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Bacterial Recovery of Copper Ores

Authors : Zh. Karaulova, D. Baizhigitov

Abstract : At the Aktogay deposit, the oxidized ore section has been developed since 2015; by now, the reserves of easily enriched ore are decreasing, and a large number of copper-poor, difficult-to-enrich ores has been accumulated in the dumps of the KAZ Minerals Aktogay deposit, which is unprofitable to mine using the traditional mining methods. Hence, another technology needs to be implemented, which will significantly expand the raw material base of copper production in Kazakhstan and ensure the efficient use of natural resources. Heap and dump bacterial recovery are the most acceptable technologies for processing low-grade secondary copper sulfide ores. Test objects were the copper ores of Aktogay deposit and chemolithotrophic bacteria Leptospirillum ferrooxidans (L.f.), Acidithiobacillus caldus (A.c.), Sulfobacillus Acidophilus (S.a.), which are mixed cultures were both used in bacterial oxidation systems. They can stay active in the 20-400C temperature range. These bacteria were the most extensively studied and widely used in sulfide mineral recovery technology. Biocatalytic acceleration was achieved as a result of bacteria oxidizing iron sulfides to form iron sulfate, which subsequently underwent chemical oxidation to become sulfate oxide. The following results have been achieved at the initial stage: the goal was to grow and maintain the life activity of bacterial cultures under laboratory conditions. These bacteria grew the best within the pH 1,2-1,8 range with light stirring and in an aerated environment. The optimal growth temperature was 30-33oC. The growth rate decreased by one-half for each 4-5°C fall in temperature from 30°C. At best, the number of bacteria doubled every 24 hours. Typically, the maximum concentration of cells that can be grown in ferrous solution is about 107/ml. A further step researched in this case was the adaptation of microorganisms to the environment of certain metals. This was followed by mass production of inoculum and maintenance for their further cultivation on a factory scale. This was done by adding sulfide concentrate, allowing the bacteria to convert the ferrous sulfate as indicated by the Eh (>600 mV), then diluting to double the volume and adding concentrate to achieve the same metal level. This process was repeated until the desired metal level and volumes were achieved. The final stage of bacterial recovery was the transportation and irrigation of secondary sulfide copper ores of the oxidized ore section. In conclusion, the project was implemented at the Aktogay mine since the bioleaching process was prolonged. Besides, the method of bacterial recovery might compete well with existing non-biological methods of extraction of metals from ores.

Keywords : bacterial recovery, copper ore, bioleaching, bacterial inoculum
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