American Journal Of Applied Science And Technology
(ISSN – 2771-2745)
VOLUME 02 ISSUE 10 Pages: 04-10
SJIF IMPACT FACTOR (2021: 5. 705) (2022: 5. 705)
OCLC – 1121105677 METADATA IF – 5.582
Publisher: Oscar Publishing Services

Journal Website: https://theusajournals.com/index.php/ajast

Research Article

HYDROMETALLURGICAL PROCESSING OF ENRICHMENT PRODUCTS

Submission Date: October 01, 2022, Accepted Date: October 05, 2022,
Published Date: October 09, 2022
Crossref doi: https://doi.org/10.37547/ajast/Volume02Issue10-02

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ABSTRACT

The article deals with the issues of hydrometallurgical processing of beneficiation products, the reasons for the loss of valuable components and the problems of rational use of natural mineral resources. The process, technological schemes, technological parameters and standard conditions for cyanidation of enrichment products are analyzed.

KEYWORDS

Hydrometallurgy, cyanidation, industrial waste, sorption, gravity concentrate, flotation, pulp, alkali, filtration, sodium cyanide, ion-exchange resin.

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INTRODUCTION

Worldwide recent years, the mining industry, the level of extraction of wolframite has decreased significantly. Many of them are worked out by artisanal methods, seasonally; stocks of ores (especially rich and easily enriched) are running out, and large concentrating enterprises have either been stopped or are not operating at full capacity. In this regard, the issues of using enrichment wastes have both economic and environmental aspects [1] .

In addition, due to the departmental affiliation of mining and processing enterprises, complex raw materials were processed only taking into account the necessary needs of the industry for a particular metal, which led to the irrational use of natural mineral resources and an increase in the cost of waste storage. Currently, more than 12 billion tons of waste have been accumulated, the content of valuable components in which in some cases exceeds their content in natural deposits [2] .

In the field of using ore-dressing wastes, the main thing is the technological and physical-mechanical study of each specific technogenic deposit. In turn, the results of the study will allow the development of an environmentally friendly and efficient technology for the development of an additional source of mineral raw materials [2] .

Results of the research and discussion. Experiments on cyanidation were carried out on enrichment products. Cyanidation by pulp mixing was carried out on a bottle agitator designed by IRGIREDMET. The experiments were carried out according to the standard method: a sample of material 100-200 g was mixed with a cyanide solution with the addition of a protective alkali. The concentration of sodium cyanide in the solution was determined in the presence of two indicators: Feigl's reagent and potassium iodide. The latter was supplied if subsequent determination of the protective alkali concentration in the same solutions was necessary. The pulp was reinforced by the concentration of cyanide and lime as they were consumed. In the starting material and cyanidation cakes , the content of noble metals was determined chemically using a Perkin-Elmer atomic absorption spectrometer .

Cyanidation of enrichment products. Products of gravitational and flotation enrichment of tailings of recleaning of gravity concentrate were subjected to cyanidation . Experiments were carried out, both direct and sorption cyanidation in the presence of AM-2B ion-exchange resin. The resin consumption in the experiments was 3% of the pulp volume.

The experiments were carried out according to the schemes of Fig. 1 and 2 .

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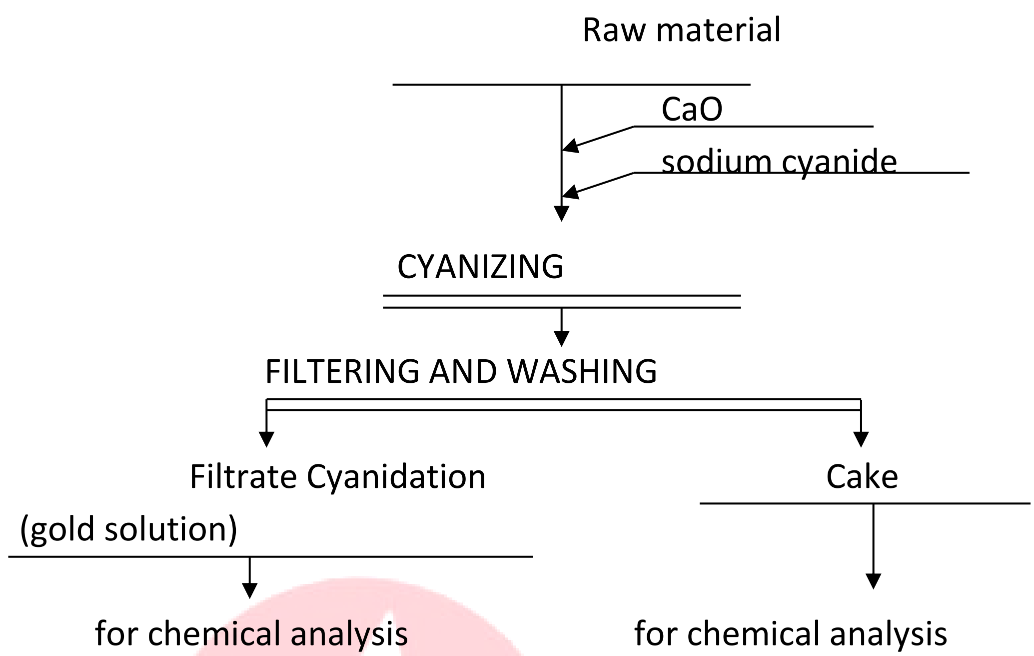
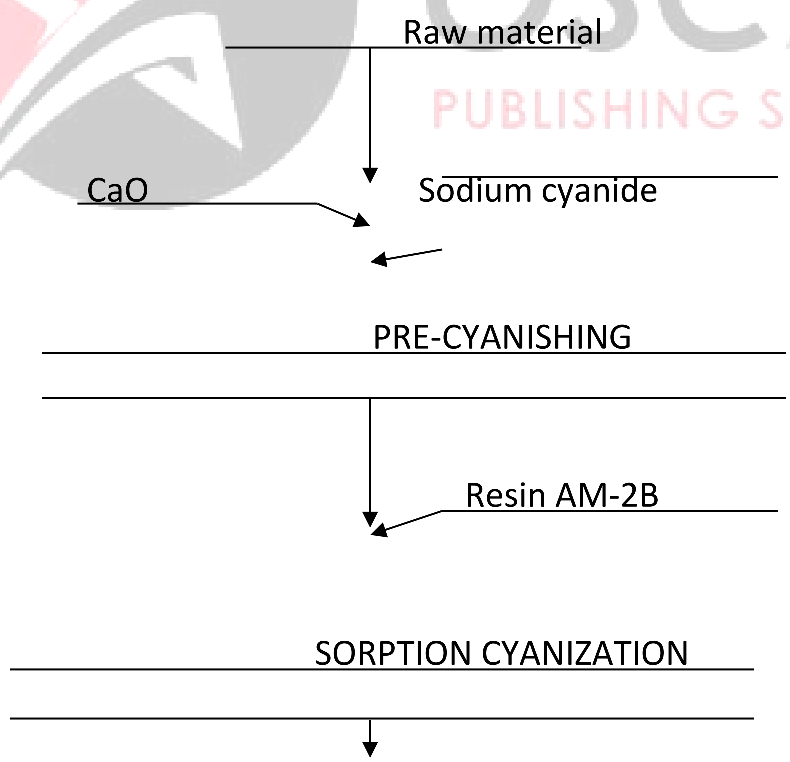


Fig.1. Scheme of experiments on cyanidation of enrichment products



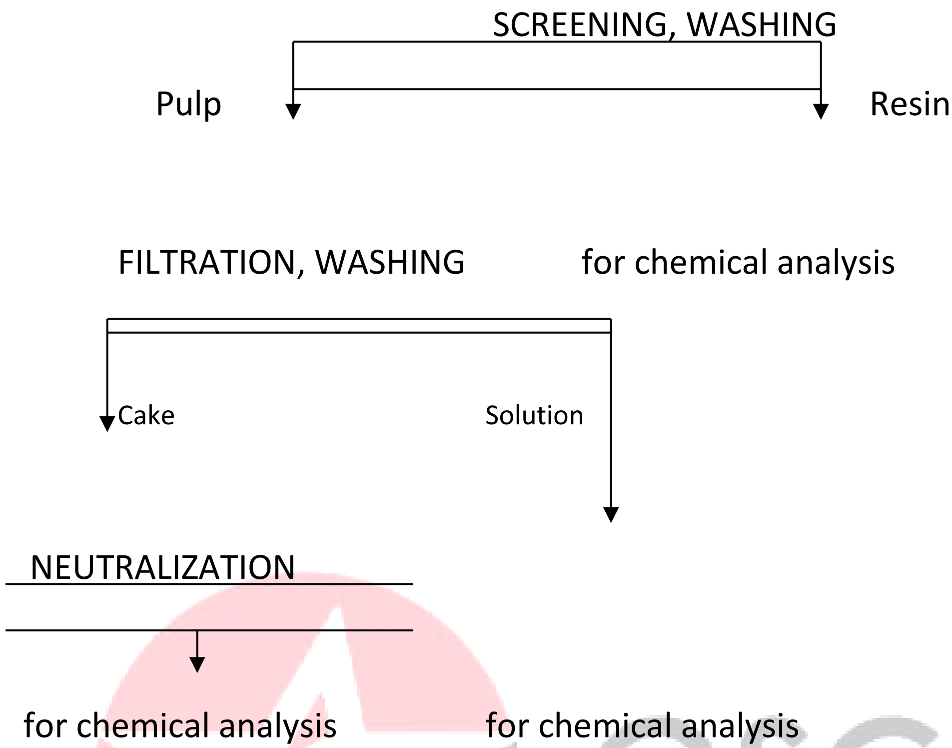


Fig. 2. Scheme of experiments on sorption cyanidation of enrichment products

In the experiments, the grinding size of the products varied, which amounted to -0.315 mm (initial size) and 90% of the -0.074 mm class. The concentration of sodium cyanide in the experiments was 0.06-0.2%. Also, for some products, intensive cyanidation was tested at a cyanide concentration of 0.6%.

The constant parameters were taken as follows: sample - 100-150 g, L:S = 2:1 and the concentration of protective alkali - 0.02%, the duration of the experiments - 24 hours.

At the end of the cyanidation process, the pulp was filtered, the cake was washed. After neutralization and filtration, the cake was dried.

In order to additionally open gold associated with sulfides with the oxidation of the latter and create favorable conditions for cyanidation and transfer of precious metals into a cyanide solution, experiments were carried out on oxidative roasting of sulfide flotation concentrate .

Oxidative firing was carried out in a laboratory muffle furnace at a temperature of 500-650°C for 2 hours. In order to activate the gold surface from the deposits formed during firing, the cinder was treated with a 3% solution of sulfuric acid at a temperature of 85-90°C, L:S = 5:1 and the duration of the process is 1 hour.

In table. Figures 1 and 2 show the results of experiments on cyanidation of enrichment products,

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respectively, at their initial fineness and with regrinding.

Table 1

The results of cyanidation of enrichment products at their initial fineness

Name products	Gold content, g/t	Extraction of gold into solution/resin , %	Experience conditions	
			C_{NaCN}, %	Resin loading in % of pulp volume
Table concentrate	69.15			
Cyanidation tailings	7.48	89.18	0.2	-
Tails of gravity	3.1			
Cyanidation tailings	1.0	67.74	0.15	-
Sulfide concentrate	73.6			
Cyanidation tailings	7.82	89.38	0.2	-
Cyanidation tailings	6.51	91.15	0.6	-
Cyanidation tailings	6.1	91.71	0.6	3
Finishing tails	4.26			
Cyanidation tailings	2.6	38.97	0.06	-
Cinder of sulfide concentrate	105.1			
Cyanidation tailings	6.4	93.91	0.2	-
Sulfuric acid treatment cake of sulfide concentrate cinder	116.7			
Cyanidation tailings	6.25	94.64	0.2	-

As can be seen from Table.1, the obtained gravity concentrate and sulfide concentrates, with their initial size, are cyanidated with high technological performance. During cyanidation of the table concentrate, 89.18% of gold is extracted into the solution. With intensive cyanidation of the sulfide

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flotation concentrate (CNaCN - 0.6%), 91.15% of gold is extracted into the solution, and 91.71% of gold is extracted on the resin in the sorption process. During cyanidation of the cinder of the flotation concentrate , the extraction of gold increases to 93.91%. During cyanidation of the cyanide of the sulfuric acid treatment of the cinder of the sulfide concentrate, the extraction of gold into the solution was 94.64%.

Table 2

Results of cyanidation of enrichment products with regrinding

Name products	**Gold content,** *g per tons*	**Extraction of gold into solution/resin**, *%*	**Experience conditions**	
			C $_{NaCN}$ **,** *%*	**Resin loading in % of pulp volume**
Table concentrate	69.15			
Cyanidation tailings	4.95	92.84	0.2	-
Tails of gravity	3.1			
Cyanidation tailings	0.86	72.26	0.15	-
Sulfide concentrate	73.6			
Cyanidation tailings	5.76	92.17	0.2	-
Cyanidation tailings	3.95	94.63	0.6	-
Cyanidation tailings	3.62	95.08	0.6	3
Finishing tails	4.26			
Cyanidation tailings	1.9	55.4	0.06	-
Cinder of sulfide concentrate	105.1			
Cyanidation tailings	4.45	95.77	0.2	-
Sulfuric acid treatment cake of sulfide concentrate cinder	116.7			
Cyanidation tailings	4.35	96.27	0.2	-

As can be seen from Table 2, the use of the operation of regrinding the enrichment products before cyanidation predetermined the receipt of a high gold recovery in comparison with the results of cyanidation of the enrichment products at their original size.

CONCLUSION

During cyanidation of the table concentrate, 92.84% of gold is extracted into the solution. With intensive cyanidation of the sulfide flotation concentrate (CNaCN - 0.6%), 94.63% of gold is extracted into the solution, and 95.08% of gold is extracted on the resin in the sorption process. During cyanidation of the cinder of the flotation concentrate , the extraction of gold increases to 95.77%. In cyanidation of the cyanide of the sulfuric acid treatment of the cinder of the sulfide concentrate, the extraction of gold into the solution was 96.27%.

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