Afyon Kocatepe Üniversitesi Uluslararası Mühendislik Teknolojileri ve Uygulamalı Bilimler Dergisi

Afyon Kocatepe University International Journal of Engineering Technology and Applied Sciences

AKÜ IJETAS Vol **1** (2018) Aralık (1-4 s) AKU J.Eng.App.Sci. **Vol 1** (2018) December (1-4 pp)

Araştırma Makalesi / Research Article

BAKIR ORE YALITIM ATIKLARINDAN BAKIR BAKTERİLERİNİN BAKTERİYEL LEVHA EDİLMESİ

B.M. Aikeshev

Zhezkazgan University named after O. Baikonurov
Zhezkazgan, Kazakhstan
e- mail: aikeshev@gmail.com

Geliş Tarihi: 15.09.18 ; Kabul Tarihi:30.10.18

Anahtar kelimeler
«Bakteriyel liç» «Thionew bacteria», «liç ceviz», «zenginleştirme atığı»

Özet

Zayıf ve karmaşık cevher işlemelerinde, binlerce ve hatta milyonlarca ton değerli metaller atık formunda kaybolur. Metallerin bakteriyel liçlenmesi bu kayıpları azaltır. Bu işlemin temeli, on yedinci bakteride bulunan sülfidik minerallerin oksidasyonuyla yapılır. Böylece çözünmeyen sülfidik formdaki metaller, suda iyi çözünür olan sülfatlara geçer. Sülfatik çözeltilerden metaller sedimantasyon, ekstraksiyon, emilim ile ekstrakte edilir. Aktif bir şekilde bakır özütleyen bakteri suşlarına dayanan biyolojik bir ürünün varlığı ve zenginleştirme atıklarından metallerin çıkarılma olasılığının temel koşuldur.

BACTERIAL LEACHING OF COPPER FROM WASTE OF ENRICHMENT OF COPPER ORE

Keywords
«Bacterial leaching», «thionew bacteria», «leaching coppe», «enrichment waste»

Abstract

In poor and complex ores processing thousands and even millions tons of valuable metals are lost in the waste form. Bacterial leaching of metals reduces these losses. The basis of this process is made by oxidation of the sulphidic minerals which are contained in ores thionew bacteria. Thus metals from an insoluble sulphidic form pass into sulfates, well soluble in water. From sulphatic solutions metals are extracted by sedimentation, extraction, sorption. Existence of a biological product on the basis of the bacterial strains which are actively leaching copper is the main condition of a possibility of extraction of metals from enrichment waste.

1. Introduction

In recent decades, many non-ferrous metal deposits located in developed areas have been depleted in favorable geological, climatic and transport conditions. The depletion of mineral resources at these sites, the increasing severity of economic and social problems, the tightening of environmental requirements and the energy difficulties of recent years require the search for new technological solutions [1].

Intensively conducted research in the field of biohydrometallurgy allows us to involve in the processing of huge reserves of off-balance sheet and waste ores, as well as middling and waste of processing plants. The well-known data in this area is sufficient to assume that the biological method is one of the most promising in the field of processing of poor ores and other sources of non-ferrous metals. This method is economically beneficial, eliminates environmental pollution and provides integrated use of mineral raw materials [2].

Of particular danger are flotation dumps and waste dumps of deposits, where the destruction of ore minerals on the surface of substandard ore and overburden occurs. The oxidation of sulphides produces soluble salts of iron, zinc, copper, cadmium, lead, sulphate ions. Mining industry waste is a man-made object that, in accordance with existing legislation, can be considered as a potential resource. Therefore, testing unconventional ways of recycling enrichment wastes and creating new technologies on their basis are urgent tasks. Their solution will allow the use of environmentally friendly microbiological methods in the mining industry in the region. The biological leaching of sulfide ores is a complex, multi-step process in which the release of metals into solution is accompanied by the sequential oxidation of sulfide sulfur contained in minerals to elemental sulfur and sulfates. Separate reactions can be carried out as one type of microorganisms, possessing a universal set of enzymes, and an association of several more specialized species [3].

The current period is characterized by the fact that all over the world complex geological and technological studies of raw materials of technogenic objects are carried out in technologically and economically efficient ways to engage in efficient processing of raw materials, resulting in comprehensive information on the quality and quantity of accumulated technogenic mineral resources in them are useful components and impurities, and other data that fully characterize the technogenic formation, as about CPC implementation perspective geotechnologies [4,5].

2. Status of the issue and review of scientific articles

The tailing of the Zhezkazgan concentrator (ZHOF) is located in the Karaganda region, 6 km south-east of the city of Zhezkazgan. Tailings were stored in the period from 1964 to 2007. During this period, 852 813.51 thousand tons of tailings with an average copper content of 0.128%, silver - 2.46 g / t were accumulated in the tailing [6].

Cu	Fe	Ca	Si	Al	Zn	Ag, г/т	Ti	S	Mn	Cr	Pb
0,12	2,90	2,92	28,94	6,21	0,067	2,13	0,31	0,36	0,13	0,017	0,082

Table 1. The chemical composition of the source tails Zhezkazgan processing plant,% [6].

Table 2. Phase composition of the sample of stale tails of the Zhezkazgan concentrator on the forms of copper compounds [6].

The name of the connections	Content,%	
ABS.	Rel.	
Oxidized compound	0.03	23.08
Secondarysulfides	0.09	69.23
Primary sulfides	< 0.01	7.69
Total	0.13	100.0

The obtained indicators indicate the possibility of effective development of old tailings of enrichment of the Zhezkzagansk concentrator to compensate for the retiring balance reserves of the existing mines.

Bioliching (bioleaching) of tailings according to literary data is a trend that is currently at the laboratory stage of development, and definitely is a new trend of modern biogeotechnological research. Scientists from Chile, China, Iran and other countries are actively developing technologies for extracting non-ferrous metals from tailings using bacterial leaching.

The simplicity of the equipment for bacterial leaching, the possibility of rapid reproduction of bacteria, especially when waste solutions containing living organisms are returned to the process, makes it possible not only to drastically reduce the cost of obtaining valuable minerals, but also significantly increase the raw material resources due to. The technology has the prospect of wider use in

2

many combined schemes, it can be used for processing ores, concentrates and tailings, sludge, slags containing sulfides of non-ferrous metals and other minerals oxidized with ferric iron, and elemental sulfur, for example, to improve the quality of molybdenum concentrates, selective extraction copper, zinc, nickel minerals, removal of impurities from mineral products such as arsenic, antimony, sulfur, for leaching of uranium [7].

We reviewed the scientific articles of several authors in 2017 on the topic of bacterial leaching of copper from enrichment tailings.

An international group developed a two-step protocol for leaching and extraction of metals to extract copper from tailings currently in Spain and Serbia. The most effective extraction of copper (from 84 to> 90%) was achieved by bioleaching tails at 45 ° C using a specific microbial consortium, where elemental sulfur was added to the tails, and the pH of the leach solutions allowed to drop to ~ pH 1, into which anaerobic were introduced conditions. The heat-resistant acidophilsAcidithiobacilluscaldus and Sulfobacillusthermosulfidooxidans appeared as the dominant bacteria present in both filtration filters under these conditions. Copper was then precipitated as a sulfide phase using hydrogen sulfide formed in a sulfide bioreactor with a low pH (4.0) [8].

The main goal of some work groups was to determine the optimal bacterial association of several bacterial strains for leaching copper from chalcopyrite. The main related species of bacteria involved in the bioleaching of sulfide ore (Acidithiobacillusferrooxidans, Acidithiobacillusthiooxidans, Leptospirillumferrooxidans and Leptospirillumferriphilum) have been established. It was found that the association with At. ferrooxidans and At. thiooxidans emit 70% of copper in 35 days from selected ore, which indicates significant differences with other associations, which isolated only 35% of copper in 35 days [9].

A thin layer heap leaching of copper flotation tailings containing high levels of fine grains was carried out on mixed cultures on a small scale for 210 days. The results showed that the chemolithotrophic genera Acidithiobacillus and Leptospirillum were always present and dominated in the microbial community in the initial and middle stages of the heap bioleaching process; both kinds may be responsible for improving copper recovery. However, the titers of Thermogymnomonas and Ferroplasma gradually increased in the final stages. [ten].

Protocols and methods are being actively worked out. So when recovering copper from low-grade sulfide ore of copper, it was found that several parameters affect the bioleaching of copper; among them pulp density and nutrient media selected for research. 5 g / ml, mixed mineral salt medium Acidithiobacillusthiooxidans (70 vol.%) And Acidithiobacillusferrooxidans (30 vol.%) And 10%% inoculum. Under these conditions, the maximum ability of the bioleaching medium for the extraction of copper was determined by about 99%. [11].

The preliminary preparation of chalcopyrite ground in a ball mill is considered. The initial samples (obtained) were thermally activated (600 ° C, 30 minutes) to notice a change in the physicochemical and mineralogical characteristics enclosing rock, and then the effect of this on copper recovery. The study showed that thermal activation leads to volume expansion in the rock with the development of cracks, micro- and macropores on its surface, which allows the bacterial solution to more easily penetrate into the body, which contributes to enhanced dissolution of copper [12].

2. Conclusions

The relevance of the topic of the proposed research is evident, as it is in the trend of the development of technologies and approaches in the matter of bacterial leaching of metals, copper in particular.

More than 100 firms in 25 countries are involved in the development of microbiological leaching processes. The advantage of the biotechnological method in comparison with the pyrometallurgical and autoclave ones is confirmed by the intensive introduction of biohydrometallurgical technologies in the production of gold from gold-arsenic materials. The task of the present time is to create a competitive, resource-saving and environmentally friendly production of non-ferrous metals using leaching. The method is easily automated and is able to completely

3

transform the entire technological chain of modern mining and processing of metal ores, to make it environmentally friendly and to achieve the highest indicators for the integrated extraction of useful components.

Systemic development and implementation of the technology of biological leaching of metals in Kazakhstan would sharply increase the competitiveness of Kazakhstan copper and other metals in the world market by reducing costs. The environmental component is also very important - it will be possible to abandon ore mining and by the open-pit and mining method, ore processing using the flotation method, and abandon the pyroprocess. That is, the modification of the environment is excluded, pollution of the biosphere is ceased by solid, liquid and gaseous emissions and waste.

Bibliographic list

1. Pavlichenko G.A. Leaching of sulphide copper and copper-zinc ores: On the example of the Safyanovskoye deposit, dissertation author's abstract for the degree of candidate of technical sciences, candidate of technical science, Ekaterinburg, 1998.

2. Hamuda Rajah AFA, The role of microorganisms in the leaching of gold from the ores of the northern regions of Kazakhstan, a thesis for the academic degree of the Doctor of Philosophy (Ph.D.) in the field of biology in the specialty “biotechnology”, Kazakh National University. Al-Farabi, Almaty, 2009.

3. Chetverikova D.V., Technology of Biological Leaching of Metals from Waste of Mining and Processing Industries, dissertation abstract for the degree of candidate of technical sciences, Shchelkovo, 2013.

4. Irfan Yolcubal, Demiray, Emi-,iftçi, Mill, Northeastern Turkey, Environmental Earth Sciences 3/2017

5. Hanjiang Pan, Zhongong Cheng, Guohua Zhou, Rong Yang, Binbin Sun, Ling He, Daoming Zeng, Jing Wang, Geochemistry and Mineralogical Characterization of tailings, China, DOI: 10.1144, 2017

6. Yun AB, Development and justification of the parameters of the mining system of integrated development of the Zhezkazgan field in conditions of replenishment of the outgoing capacities of the mines, the dissertation for the degree

Doctors of Technical Sciences, Karaganda, 2016, Research Center for Innovative Technologies of KazHydroMed LLP

7. A.A. Sultanbekov, Bacterial-chemical leaching of non-ferrous metals, KazNTU. K.I. Satpayev, 2010

8. Carmen Falagán, Barry M.Grail, Barrie Johnson, New approaches for extracting and recovering metals from mine tailings, Minerals Engineering Volume 106, 15 May 2017, Pages 71-78,

9. E. Romo, D.F. Weinacker, A.B. Zepeda, C.A. Figueroa, P. Chavez-Crooker, J.G. Farias Bacterial consortium for copper extraction from sulphide ore consisting mainly of chalcopyrite, Brazilian Journal of Microbiology 44, 2, 523-528 (2013) , SociedadeBrasileira de Microbiologia, Universidad de La Frontera, Temuco, Chile.

10. Xiao-dong, HaoYi-li, Liang Hua-qun, Yin Hong-wei, LiuWei-min, Zeng Xue-duan Liu, International Journal of Minerals, Metallurgy, and Materials, Thin-layer heap bioleaching of copper flotation tailings containing high levels of fine grains and microbial community succession analysis, April 2017, Volume 24, Issue 4, pp 360–368

11. SamanBeikzadehNoei, Saeed Sheibani, FereshtehRashchi, and Seyed Mohammad JavadMirazimi, Kinetic modeling of copper bioleaching from low-grade ore from the Shahrbabak Copper Complex, International Journal of Minerals, Metallurgy and Materials, Volume 24, Number 6, June 2017, Page 611

12. Sandeep Panda , Nilotpala Pradhan, UmaballavMohapatra, Sandeep K. Panda, Swagat S. Rath, Danda S. RAO, Bansi D. Nayak, Lala B. Sukla, Barada K. Mishra, Bioleaching of copper from pre and post thermally activatedlow grade chalcopyrite contained ball mill spillage, Frontiers of Environmental Science & Engineering, April 2013, Volume 7, Issue 2, pp 281–293

4