

FEATURES OF ELECTROOXIDATION LEACHING OF METALS**Jakhongir Kurbanov**

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ОСОБЕННОСТИ ЭЛЕКТРООКСИДАЦИОННОГО ВЫЩЕЛАЧИВАНИЯ МЕТАЛЛОВ**Курбанов Жахонгир Хамитович**

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ABSTRACT

With the production of deposits by methods of environmentally safe hydrometallurgical processing, decrease the share of valuable components in raw materials, including Mo-, Cu - containing and stubborn gold, which is an important development of adequate hydrochemical technologies for its oxidation and leaching [1].

Sulfide minerals are prone to surface passivation due to the sulfur barrier layer. Overcoming it is more often achieved by roasting, less often by hydrometallurgical methods. Sample preparation of ore minerals for chemical analysis is traditionally carried out by leaching in "aqua regia". This work proposes, for comparison, an alternative method of electrooxidation - leaching them in a 10 % NaCl solution. Samples. Were used the original Mo concentrate (MOC), molybdenum cake of the sludge field, and Mo cinder of the plant in the form of weighed portions of averaged. Was used the method of generating sodium hypochlorite in electrolysis cells of a potentiostat PI-50-1, with graphite electrodes. Was performed sample analysis on Perkin-Elmer 3030B and Agilent 7500 ICP MS spectrometers. It has been established that the "hypochlorite" method of sample preparation, in comparison with GOST 2082.3 and GOST 2082.16, has an advantage: a minimum of consumables, the possibility of analysis in one sample of Mo, Re, Au [2].

АННОТАЦИЯ

По мере выработки месторождений методами экологически безопасной гидрометаллургической переработки снижается доля ценных компонентов в сырье, в том числе Mo-, Cu- содержащем и упорном золотоносном, что является важным разработку адекватных гидрохимических технологий его окисления и выщелачивания [1].

Сульфидные минералы склонны к пассивированию поверхности за счет барьерного слоя серы. Преодоление его чаще достигается обжигом, реже - гидрометаллургическими способами. Пробоподготовка рудных минералов

к химическому анализу традиционно осуществляется выщелачиванием в «царской водке». В данной работе предложен, для сравнения, альтернативный метод электроокислации-выщелачивания их в растворе 10 % NaCl. Используются исходный Мо-концентрат (МОК), молибденовый кек шламового поля и Мо-огарок комбината в виде навесок усредненных проб. Применялся метод генерирования гипохлорита натрия в электролизных ячейках потенциостата ПИ-50-1, с графитовыми электродами. Анализ проб выполнен на спектрометрах Perkin-Elmer 3030В и Agilent 7500 ICP MS. Установлено, что «гипохлоритный» метод подготовки проб, по сравнению с ГОСТ 2082.3 и ГОСТ 2082.16, имеет преимущество: минимум расходных материалов, возможность анализа в одной пробе Мо, Re, Au [2].

Keywords: molybdenite concentrate, molybdenum cake, electrooxidation, passivation, hypo sodium chlorite, sample preparation.

Ключевые слова: Молибденитовый концентрат, молибденовый кек, электроокислация, пассивация, гипохлорит натрия, пробоподготовка.

On today in the world is increasing interest in finding alternatives to the existing scheme of processing of sulphide ore based on oxidative roasting and development of the kinetics of oxidation-reduction reactions at electrically conductive surfaces chalcogenides, in particular, metal sulfides, composed of natural minerals. With the development of deposits by methods of environmentally safe hydrometallurgical processing, the share of valuable components in raw materials, including Mo-, Cu-containing and stubborn gold, decreases, which is important to production adequate hydrochemical technologies for its oxidation and leaching.

In the world for the development of scientific representations about the kinetics of the reactions of oxidation of sulphides of transition metal research is underway are redox-processes on their surface in the in aquatic environments, in the presence of oxidants. For the same purpose, are carried out electrochemical research of cathodic and anodic reactions by the method of a rotating disk electrode made of electrically conductive synthetic metal sulfides.

Today in the republic have been achieved results in the theory and practice of hydro-chemical technologists recycling metal-sulfide ores, including the stubborn gold raw materials from local deposits. The Action Strategy for the further development of the Republic of Uzbekistan provides for the following tasks: "the rise of industry by transferring it to a qualitatively new level, to further intensification of the production of finished products based on deep processing of local raw materials, and the release of new types of products and technologies". In connection with this, important research fundamental characteristic directed at reasonable choice oxidation regimes Cu -, Mo, Au-containing ores and concentrates [1].

Sulfide minerals are passivated under oxidizing conditions due to the sulfur barrier layer on the surface. Its overcoming is achieved under conditions conducive to further oxidation of sulfur: 1-by roasting, 2-in an autoclave, 3- by hydrometallurgical methods. Roasting, of which is the most common method, used for processing Pb-Mo ore, molybdenite concentrate (MOC), including JSC "Almalyk MMC". Its disadvantages include the burden on the environment. They began to industrially oxidize MOC in an autoclave, with the addition of an HNO₃ catalyst, in the POX \ SX process - under pressure. The autoclave is convenient for experimental processes, for example, the reduction of Re to metal in a sulfur melt, LSO conversion of Re. Hydrometallurgical processes are ecologically and economically beneficial, since at ordinary pressure and temperature they

are able to vary the Redox-potential of the system, achieving the desired result. Recently, hypochlorite generated by electrolysis of 10% NaCl has come to this role. It was of interest to test it as an alternative to "aqua regia" used in the preparation of ore minerals. [2]

It is known that gold in refractory ore is present in dispersed and isomorphic form and is mainly associated with pyrite and arsenopyrite. Conventional cyanide leach technology assumes that the leach agent comes into contact with a gold particle, dissolving it and forming a gold-cyanide compound. However, when processing refractory ores, cyanide is unable to penetrate the sulfide particles and contact with gold. As a result, cyanidation is either impossible at all or has low recovery rates.

The Albion process is a combination of ultrafine grinding and oxidative leaching at atmospheric pressure. [3].

The key to the Albion Technology is the ultrafine grinding stage. The superfine grinding process results in a high degree of deformation introduced into the crystal lattice. As a result, the number of surface fractures of grains and crystal lattice defects increases in magnitude by several orders of magnitude in relation to non-ground minerals. An increase in the number of defects in the crystal lattice "activates" the mineral, promoting leaching. Due to the sharp increase in the surface area of the mineral, the leaching depth also increases.

Ultrafine grinding also minimizes the passivation of the mineral surface by sulfur-based leach products. Usually, sediments that form on the surface of the leached mineral slowly passivate the mineral, preventing the access of chemicals to the surface of the mineral. Passivation usually ends when the thickness of the sediment layer reaches 2 - 3 microns. Ultrafine grinding of the mineral to 80% finer than 8-12 microns eliminates passivation, as the leached mineral is destroyed before the sediment layer becomes sufficient to passivate the mineral.

The oxidative leaching stage is carried out in agitation vats operated at atmospheric pressure. Oxygen is introduced into the reaction slurry to promote oxidation. Leaching occurs autothermally, so that the temperature of the reaction slurry is set by the amount of heat released during the leaching reaction. Heat from external sources does not enter the reaction vessel. The temperature is controlled by the flow rate of added oxygen and the density of the reaction slurry.

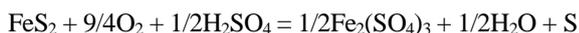
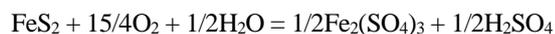
When applied to the recovery of precious metals, the Albion Technology can be used over a wide pH range, depending on the mineralogy of the feed source. Where pyrite

is the main refractory gold-bearing mineral in the concentrate, oxidative leaching is usually carried out in an alkaline environment. The leaching conditions are adjusted to ensure the formation of goethite as the main product of the iron reaction. Alkaline conditions increase the rate of pyrite leaching due to the constant neutralization of the acid formed during pyrite oxidation. Most preferred for use in oxidative leaching are cheap alkalis such as limestone and lime.

Where the processed concentrate contains significant amounts of arsenic or recoverable non-ferrous metals, oxidative leaching is carried out under acidic conditions, followed by neutralization of the pulp prior to cyanide leaching.

Below are some of the major oxidation reactions that occur in the Albion Process oxidative leach of refractory gold concentrate. For simplicity, it is assumed that the main carriers of precious metals are pyrite, arsenopyrite, and telluride varieties, although the studies were carried out on samples of concentrates containing a wide range of refractory sulfides.

Pyrite Leaching - Acidic Conditions



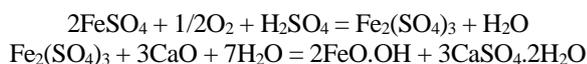
The first reaction is the main pyrite leach reaction, however, the leach conditions can be set in favor of the second reaction and, if necessary, minimize oxygen consumption.

Arsenopyrite leaching - acidic conditions

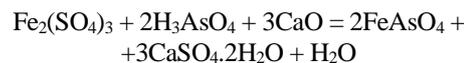
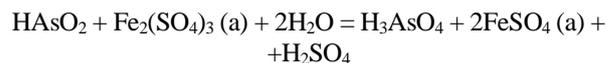


At the end of the leaching step, the iron and acid generated by the oxidative leach are neutralized with limestone or lime before cyanidation of the neutralized residue. The main neutralization reactions are:

Ferrous oxidation and precipitation in the form of goethite

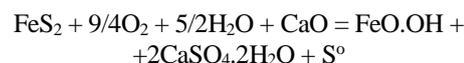
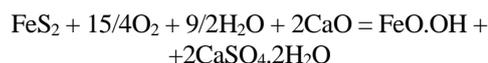


Arsenic oxidation and binding in the form of iron arsenate



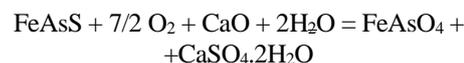
Where the processed concentrate does not contain significant amounts of arsenic or recoverable non-ferrous metals, oxidative leaching is carried out under alkaline conditions with a pH value maintained above 4. The main leaching reactions are:

Pyrite Leaching - Alkaline Conditions

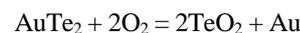


In an alkaline environment, the first reaction is predominant.

Arsenopyrite Leaching - Alkaline Conditions



Telluride Leaching - Alkaline Conditions



The telluride and selenide phases are easily oxidized under the alkaline conditions that occur during leaching using the Albion Technology [4].

Albion Process leaching is usually carried out at a slurry density of 25–35% by weight, depending on the sulfide content of the concentrate. At the outlet of the Albion Process leach, the pH is raised to 8–10 in the last oxidative leach tank to suppress any sulfate phases prior to the cyanide leach stage. Thus, the final slurry can be fed directly to the cyanidation stage without separating the solid from the liquid.

Upon completion of the oxidative leaching, the final residue contains predominantly goethite and is stable against environmental impact, and any arsenic that can be released in the liquor is bound in the solid phase in the form of iron arsenate [4].

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