Flexicone Fe-regeneration plant for the regeneration of ferrous oxide Fe2+ to Fe3+ for the oxidation of polymetallic, sulphide ores and concentrates

Various technologies are currently used for the oxidation of sulfide refractory ores: roasting, autoclave oxidation, ultrafine grinding with oxidation in solution, bacterial oxidation, and others. Each of the above has its own advantages and disadvantages. We have developed an electrochemical technology that combines the advantages of several technologies, such as low cost of the process combined with low capital costs, environmental safety, high degree of sulfide oxidation, as well as scalability and process automation. This allows the technology to be used both for small artels and for large companies.

In the developed hydrometallurgical technology Flexicone Fe-regeneration, the transfer of ionic iron to the highest oxidation state is a necessary step for the regeneration of the Fe2+ solution, after being used as an oxidizing agent:

1. in the oxidation of sulfide ores

2. in sulfate and chloride solutions for the extraction of non-ferrous metals and platinum metals from concentrates

3. in thiourea and chloride Fe3+ leaching systems for gold and silver

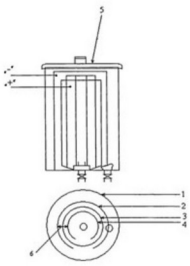
As is known, Fe2+ is easily oxidized by air in a neutral or alkaline medium. However, the oxidation of ferrous salts with oxygen proceeds very slowly along complex, multi-stage routes and strongly depends on the composition of the reaction medium and other process conditions. It is especially difficult to oxidize Fe2+ in chlorate and sulfate solutions; in these cases, the oxidation rate can be inversely proportional to the square of the concentrations of H+ and Fe2+.

To achieve deeper degrees of conversion, it was proposed to use expensive oxidizing agents, in particular iodate, chlorate, nitric acid, ozonized air, hydrogen peroxide, chlorine dioxide, pyrolusite, and also to introduce various additives (alcohols, thyron, EDTA and similar ligands). Attempts have been made to solve this problem by using homogeneous catalysts (copper salts, porphyrins, nitrogen oxides and nitrous acid). Of the heterogeneous catalysts for this purpose, they tried to use shales, activated carbons, but all of them turned out to be extremely ineffective. For example, under conditions of air oxidation of FeSO4 (0.1 mol/l) in a solution of H2SO4 with a concentration of 0.15 mol/l at 35°C in the presence of activated carbon (subjected to heat treatment in vacuum to increase activity), the conversion of Fe2+ to Fe3+ in three days was only 25% , although this is 10 times more than in the absence of a catalyst. It was found that the modification of the carbon surface with nitrogen-containing groups increases the reaction rate by an order of magnitude, but the absolute activity remains low and, as a rule, decreases with time.

Exothermic process of Fe2+ oxidation in air (self-heating temperature 72C)

When studying the oxidation of Fe(2) with oxygen, we found that, under electrochemical action, bimetallic systems deposited on a porous carrier turned out to be the most effective, with an oxidation rate an order of magnitude higher than that of bacterial oxidation. The whole process takes place in an open system at ambient temperature and normal atmospheric pressure. This makes it possible to use the technology for ore leaching both in vat mode and in heap leaching.

Flexicone Fe-regeneration Pilot Plants for Ferrous Oxide Regeneration



1 - корпус
2 - катод
3 - диафрагма
4 - анод
5 - крышка

Реактор с электродами и ионопроницаемой диафрагмой

The world has accumulated a huge amount of technogenic tailings of non-ferrous metals flotation and gold cyanidation. As a rule, the processing of such tailings by existing technologies is unprofitable or requires huge capital investments.

We offer an integrated approach to tailings processing using Flexicone Fe-regeneration technology.

In the process of processing technogenic tailings, even with a low content of target metals, profitability is achieved through the most complete processing of waste to obtain finished marketable products:

1. Precious Metals : Gold, Silver and PGM

2. non-ferrous metal powder or ingots

3. iron in the form of: metal powder, iron hydroxide or FeSO4 salt

4. sulfur in the form of gypsum or salt

5. electrochemically generated electricity

The profitability of processing sulphide tailings depends on many factors. The most important, on which the percentage of extraction of metals depends, is the oxidation process and the degree of opening of sulfides: pyrite, chalcopyrite, etc.

With the use of Flexicone Fe-regeneration technology, the cost of the sulfide stripping process in heap leaching is minimized to 50 rubles / ton of sulfides.

At the same time, an important stage is the extraction of copper, etc., non-ferrous metals from solutions in the process of oxidation of sulfides electrolytically and using a cation-exchange resin.

With the use of low-hazard Fe2(SO4)3 solutions in open systems, the maximum environmental safety of the process has been achieved

Sulfide iron and sulfur are removed from the solution in the form of salt FeSO4, powdered iron or hydroxide, gypsum CaSO4

With the use of Flexicone Fe-regeneration and Flexicone Thiourea Leaching technology, the maximum degree of 99% extraction of gold and silver from refractory ores and concentrates has been achieved at minimal cost and absolute safety of the process.

Our campaign offers Flexicone Fe-regeneration plants with volumes from 1m3