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Processing results of ore samples of the “Northern Balpantau” deposit

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ABSTRACT: The article presents the results of processing a technological sample of ore from the “Northern Balpantau” deposit. Experiments on gravity, flotation concentration and hydrometallurgical processing of concentrates were carried out. As a result of the tests performed, for ore processing, a flotation beneficiation scheme, sweet roasting of concentrate and sorption cyanidation of roasted product are recommended. According to the recommended scheme, the recovery of gold for resin is 98.82% and silver 82.54% from the operation or 81.48% of gold and 44.07% of silver from ore.

KEY WORDS: ore sample, screening, grinding, concentration on the table, gravity concentrate, middling product, gravity tails.

I.INTRODUCTION

Gold-bearing ores are very diverse in material composition. In some ores, more than 90% by weight is quartz, in others, along with quartz, the predominant minerals are barite (up to 50-60%), carbonates (up to 20-30%), iron oxides (up to 25%), tourmaline (up to 50%). The content of sulfides (mainly pyrite, arsenopyrite and pyrrhotite) ranges from 0 to 80%. Many other minerals, as well as host rocks (shale, granite, diorite, etc.) are also present in the ores in varying amounts. Ores also differ in physical condition. After mining, most of them are represented by strong lumpy material, some have the appearance of a loose clay mass with individual pieces. Ores differ even more in the properties of gold and its association with minerals.

II. LITERATURE SURVEY

When performing technological research, of primary interest are those features of the material composition, which to the greatest extent determine the technology of ore processing. These signs are:
- the presence in ores, along with gold, of other useful components with industrial content;
- the content of oxidized minerals in ores in comparison with sulfide, i.e. oxidation state of ores;
- the presence in the ores of components that significantly complicate the processing technology;
- the nature of gold in ores, primarily the size of gold particles.

Before starting the research, it is necessary to determine what type this ore belongs to. Usually, a preliminary determination is performed on the basis of geological and mineralogical information obtained with the sample passport. More precisely, the type of ore is determined after studying the material composition of the sample, the conclusions and conclusions of which play a major role in determining the choice of the ore processing technological scheme.
Based on the results of studying the material composition of the ore, the use of gravity and flotation methods of concentration was recommended for the concentration of the studied sample.

III. METHODOLOGY AND EXPERIMENTAL RESULTS

Gravitational concentration of the ore sample was carried out on a 30KS grade concentration table at various ore grinding sizes (Fig. 1). The results of concentration of ore samples on the concentration table are shown in Table 1.

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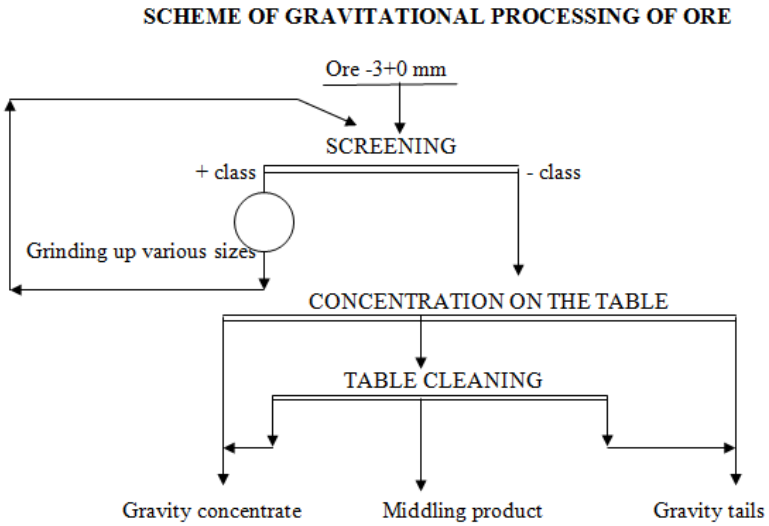

Fig.1.

Table 1
Results of gravity concentration of ore sample"Northern Balpantau" deposit

Products enrichment	Yield, %	Content, c.u.		Recovery,%		Size class, mm
		Au	Ag	Au	Ag	
1	2	3	4	5	6	7
Gravity concentrate	3,58	19,5	23,88	35,65	36,73	
Middling product	9,60	7,42	3,75	36,38	15,50	
Gravity tails	63,0	0,62	1,20	19,95	32,47	-1+0
Sludge	23,82	0,66	1,50	8,02	15,30	
Ore, -1+0мм	100	1,96	2,33	100	100	
Gravity concentrate	6,23	17,27	12,50	58,82	47,22	
Middling product	10,38	1,13	1,08	6,39	6,8	
Gravity tails	54,67	0,67	1,05	19,90	34,8	-0,5+0
Sludge	28,72	0,95	0,64	14,90	11,19	
Ore, -0,5+0мм	100	1,83	1,65	100	100	
Gravity concentrate	5,20	21,73	11,02	53,80	30,64	
Middling product	7,02	1,90	2,75	6,35	10,34	
Gravity tails	39,93	0,98	0,90	18,61	19,28	-0,25+0
Sludge	47,85	0,93	1,55	21,24	39,74	
Ore, -0,25+0мм	100	2,10	1,87	100	100	
Gravity concentrate	3,18	22,40	13,15	37,10	21,44	
Middling product	2,83	14,54	5,67	21,43	8,23	
Gravity tails	27,56	0,97	1,04	13,94	14,73	-0,1+0
Sludge	66,43	0,80	1,63	27,53	55,60	
Ore, -0,1+0мм	100	1,92	1,95	100	100	

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As follows from Table 1, the optimal size for the gravitational concentration of gold-bearing ore from the "Northern Balpantau" deposit is grain-size class -0.5 + 0mm. When concentrating ore of this size, a gravity concentrate was obtained containing 17.27 conventional units gold and 12.5c.u. silver with metal recovery 58.82% and 47.22% respectively. It should be noted that the concentrate from this ore is substandard in terms of gold content (17.27 c.u**.** versus 50 c.u.as required).

In flotation concentration, the classical flotation scheme for gold-bearing ores was taken as a basis (Fig. 2), including ore grinding, roughing, recleaner flotation and bulk cleaner flotation. The experiments varied: the size of ore grinding, the consumption of reagents. Soda ash, sodium sulfide, copper sulfate, potassium butyl xanthate (PBX) and T-92 frother were used as reagents. Table 2 shows the results of flotation at various flow rates of the PBX.

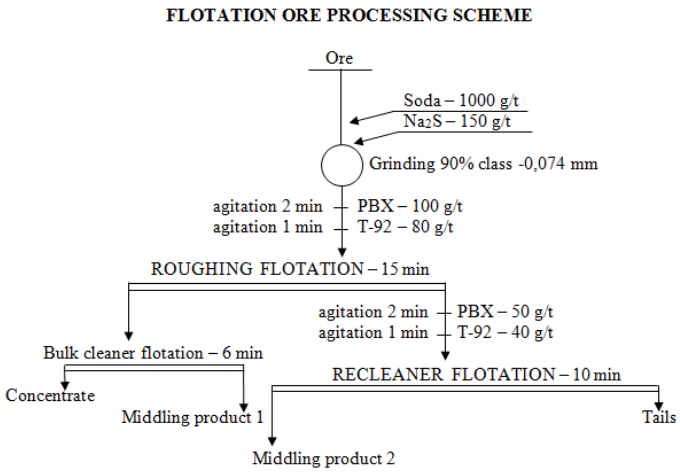

Fig.2.

Table 2

Results of ore flotation at different xanthate flow rates

Products enrichment	**Yield,%**	**Content, c.u.**		**Extraction, %**		**Consumption of PBX in roughing and recleaner flotation, g/t**
		Au	**Ag**	**Au**	**Ag**	
Concentrate	3,06	43,9	22,1	67,2	37,2	50+25
Middling product -1	9,18	1,33	2,4	6,1	12,1	
Middling product -2	3,06	1,50	2,5	2,3	4,2	
Tails	84,7	0,58	1,0	24,4	46,5	
Ore	100,0	2,0	1,82	100	100	
Concentrate	3,23	48,1	21,3	73,95	43,1	75+50
Middling product -1	8,63	1,64	2,2	6,73	12,1	
Middling product -2	5,08	1,57	2,6	3,80	8,2	
Tails	83,06	0,39	0,70	15,52	36,6	
Ore	100,0	2,1	1,6	100	100	
Concentrate	3,40	49,9	23,9	78,90	48,56	100+50
Middling product -1	10,2	2,3	2,40	10,90	14,67	
Middling product -2	4,04	1,76	1,9	3,30	4,6	
Tails	82,36	0,18	0,65	6,90	32,17	
Ore	100,0	2,15	1,67	100	100	
Concentrate	3,84	43,7	24	76,94	53,55	120+60
Middling product -1	7,06	2,0	3	6,57	12,50	
Middling product -2	5,11	2,10	2	4,93	5,95	
Tails	83,39	0,3	0,57	11,56	28,0	
Ore	100,0	2,18	1,72	100	100	

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As you can see from the table. 2, the best performance was obtained at a PBX flow rate of 100 + 50 g/t. Under these conditions, a concentrate containing 49.9 conventional units was obtained gold and 23.9 c.u. silver with the recovery of gold 78.9% and silver 48.56%. Thus, the optimal costs of the remaining reagents are determined. In order to improve the quality of the concentrate, an additional cleaning operation has been added to the scheme.
In the developed optimal mode, experiments were carried out in open and closed circutes, the results of which are shown in Table 3.

Table 3
Results of flotation of ore from the "Northern Balpantau" deposit in open and closed cycles

Products enrichment	Yield, %	Content, c.u.		Extraction, %	
		Au	Ag	Au	Ag
Open circuit					
Concentrate	2,25	67,5	39,1	71,64	50,27
Mid-product -1	6,18	1,8	3,7	5,25	13,07
Mid-product -2	6,34	0,72	1,4	2,15	5,07
Mid-product -3	1,23	10,3	5,4	5,98	3,8
Tails	84,0	0,38	0,58	14,98	27,79
Ore	100	2,12	1,75	100	100
Closed circuit					
Concentrate	3,64	48,7	26,4	82,45	53,39
Tails	96,36	0,39	0,87	17,55	46,61
Ore	100,0	2,15	1,8	100	100

As can be seen from Table 3, during the flotation of ore from the Northern Balpantau deposit in an open cycle, a concentrate was obtained with a yield of 2.25%, containing 67.5 c.u. gold and 39.1 c.u.silver with metal recovery 71.64% and 50.27%, respectively; in experiments on the principle of a continuous process, the concentrate yield increases to 3.64%, gold recovery rises to 82.45% and silver to 53.39%. At the same time, the quality of the concentrate decreases slightly, the gold content in the concentrate is 48.7 c.u., silver is 26.4 c.u.

IV. CONCLUSION

Thus, as a result of the studies carried out to study the ore preparation of an ore sample from the "Northern Balpantau" deposit, a flotation ore concentration scheme is recommended, as a result of which it is possible to obtain conditioned concentrates by the content of the main valuable component.
In order to assess the extraction of noble metals from the concentrate, direct and sorption cyanidation experiments were carried out. In the course of the tests, the size of grinding of the material was 85-95% of the class -0.074 mm; concentration of sodium cyanide 0.1%; the duration of the process is 24 hours, the consumption of resin AM-2B is 3% of the pulp volume.
To open up gold associated with sulfides, experiments were carried out on oxidative roasting of gravity and flotation concentrates in a muffle furnace at a temperature of 550-650 ° C until the gases were completely liberated. The duration of the experiment was 2 hours. The yield of cinders was 75-80% of the original concentrate. The original concentrate and its cinder were subjected to sorption cyanidation in the presence of AM-2B resin in an amount of 3% of the pulp volume. The results of the cyanidation experiments are shown in Table 4.
On the basis of the studies performed, for the processing of the studied ore, it is recommended to use a flotation enrichment scheme, oxidative roasting of flotation concentrate followed by cyanidation of cinder. When processing flotation concentrate ore from the "Northern Balpantau" deposit according to the recommended scheme, the extraction of gold for resin was 98.82% and silver 82.54% of the operation or 81.48% of gold and 44.07% of silver from the ore.

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Table 4
Results of cyanidation of processed products

Products enrichment	Content, c.u.		Extraction into solution/resin, %		Experimental conditions	
	Au	Ag	Au	Ag	C_{NaCN}, %	Resin consumption,% of the pulp volume
Gravity concentrate	17,27	12,5				
Cyanidation tails	2,7	3,6	84,4	71,2	0,1	-
Cyanidation tails	2,2	3,4	87,26	72,8	0,1	3,0
Flotation concentrate	48,7	26,4				
Cyanidation tails	6,6	4,9	86,4	81,4	0,1	-
Cyanidation tails	6,0	4,36	87,68	83,48	0,1	5,0
Cinder concentrate	50,7	27,5				
Cyanidation tails	1,9	5,6	96,25	79,64	0,1	-
Cyanidation tails	0,6	4,8	98,82	82,54	0,1	5,0

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