PROCESSING OF DOMESTIC ANTIMONITE LOW GRADE ORE BY FLOTATION

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ABSTRACT:

These investigations have developed an effective flotation method to recover antimony metal. In this paper will be shown bench-scale laboratory investigations for the possibility of th antimonite recovery from the domestic antimonite ore. The otimization of the technological process in these laboratory investigations provide the bulk antimonite and operating conditions.

Keywords: flotation, antimonite, arsenic, regime

1. INTRODUCTION

Antimony and arsenic investigation and exploatation were carried out after the Second World War. They resulted in the discovery of significant ore reserves in the Alshar, Lojane and Krstov Dol deposits. Qualitative indices the average appearance of the antimony and arsenic: Alshar (2,5%Sb; 1,09%As; 2,0 g/t Au); Lojane (3,5%Sb; 4,55%As); Krstov Dol (2,20%Sb). They also determined several promising are such as the Nikustak, Smrdliva Voda and Dzermol deposits. Today, antimony and arsenic ores are not mined although their demand is great.

The generally conceppt of the bench-scale laboratory experiments and new investigated technological scheme of the flotation concentration proces of the antimony domestic ore from Alshar deposit was based on the demands of the possible recovery from the useful present antmony minerals.

The investigation should be to serve as a basis of the invention by possibilities for the increase Sb-recovery in the concentrate, and the decrease As-appearace in obtained concentrate. The optimization process in these techno-laboratory investigations has understood the bulk flotation of the SbS-AsS have to operate by the appropriate pH values, at the same time making possibilities of the increased recovery of the antimony and gold and decreasing of the arsenic appearing, contemporary protecting the environment. Also, these laboratory experiments have enabled to prove the optimum conditions of the process of bulk flotation on the appropriate pH-value.

The minerology of the Alshar antimony-arsenic deposit is represented by minerals which are extracted in three phases: minerals of the hydrothermal phase; minerals of the orebearing phase and minerals of th descedentic phase.

According to the recent degree of acknowledge of the deposit the mineral of the hydrothermal phase consist kaolin minerals, sericite, dolomite, quartz, kalcedon, opal and hematite.

According to the recent degree of acknowledge of the deposit the mineral of the orebearing phase consist bravoit, arsenopyrite, markasite, antimonite, lorandit, realgar, auropigment, barite, gold, sulfur and uncomplete determined talium minerals. The antimonite is main ore mineral in the deposit with wire-forms and impregnations. The Alshar deposit is illustrated by the coarse crystals of the antimonite with particle size of 10 cm. Antimonite is very often dovetailed in the previous mentioned minerals. Vrbait mineral is mainly tied up with the arsenic of the deposit. Lorandit mineral is appeared either in coarse and long crystals or fine size crystals, red colour, and in wire-forms in the auropigment mass. Realgar

mineral according itself intensity of representation is the most repesentative mineral in the deposit together with the antimonite mineral.

The average quality or ore content in the Alshar deposit is followed:

Sb 3,25%
As 1,41%
Tl 0,008%
Mn 0,14%
Fe_{total} 8,47%
S 10,76%
SiO_2..... 37,85%
Al_2O_3..... 2,27%
CaO 12,30%
MgO 7,75%

The representative samples from the Alshar-mine (-5,0+0,0mm) were with the average Sb-content from 1,3-1,65%Sb and average As-content from 0,4%. The bench-scale selective laboratory experiments were made for the antimony and arsenic minerals depending on pH-value and determined reagent regime with optimal conditions for recovery of rougher concentrates and cleaned concentrates by means of one or two stadiums of cleaning.

The bench-scale laboratory investigations have to enable knowledge for the influence of the following factors:

- grinding conditions;
- conditioning conditions;
- flotation conditions
- ore/water conditions
- reagent regime

Table 1. The operating conditions

Test	grinding		conditioning	
	$KMnO_4$ g/t	dextrine g/t	KAX g/t	NaIPX g/t
1	-	150	-	20
2	-	150	-	20
3	150	-	-	20
4	150	-	-	20
5	-	150	20	-
6	-	150	20	-
7	150	-	20	-
8*	150	-	20	-
9*	200	-	25	-
10*	200	-	25	-

grinding conditions: *Na_2CO_3..... 885 g/t*
NaCN..... 40 g/t
95% -0,147mm
conditionoing conditions: *t=5 min; pH=6,5*
$CuSO_4/_{1,3,5,7}$.....100 g/t
$CuSO_4/_{2,4,6,8,9,10}$.....150 g/t
flotation$_{1-9}$: *DOW-250 20% (20 ml)*
flotation$_{10}$: *DOW-250 20% (40 ml)*
flotation time$_{1-10}$: *t_f=10 min*
cleaning time$_{8-9}$: *t_c=3 min*
cleaning time$_{10}$: *t_c=(3+1) min*
8**.... with one cleaning;$KMnO_4$(150 g/t)
9**.... with one cleaning;$KMnO_4$(200 g/t)
10**.. with two cleaning $KMnO_4$(200 g/t)

Table 2. Effect of operating conditions(test 1)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	9,5	0,9	58,5	18,5
C/Sb	21,2	1,1	52,8	8.5
M/Sb	1,6	0,8	5,7	9,0
Tailing	0,6	0,3	42,5	81,5

Table 3. Effect of operating conditions(test 2)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	7,5	0,5	50,3	34,5
C/Sb	20,5	0,4	43,2	8.1
M/Sb	1,8	0,7	7,1	26,4
Tailing	0,5	0,1	49,7	65,5

Table 4. Effect of operating conditions(test 3)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	14,5	0,7	74,9	18,5
C/Sb	32,5	0,6	65,8	6,5
M/Sb	2,6	0,7	9,1	12,0
Tailing	0,4	0,2	25,1	81,5

Table 5. Effect of operating conditions(test 4)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	16,0	0,3	68,5	8,5
C/Sb	29,5	0,5	64,8	6.5
M/Sb	1,9	0,1	3,7	2,0
Tailing	0,5	0,3	31,5	91,5

Table 6. Effect of operating conditions(test 5)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	9,5	0,6	57,3	14,0
C/Sb	22,0	0,3	47,8	2.5
M/Sb	2,6	0,7	9,5	11,5
Tailing	0,5	0,3	42,7	86,0

Table 7. Effect of operating conditions(test 6)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	18,5	0,7	68,1	11,4
C/Sb	38,0	0,7	61,3	5.0
M/Sb	3,2	0,7	6,8	6,4
Tailing	0,4	0,3	31,9	88,6

Table 8. Effect of operating conditions(test 7)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	23,4	1,0	76,2	16,5
C/Sb	45,2	1,3	72,0	10.5
M/Sb	2,5	0,7	4,2	6,0
Tailing	0,4	0,3	23,8	83,5

Table 9. Effect of operating conditions(test 8)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	15,9	0,5	82,0	10,0
C/Sb	40,5	0,5	74,2	4,0
M/Sb	2,3	0,5	7,8	6,0
Tailing	0,2	0,3	18,0	90,0

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Table 10. Effect of operating conditions(test 9)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	14,5	0,7	85,5	14,5
C/Sb	28,5	0,5	82,8	5.5
M/Sb	0,6	0,9	2,7	9,0
Tailing	0,2	0,3	14,5	85,5

Table 11. Effect of operating conditions(test 10)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/Sb	16,2	0,7	87,5	15,9
C+M$_2$	32,5	0,8	85,8	9,2
C/Sb	48,7	1,0	69,7	6,3
M$_3$/Sb	13,2	0,6	16,1	2,9
M$_2$/Sb	0,6	0,6	1,7	6,7
Tailing$_1$	0,2	0,3	12,5	84,1

The bench-scale selective laboratory experiments were made for the antimony and arsenic minerals depending on pH-value and determined reagent regime with optimal conditions for recovery of rougher concentrates and cleaned concentrates by means of three stadiums of cleaning. The bench-scale laboratory investigations have to enable knowledge for the influence of the following factors:

- grinding conditions;
- conditioning conditions;
- flotation conditions
- ore/water conditions
- reagent regime

Table 12. Effect of operating conditions

Test	grinding		conditioning	
	$KMnO_4$ g/t	dextrine g/t	KAX g/t	NaIPX g/t
11	200	-	25	-
12	200	-	-	25
13	300	-	-	25

grinding conditions: *Na_2CO_3..... 885 g/t*
NaCN..... 40 g/t;
conditionoing conditions: *t=5 min; pH=6,5*
$CuSO_4$/$_{11,12,13}$.....150 g/t
flotation$_{11\text{-}13}$: *DOW-250 20% (60 ml)*
flotation time1$_{11\text{-}13}$: *t_f=10 min*
cleaning time$_{1/11,12,13}$: *t_c=3 min;50g/t $KMnO_4$*
cleaning time$_{2/11,12,13}$: *t_c=2 min; 25g/t $KMnO_4$*
cleaning time$_{3/11,12,13}$: *t_c=1 min; 25g/t $KMnO_4$*

Table 13. Effect of operating conditions(test 11)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/SB	16,6	1,0	78,3	14,5
C+M$_2$+M$_3$	36,0	0,9	73,5	5,9
C+M$_3$	43,6	0,8	66,5	3,7
C/Sb	49,2	0,7	53,7	2,5
M$_3$/Sb	29,5	0,9	12,8	1,2
M$_2$/Sb	13,5	1,4	7,0	2,2
M$_1$/Sb	1,8	1,0	4,8	8,6
Tailing	0,3	0,4	21,7	85,5

Table 14. Effect of operating conditions(test 12)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/SB	16,1	0,6	76,8	8,9
C+M$_2$+M$_3$	36,8	0,6	73,5	4,2
C+M$_3$	45,8	0,6	67,3	3,0
C/Sb	49,4	0,5	45,5	1,5
M$_3$/Sb	39,2	0,8	21,7	1,5
M$_2$/Sb	11,9	0,7	6,2	1,2
M$_1$/Sb	1,2	0,5	3,3	4,6
Tailing	0,3	0,4	23,2	91,1

Table 15. Effect of operating conditions(test 13)

Products	Technological indicators			
	Sb%	As%	R_{Sb}%	R_{As}%
RC/SB	7,8	1,0	89,3	27,3
C+M$_2$+M$_3$	23,7	1,5	83,5	12,0
C+M$_3$	40,0	1,8	79,0	8,3
C/Sb	46,2	1,8	63,5	5,8
M$_3$/Sb	25,8	1,8	15,5	2,5
M$_2$/Sb	2,9	1,0	4,5	3,7
M$_1$/Sb	0,7	0,8	5,8	15,2
Tailing	0,1	0,3	10,7	72,7

Conclusions

The bench-scale laboratory investigations carried out to conclude the influence of the applied reagent regime in the antimonite flotation show the following conclusions:

- The chemical content of the investigated samples are with average 1,4%S and 0,4%As;
- The main antimony-bearing mineral in the samples is antimonite;
- The main arsenic-bearing minerals in the samples are realgar and arsenic-pyrite;
- The main liberation of the samples is reached with grinding of 95%-0,147 mm;
- The antimony recovery R_{Sb} in the rougher concentrates is varried from 50%-90%;
- The cleaning of the rougher concentrates are obtained apropriate concentrates with Sb quality of 49% and 0,49%As;

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