1. Metal balance according to the selective lead and zinc flotation

Product	Masse, %	Pb-%	Zn-%	Ag-g/t	R-Pb%	R-Zn%	R-Ag%
Ore	100,00	4,60	4,40	28,04	100,00	100,00	100,00
Conc. Pb	5,83	73,00	3,40	340,60	92,50	4,50	70,80
Conc. Zn	7,42	1,05	51,00	45,35	1,70	86,00	12,00
Tailings	86,75	0,31	0,48	5,56	5,80	9,50	17,20

Table 2. Metal balance according to the selective lead-collective lead-zinc flotation

Product	Masse, %	Pb-%	Zn-%	Ag-g/t	R-Pb%	R-Zn%	R-Ag%
Ore	100,00	4,60	4,40	28,04	100,00	100,00	100,00
Conc. Pb	2,80	73,00	2,75	385,00	44,50	1,75	38,50
Coll.Conc. Pb+Zn	11,22	20,50	35,50	108,73	50,00	90,50	45,00
Tailings	85,98	0,29	0,40	5,38	5,50	7,75	16,50

Table 3. Metal balance according to the collective lead-zinc flotation

Product	Masse, %	Pb-%	Zn-%	Ag-g/t	R-Pb%	R-Zn%	R-Ag%
Ore	100,00	4,60	4,40	28,04	100,00	100,00	100,00
Coll.Conc. Pb+Zn	15,05	28,97	27,03	156,45	94,80	92,50	84,00
Tailing	84,95	0,28	0,39	5,28	5,20	7,50	16,00

CONCLUSION

According to the world modern mineral processing trends in the reconstruction of the Concentrator of the Sasa Mine, the following can be concluded :

1.- With the new primary crushing and SAG-Mill grinding process, together with the reconstruction of the existing grinding mills is possible to increase the needed annual capacity to 0,92M t ore, and due to that to ;

- to replace the existing primary, secondary and tertiary crushing process;
 - to keep the existing mills (only with reconstruction of the mills with rods in balls), together with the existing construction building for grinding and flotation plant.
- 2.- With the new alternative flow-sheet it is possible to produce the following assortments and concentrate types;
- max. necessary quantities of the collective lead-zinc concentrate for the metallurgical –

ISP, MHK Zletovo-Veles, R.of Macedonia (quality: min. 55% Pb+Zn, max. 30% Pb, and min. 25% Zn); and

- selective lead concentrate suitable for export (quality: min. 73% Pb, max 3,4% Zn, and min. 340 g/t Ag) ;

3.- With the new regrinding process, and the needed auto control process systems to increase the technological qualitative results;

- quality of lead and zinc in the concentrates themselves;
- recovery of lead and zinc in the concentrates themselves;

Thus the total effects for the annual max. capacity of 0,92M t ore, are manifested by decreasing the investment, and increasing the total income of the Sasa Mine, over US \$ 10M.

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