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Study of the Composition of the Stale Tailings of the Tailings of Hydrometallurgical Plants

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ABSTRACT: This article provides information on waste sorting methods for the study of the composition of the waste of hydrometallurgical plants located in the country and the analysis of the location of the sorted waste. At the same time, work was carried out to find out the exact location of the waste.

KEY WORDS: hydrocyclone, concentrate, product, component, atomic, solution, tail, regeneration, precious metals analysis, silver, gold, useful components, departure.

I. INTRODUCTION

Based on the study of the material composition of the initial old tailings of the factory, the nature of the impregnation of minerals of their constituents, and the study of the results of previous studies of the tailings of the Chadaksky Mill, gravity, flotation, magnetic, and cyanidation of the initial tailings of their enrichment products were adopted as the main enrichment methods. The grinding of tailings was carried out in a laboratory ball mill brand 40 ML at T: W: W = 1: 0.75: 8. For the gravitational enrichment of the original tailings, the cheapest methods and equipment for concentrating gold were used - screw separators and gateways (in laboratory form), ZOKS concentration table, felt-coated gateway, laboratory GL hydro cyclone. Studies on the theory of the enrichment process and the processing of various wastes and mineral resources using pyrometallurgical and hydrometallurgical methods were carried out by A.P. Vinogradov, I.V. Petryanov, B.N. Laskorin, N.N. Semenov, E.V. Adamov, I.F. Baryshnikov, A.V. Vanyukov, Yu.P. Kupryakov, I.F. Khudyakov and etc. Scientific research regarding the study of object was carried out in various regions of the world in the field of rational use of mineral resources and improving the technological process of their processing by scientists such as Hector Jordan, Angel Saqhueza, Veronica Ganter, Bevilaqua D., Acciari HA, Benedetti A.V, Fugivara CS, Garciae Jr., O. FremiliosiFilho G, Jacques V., Wiertz, Magda Mateo, Berg H. and others. The scientific research A. P.Vinogradov, B.N. Laskorin, I.V. Petryanov, K. Sanakulov, NN Semenov, A. S. Khasanov, A. A. Yusuphodzhaev, M. M. Yakubov, and others devoted their problems to the processing of waste from mining and metallurgical enterprises. The research of A. A. Andreev, A. N. Dyachenko, A.A. Chizhik, I.P. Markevich, M. Ernazarov, is devoted to the study of halogenammonium technology for processing raw materials and waste and others. In world practice, the improvement of existing technological processes for the processing of mineral raw materials to produce additional metals with the aim of comprehensively extracting valuable components from the waste of mining and metallurgical enterprises is currently becoming very important when creating new highly cost-effective technologies for processing technogenic raw materials.

II. METHODOLOGY

The frequency of occurrence of the class of gold grades is established by conditional criteria for the profitability of gold production. According to the gold content and other technical and economic parameters (the value on the world market is not less than $ 30 / g, the degree of through extraction is not less than 60%) and when compiling a gold distribution map, the criterion value of gold can be divided into three groups: low profitability ($\leq$ 0.4 g / t), average profitable content (0.5 ÷ 0.7 g / t), highly profitable content ($\geq$ 0.8 g / t).
When conducting a rational analysis of averaged samples and testing for cyanideability of gold, the assay method is used. [1]
To determine the standard deviation of the gamma-activation analysis of gold from the average values, 4 samples were formed weighing 4 kg each and the analysis was performed with 6 repetitions. The deviation from the average results

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in the range of contents of 0.6-1.0 g / t was not more than 15 rel.%. In the selected samples, the gold content was determined by the method of gamma activation, assay, and atomic emission analysis with inductively coupled plasma (Table 1). A satisfactory deviation was noted between the results of the analysis. Averaged samples were subjected to elemental and mineralogical analysis.

Table 1.The results of the analysis of selected samples by various methods.

№ sample	Place of selection	Goldcontent, g/t			
		GAA	Assay	ESA(ISP)	Averaged analysis
1	Northwest(averaged)	0,7	0,97	1,4	1,02
2	North (averaged)	0,8	1,1	0,9	0,93
3	West(averaged)	0,6	0,93	1,5	1,01
4	South (averaged)	0,8	1,1	1,1	1,0

Of the averaged samples, 3 kg were transferred for microbiological studies and 1 kg of samples for mineralogical analysis. Using the GAA method, the gold content was analyzed with a 6-fold repetition from a 0.5 kg sample. The average gold content in the samples taken from the northwestern part of the tailings (sample 1) is 0.7 ± 0.10 g / t; the northern part of the tailings (sample 2) is 0.8 ± 0.15 g / t; the western part of the tailings (sample 3) is 0.59 ± 0.10 g / t; and the southern part of the tailings (sample 4) is 0.73 ± 0.15 g / t.

III. EXPERIMENTAL RESULTS

For mineralogical and geochemical studies, the Institute of Geology and Geophysics was presented 4 samples taken from the tailing dump HMP-3 NMMC. These samples were subjected to spectral and ISP mass spectrometric, microscopic analyzes. [2] According to the data of spectral and mass spectrometric analyzes, increased concentrations of the following metals were established, taking into account that the tailings are a complex heterogeneous geochemical system. In addition to the increased contents of rock-forming oxides SiO_2, MgO, Al_2O_3, K_2O, CaO, Fetotal, TiO_2, which are represented by mineral forms (mainly quartz, feldspars, clay, carbonate minerals, apatite, and titanium minerals) (Table 2).

Table 2 The content of chemical compounds (%) in dump tailings HMP-3 (according to ISP MS).

№ s-s	Element	sample 1	sample 2	sample 3	sample4	Average results
1	Na_2O	3,25	2,05	3,85	3,93	3,27
2	MgO	3,08	2,85	1,83	2,08	2,45
3	Al_2O_3	10,99	9,63	13,69	12,49	11,70
4	SiO_2	56,42	60,01	60,25	59,29	60,00
5	P_2O_5	0,14	0,11	0,26	0,17	0,17
6	K_2O	2,92	2,70	4,15	3,59	3,34
7	CaO	3,87	2,81	3,16	1,87	2,92
8	TiO_2	0,90	0,86	0,80	0,70	0,81
9	MnO	0,08	0,048	0,028	0,95	0,27
10	Othercomponents	18,31	18,93	11,99	14,93	16,04
	Total	100	100	100	100	100

Metals such as Bi (up to 7.3 g / t), As (up to 501 g / t), Sb (up to 91 g / t), Au (up to 3.46 g / t), Ag (up to 3.9 g / t), ∑ EPG (up to 0.165 g / t), Se (up to 8.1 g / t), Te (up to 20.6 g / t), Cd (up to 1.6 g / t), Ge (3.9 g / t), W (up to 72 g / t), Hg (1.5 g / t), Tl (1.5 g / t) and rare earth elements (∑ TR = 229 g / t)
The content of some elements characterizing the persistence of raw materials (according to the Lecco analyzer) is given in Table.3. A relatively high content of Ss is found in the south side of the tailings pond, a relatively high content of Corg is found in the Northwest and Western sides of the tailings pond. The average content of Stot according to the

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Lecco analyzer and according to ISP MS is 1.82 and 1.9%, respectively, which proves the reliability of the results. The gold content was determined by assay.

Table 3 The content of some elements (%) characterizing the stability of raw materials (according to the analyzer "Lecco")

№ s/s	Side of selection (numbering by card)	Depth of selection, m	Number of samples	Content, %						
				Au, g/t	Fe_{gen}	S_{gen}	S_s	C_{gen}	C_{org}	CO_2
1	North-west(I-II)	1-3	300	0,95	4,2	1,88	0,37	1,63	0,26	5,03
2	North (III-IV)	1-3	401	0,99	4,5	1,79	0,47	1,61	0,24	5,03
3	West (V)	1-3	482	0,98	5,0	1,77	0,45	1,66	0,27	5,11
4	South (VI-VII)	1-3	342	1,0	3,5	1,74	0,61	1,67	0,25	5,2

As a result of microscopic and microprobe studies and conversion to mass spectrometric analyzes for ISPs, the average mineral composition of the tailings of the HMP-3 NGMK enrichment was revealed (Table 4).

Table 4 The average mineral composition of HMP-3 stale tails

№ s/s	Minerals	Content, %
1	Quartz> potassium feldspars>hydromica> chlorite>biotite> calcite> carbonaceous matter	90,58
2	Pyrites	3,44
3	Arsenopyrite	0,22
4	Othersulfides, sulfasalts	0,06
5	Oxides, hydroxides Fe, V, Ti, Cr	5,49
6	Apatite	0,20
7	Scheelit	0,010
	Total	100

From table 4 it follows that 90.58% of tailings are presented with the rock-forming minerals: quartz, potassium feldspars, with hydromica, chlorite, biotite, carbonates, organic matter. The tails are present, in addition to the above minerals pyrite to 3.44%, arsenopyrite up to 0.22%, other sulfides, sulphosalts etc. to 0.06%, the oxides and hydroxides of Fe, Ti, Cr to 5.49%, Apatite to 0.20%, scheelite up to 0,013%.
Rational analysis is:
• gold in the free state and in the form of aggregates (Cinerama) is in the range of 23-25 Rel. % in the southern (deeper than 5-6m), South-Eastern and South-Western part of the tailings at a depth of 1-3 m;
• gold, covered with films associated with antimonite and amorphous silica (Cinerama after treatment NaOH) is located in the North-West, North-East, the Western part of the tailing (25-40 Rel. %);
• gold associated with oxides, hydroxides of iron, carbonates, chlorite, an antimonite, and amorphous silica (Cinerama after treatment with HCl) is in the range of 10-15 Rel.% in the Northern and southern parts of the tailings;
• gold is associated with sulphides (extracted by cyanidation after treatment with HNO_3) is in the range of 15-27 Rel.% in the Northern Western and southern parts of the tailings.
Before testing of samples for direct cyanidation of gold was determined the gold content of the assay method and content related items using the analyzer "Leco".
It is known that microbiological processes occurring in the tailings, involving various microorganisms. However, a key role in the actual processes belong to a limited number of bacteria. Until recently, little attention has been paid to the Association of organotrophs included in the ore biocenosis of microorganisms and is most often detected during the examination of the tailings. In stale tails can be noted a similar, previously identified during the examination of the deposits, the relationship between the material composition of ores and physiological groups of microorganisms. Stale tails are characterized by the presence of such associations of microorganisms as ammonificators, the denitrifying microorganisms and oligonitrophilic, indicating that the tailing ponds creates favorable conditions for development of microorganisms, as a result of various transformations of metals, the dissipation and concentration. Of the associations

Tihonovich bacteria in all three studied TMF dedicated thionic bacteria mixotrophic from heterotrophic bacteria belonging to genera Bacillus and Pseudomonas (table. 5).

Table 5. The number of microorganisms in the effluents of various tailings of the mill (n * 102cl / g, ml)

№ п.п	Association of Microorganisms	Tailings						
		MZIU		AngrenGoldMill		ChadakGoldMill		HMP-2
		cyanide stock	chlorinated. stock	cyanidestock	chlorinatedstock	cyanidestock	chlorinatedstock	
1	AcidophilicIronOxidizing	-		-	-			-
2	Acid ophilicSulfur Oxidizing	2,5		-	-			-
3	Thiosulfate-oxidizing neutrophils: autotrophicmixotrophic	2,5 25	- -	60 60	- 0,25	6,0 0,25	- -	25 0,25
4	Thiocyanate	60	13	25	0,13	6,0	0,13	60
5	Nitrifying	1,3	0,13	2,5	0,25	6,0	0,13	60
6	Sulfate Reducing	2,5-	-	6,0	-	6,0		2,5
7 8	Ammonifying Denitrifying	60 25	0,13 -	70 2,5	0,13 -	6,0 25	0,13 -	60 3,0
9	Oligonitrophils	0,35	-	15	-	0,1	-	30
10	Microscopicmushrooms	2,0	-	20	-	200	-	60

Of tailings and fresh tail pulp was selected microorganisms with different degree of resistance to the metal ions and cyanides in the environment.

To identify the microorganisms were used in the research elective nutrient media including nutrient agar (for the detection of heterotrophic microorganisms growing on meat or fish extract), environment Gilta and Baalsrud for separation of heterotrophic and autotrophic denitrifying microorganisms, the environment Waxman for separation of sulphide-oxidizing microorganisms, the environment of London for tiolovykh of mixotrophs, Wednesday Capek for isolation of microscopic fungi and bacteria and the environment Balerinka to identify thiosulfinates bacteria.

For isolation and cultivation of microorganisms from areas of the chiricahua and Mescalero Apache used the following nutrient medium: Baalsrud, Waxman, of London, of Postgate, Gilta, KAA, Capek, Meat agar, Ashby, 9K Silverman-Lundgren, Løten, manning and environment for the cultivation of the individual geochemical types of active microorganisms (Karavaiko G. I., 1989).

Tribal affiliation isolated bacteria were identified using morphological and cultural characteristics respectively Bergeyet all 1980. The total number of microorganisms was determined by serial dilution method by sowing on liquid and dense nutrient medium. [3]

Determining the number of microorganisms in 1G (1ml) of the source substrate is carried out by serial dilution method by sowing on solid and liquid medium [78]. The number of microorganisms in liquid media was determined using table Mac-credit, and the number of CFU on solid media is calculated according to the formula in confidence level 95% (P (0,95):

$$(x \pm 2\, \sigma x-) \cdot To \cdot 1/V,$$

Where x= Σx / n is the average number of colonies that grew in the seeding of the dilution ;σx- = ±√ Σx / n standard deviation ; 2 - t – test at P 0,95 ; K - breeding , which conducted the sowing ; V - volume of the suspension taken for sowing, ml; Σx is the total number of counted colonies when seeding this breeding ; n is the number of replications.

the pH was determined by potentiometric for pH meter "Mettlertoledo".

The number of microorganisms in liquid media was determined using table Mac-credit. Cultivation of bacteria was carried out in stationary and cacalacky (180 rpm) conditions.

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The studies used cultures of bacteria of B. subtilis – strains 1 and 2 and the species of the genus Pseudomonas – strains 1 and 2. Were used standard solutions of rhodanides (Lurie Y., 1984).

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