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STUDYING OF THE MATERIAL COMPOSITION AND DEVELOPMENT OF THE TECHNOLOGY OF PROCESSING OF GOLD-CONTAINING SULFIDE SAMPLES OF ONE OF THE DEPOSITS OF THE REPUBLIC UZBEKISTAN

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Abstract

The article discusses the results of studying the material composition and the development of technology for processing gold-bearing sulfide ore samples. The material composition of the ore samples was studied by spectral, chemical, assay and rational analysis of gold and silver. Based on a study of the material composition of the ore samples, the following conclusions were made: gold and silver are the industry's most valuable components. It is shown that the use of sulfuric acid treatment of a cinder of graviofloraf concentrate can allow to improve the technological performance of the process. As a result of the mixture of gravio-flotation concentrate after sulfuric acid treatment drying, grinding to a size of 95% CL. -0,074+0 mm and subjected to sorption cyanidation. In the initial cake, the content of gold -77.83 u. e. and silver-16.3 u. e., the concentration of sodium cyanide 0.15%, the ratio W:t=2:1; resin AM-2B-5% of the pulp volume, the duration of cyanidation 36 hours.the Content in the tailings of cyanidation of gold - 6.5 u. e., and silver - 4.8 u. e. the Extraction of noble metals in solution and on the resin was 91.65 and 70.55%, respectively. Through extraction of 87.63% gold and 55.6% silver from ore.

Key words: *spectral analysis, flotation enrichment, cyanide solution, chemical analysis, gold, silver, traditional reagents.*

Introduction

The material composition of ore samples was studied by spectral, chemical, assay and rational analysis for gold and silver.

The results of spectral analysis of the average sample are determined in% *Si> 1; Al> 1; Mg-1; Ca - 1; Fe>1; Mn – 0.05; Ni – 0.002;Ti -0.4; Cr-0,02; Mo<0,001*; Zr-0,03; Cu-0,13; Pb-1,0;Zn-0,006; Sb-0; Na-1; Sr-0,02; Ba-0,02; Co-0,004; V-0,002; As>*1; Sn-0,001;*As>*1;Ga<0,001*; Be<*0,001*;

Chemical analysis determined in an average sample in%: SiO_2 – 62,0;*Fe_2O_3-5,85;FeO-1,48;TiO_2-0,7;MnO-0,05;Al_2O_3-13,1;CaO-3,22;MgO-1,1;Na_2O-1,22;K_2O-3;$S_{общ}$-3,39;$S_{с-д}$-3,35;SO_3-0,1;P_2O_5-0,14;CO_2 – 3,08;H_2O-0,6;n.n. n.-5,32; Au-16,48 y.e.*
*Ag -4,2y.e.*Cu-0,13; As-4,16.

In table.1 the results of rational analysis for gold and silver in the average ore sample are presented.

Table. 1.

Results of rational analysis for gold and silver in the average ore sample

Form of precious metals and the nature of their connection with ore minerals	Distribution of metals			
	Gold		Silver	
	u. e.	%	u. e.	%
1	2	3	4	5
Au and Ag native, in accretions with other minerals: chlorides, sulfates, simple sulfides of silver (cyanide)	0,75	4,6	1,5	35,7
Au, Ag associated with minerals and chemical compounds of antimony and arsenic (except arsenopyrite and 5-valence antimony compounds), silver sulfosols (cyanizable after alkaline treatment)	0,3	1,8	-	-
Au and Ag associated with acid-soluble minerals, oxidized iron and manganese minerals (carbonates, oxides and hydroxides) (cyanizable after HCl treatment)	0,73	4,4	1,6	38
Au and Ag, finely interspersed in sulfides (pyrite and arsenopyrite) and (cyanized after HNO3-processings)	13,8	837	0,9	21,5
Au, Ag in quartz, aluminosilicates and other acid-insoluble minerals	0,9	5,5	0,2	4,8
Total in ore	16,48	100	4,2	100

Based on the study of the material composition of ore samples, the following conclusions can be drawn: the industrially valuable components of the sample are gold and silver. Finding the form of base, of dispersed colloidal, silver is present in the form of arsenides and the sulfosalts (cation exchange resin, polybasite and proustite). Silver in comparison with gold is in a subordinate quantity.

The main ore minerals and concentrates of gold and silver are pyrite and arsenopyrite. From nonmetallic widely distributed quartz, sericite, carbonate and feldspar. The sample mainly consists of non-oxidized rocks. Gravity enrichment was carried out to separate relatively large particles of native gold and sulfides from the ore into the gravity concentrate. The results of experiments of gravitational enrichment of ore samples are given in table.2.

Table. 2.

Results of gravitational enrichment of gold-containing ore samples of different sizes

Enrichment products	Exit, %	Content u. e.		Extractions , %		Size class, mm
		Au	Ag	Au	Ag	
Gravity concentrate	14,25	70,43	15,21	61,42	50,4	-1+0
Middlings	21,17	10,11	2,96	13,1	14,55	
The tails of gravitation	49,32	1,72	0,98	5,18	11,2	
Sludges	15,26	21,74	6,72	20,3	23,85	
Ore -1+0 mm	100	16,34	4,3	100	100	
Gravity concentrate	18,35	68,73	13,63	76,76	55,6	
Middlings	22,06	6,22	2,63	8,35	12,9	

The tails of Gravitation	38,0	1,93	1,34	4,96	11,3	-0,5+0
Sludges	21,59	7,94	4,21	10,43	20,2	
Ore -0.5+0 mm	100	16,43	4,5	100	100	
Gravity concentrate	16,44	57,49	11,54	57,7	45,16	-0,25+0
Middlings	20,64	9,12	3,35	12,37	16,46	
The tails of gravitation	35,57	3,13	1,30	6,79	11,0	
Sludges	27,35	13,86	4,2	23,14	27,38	
Ore -0.25+0 mm	100	16,38	4,2	100	100	

As follows from table. 2, the optimal size for gravitational enrichment of gold-containing ore of this Deposit is -0.5 + 0 mm. at the same time, the maximum extraction of gold and silver into the gravity concentrate is 76.76 and 55.6%.

In the experiments of flotation varied: the size of grinding from 75 to 95% CL. -0,074+0 mm, the cost of soda ash, sodium sulfide, copper sulfate. Particular attention was paid to the use of BCC collector (potassium butyl xanthogenate).

As a result of the tests carried out on the ore samples enrichment, the optimal flotation mode was established.

Grinding size, 80% CL. - 0,074 mm.

Reagent consumption, g / t: in grinding: soda ash -1000 in the main flotation: CuSO4-100, BK-120, T-92 -120.

The control flotation: CCL-60; T-92 -60 without cleaning out the reagents.

Main flotation time, min -12.

Control flotation time, min -10.

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In the developed mode, experiments were conducted in open and closed cycles, the results of which are given in table. 3 (Fig.1).

Table. 3.

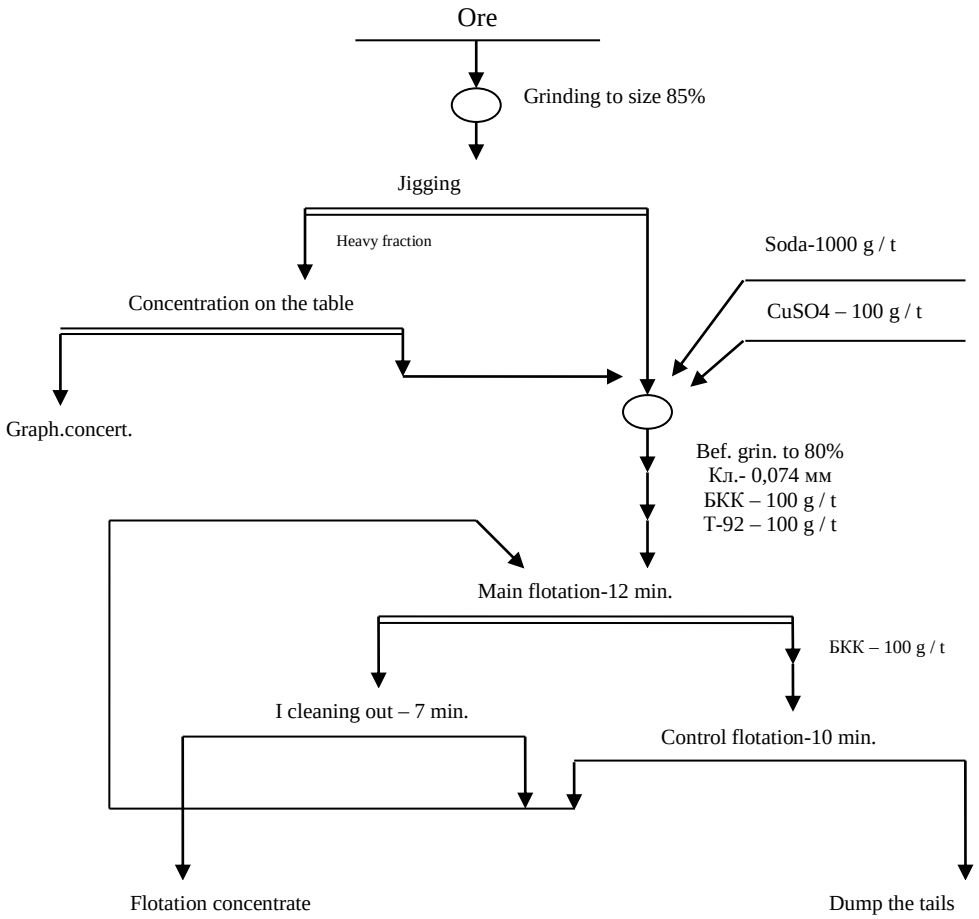
Results of flotation of gold ore in open and closed cycles

Enrichment products	Exit, %	Content, u. e.		Extraction , %	
		Au	Ag	Au	Ag
	Open cycle				
Concentrate	19,43	74,2	18,36	88,34	79,28
Promprodukt-1	5,21	11,4	5,3	3,64	6,12
Promprodukt-2	6,86	5,6	2,6	2,35	3,94
The flotation tailings.	68,5	1,35	0,7	5,67	10,66
Ore	100	16,32	4,5	100	100
Closed loop (on the principle of continuous process)					
Concentrate	24,8	62,1	14,5	93,48	85,62
The flotation tailings.	75,2	1,43	0,8	6,52	14,38
Ore	100	16,48	4,2	100	100

As can be seen from table. 3, during flotation enrichment of ore samples, it is possible to obtain in an open cycle a concentrate with an output of 19.43% containing 74.2 cu of gold and 18.3 cu of silver, while extracting 88.34 and 79.28 % of the ore, respectively.

In experiments on the principle of continuous process concentrate yield increases to 24.8%, gold

recovery - up to 93.48% and silver-up to 85.62%.



Rice. 1. Recommended scheme of ore sample enrichment

At the same time, the gold content in the concentrate is reduced to 62.1 cu, silver-to 14.5 cu, since more than 1 cu of gold remains in the flotation tails. It was of interest to conduct experiments of flotation on the tails of gravity. Flotation experiments were carried out with a decrease in the flow rate of BCC in the main flotation to 100 g/t and in the control to 50 g / t. the results of the experiments are shown in table. 4.

Table. 4.

Results of flotation of ore gravity tails in open and closed cycles

Enrichment products	Exit,%	Content, u. e.		Extraction , %	
		Au	Ag	Au	Ag
	Open cycle				
Concentrate	13,25	27,36	8,4	77,0	48,35
Promprodukt-1	19,3	3,12	2,3	12,83	19,33
Promprodukt-2	6,6	1,74	1,7	2,45	5,04
The flotation tailings.	60,9	0,59	1,0	7,72	27,28
Ore	100	4,69	2,28	100	100
Closed loop (on the principle of continuous process)					
Concentrate	18,15	21,0	6,6	81,26	52,28
The flotation tailings.	81,85	1,07	1,33	18,74	47,72

Ore	100	4,69	2,28	100	100

As can be seen from the data given in table. 4, when flotation tailings gravity ore can be obtained flotation concentrate containing 21 cu. e. gold and 6.6 cu. e. silver in the extraction of metals 81.26 and 52.28% of the operation, or 18.88 and 23.21% of the ore, respectively. The combined gravio flotation concentrate containing 47.52 cu gold and 10 cu silver extracts 95.64 % gold and 78.81 % silver.

Cyanidation of ore and tailings enrichment. The cyanidation process was carried out by mixing the pulp in open flasks with a capacity of 0.75 dm3 on a bottle agitator of IRGIREDMET design. The material 50-200 g was placed in glass, filled with an aqueous solution of sodium cyanide, adding the necessary amount of protective alkali. The process was controlled by determining the concentration of sodium cyanide and protective alkali in the liquid phase of the pulp. Indicators of the cyanidation process of ore and tailings enrichment in the optimal mode are given in table. 5.

Table. 5.

The results of cyanidation of products in the optimal mode. Constant parameters W: t=2:1; CCaO-0.002 % t=24 h

Source material	Content, u. e.		Cacciavillani, u. e.		Извл. вр-р , %		C_{NaCN}, %	Кл. круп-ности %, 0,074 мм
	Au	Ag	Au	Ag	Au	Ag		
Ore	16,48	4,2	15,8	2,9	4,1	31	0,15	90
Gravity tails.	4,68	2,45	3,75	1,55	19,9	36,7	0,1	90
The tails of the fleet .	1,43	0,8	1,0	0,1	30,1	87,5	0,06	85
The flotation tailings.	1,43	0,8	0,8	0,1	44,1	87,5	0,06	90

Sorption cyanidation of concentrates was carried out on gravel and flotation concentrates obtained from ore after sulfuric acid treatment. The results are shown in table.6.

Table. 6.

The performance of the process of sorption leaching of concentrates and slag, a waste product after sulfuric acid treatment

The source material	Content, u. e.		Cacciavillani, u. e.		Извл. вр-р , %	
	Au	Ag	Au	Ag	Au	Ag
Gravity concentrate	68,73	13,63	55,6	4,8	19,1	64,7
Flotation concentrate	62,1	14,5	50,6	6,5	18,5	55,3
Stub of gravio flotation concentrate	71,6	14,2	28,1	7,7	60,8	45,8
The calcine flotation concentrate	64,7	15,1	12,2	7,5	81,1	50,3

Constant conditions: CL. size-95% CL. -0,074 mm; duration of cyanidation-36 h., the concentration of protective alkali CaO-0.02 %, the concentration of sodium cyanide 0.15%; firing concentrates at a temperature of 550-600 0 C to complete the release of gases. Resin AM-2B-5% of the pulp volume. As can be seen from table.6, acceptable results were obtained by

sorption cyanidation of flotation concentrate stub.

The use of sulfuric acid treatment of the stub of the gravio-flotation concentrate will improve the technological parameters of the process. Stub gravio flotoconcentrate was subjected to sulfuric acid leaching at a ratio W: t=4:1, the concentration of sulfuric acid 5% at a temperature of 85-90 oC for two hours. The pulp was filtered, the cake was washed after drying, before grinding to a size of 95 % CL. -0,074+0 mm and subjected to cyanidation. The results of the experiment are given in table.7.

Table. 7.

Results of the cyanidation experiment

Enrichment products	Exit %	Content u. e.		Extraction , %	
		Au	Ag	Au	Ag
Gravity concentrate	18,35	68,94	1,27	76,76	55,6
Flotation concentrate	14,82	21,0	6,6	18,88	23,21
'ed. concentrate	33,17	47,52	10	95,64	78,81
Tails flotation	68,83	1,08	1,33	4,36	21,29
Ore	100	16,48	4,2	100	100

As a result, the mixture of gravel-flotation concentrate after sulfuric acid treatment drying was crushed to a size of 95% CL. - 0.074+0 mm and subjected to sorption cyanidation. In the initial cake, the content of gold -77.83 cu and silver-16.3 cu, the concentration of sodium cyanide 0.15%, the ratio W: t=2: 1; resin AM-2B-5% of the pulp volume, the duration of cyanidation 36 hours.

The content in the tailings of cyanidation-gold-6.5 u. e., and silver-4.8 u.e. Extraction of noble metals in solution and resin was 91.65 and 70.55%, respectively.

Through extraction of 87.63% gold and 55.6% silver from ore.

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