

# Application of Bioleaching for Recovery of Valuable Product

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**Abstract:** Bioleaching is process of sustainable technology used for recovery of verity of valuable product. This paper is review of application of bioleaching. In earlier phase of bio hydrometallurgy development, Bioleaching is used for recovery of copper ore. Now a day, it is further extended towards the extraction of aluminum, uranium, gold etc.

**Keywords:** Bioleaching, microorganism, copper

## 1. Introduction

The first observation of leaching has been seen during the installation of pipe in mines. Further this method is used for recovery of metal from low or lean grade ore. Now a day's leaching is extensively used for extraction of certain metal from sulphide mineral and other mineral. Leaching process is further subjected to use microorganism to enhance the rate of reaction, known as bioleaching. The treatment of low grade ore produced during separation of high grade ore by chemical method is not economic feasible. So another profitable method for extraction of metal is bioleaching. Commercially, copper and uranium can be produced by bioleaching. [1]

## 2. Bioleaching of copper

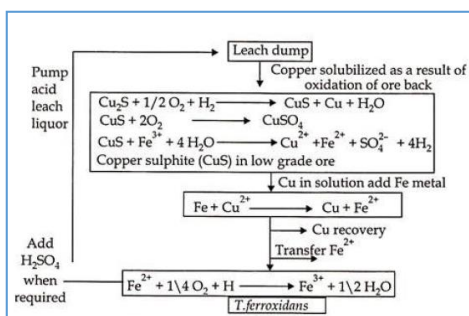


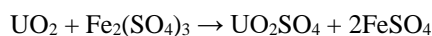
Fig. 1. Bioleaching of copper

Copper ores such as chalcopyrite, covellite and chalcocite are consist of copper and other matter. For an example, chalcopyrite contains 26% copper, 26% iron, 33% sulfur and 2.5% zinc. Bioleaching of copper ore is extensively used in many developed and developing county. Bioleaching of copper ore is done with help of the microorganism known as *Thiobacillus ferrooxidans* which oxidizes chalcopyrite ( $\text{CuFeS}_2$ ) and lead to form copper sulfate ( $\text{CuSO}_4$ ). Sulfuric acid is also formed in this reaction as by product, wish lead to

produce acidic condition, required for growth of culture [4]. It is done by heap and in-situ leaching. Through the process of bio leaching, copper can be easily extracted. The extraction of copper is very simple and economical process.

### A. Bioleaching of uranium

Uranium bioleaching is another method for industrial scale production of uranium from its ore. It is used in India, USA, Canada and several other countries. This process is mainly used to recover uranium from low grade ore and low grade nuclear waste. In-situ bioleaching technique is generally used for extraction of uranium from its ore. In this process insoluble tetravalent uranium is oxidized (in the presence of hot  $\text{H}_2\text{SO}_4/\text{Fe}^{3+}$  solution) to soluble hexavalent uranium sulfate.



The process of bio leaching of uranium ore is indirect process science the the microbial action is carried out on the iron oxidant not directly on the uranium. For optimal condition for extraction of uranium by bioleaching are temperature 45-50°C, pH 1.5-3.5, and  $\text{CO}_2$  around 0.2% of the incoming air. After completion of leaching the uranium solution is treated with organic solvent. Heap leaching can be also carried out as uranium recovery is more in heap leaching

### B. Bioleaching in desulfurization of coal

Desulfurization is a process through which sulphur is removed from pyrite present in high sulfur coal. It can be carried out by bioleaching of coal using microorganism *Thiobacillus ferrooxidans* and *T. thiooxidans* [3]. In this process ferrous sulphate is rapidly converted in ferric sulphate and thus this lead to remove sulphur. So bio leaching helps to generate environmental friendly coal.

### C. Bioleaching process to recover valuable metals from Indian Ocean nodules

As land based recourses are consumed rapidly there is highly demand for alternate sources. To look forward ocean nodule is greatly important. Recovery of copper, nickel and cobalt from polymetallic Indian Ocean nodules can be done by bioleaching method.

#### D. Bioleaching process for germanium recovery from brown coal

Certain coal mines such as Kaiyuan Coal Mine contain certain amount of rare metals, such as Ge and Ga. The conventional approach for recovery of germanium required following process

- Brown coal is burned
- Sulfuric acid leaching
- Germanium precipitation
- Roasting

The above method is very complex process and gives low recovery which is a waste of resources the recovery can be enhanced by using micro-organism

#### E. Bio-leaching of manganese ore

The bioleaching of manganese ore can be carried out by reduce the manganese dioxide to the soluble  $Mn^{2+}$  form [2]. The bioleaching is carried out with help of such as *Bacillus*, *Micrococcus*, *Pseudomonas*, *Achromobacter*, *Enterobacter*. Manganese solubilization can be achieved by heterotrophic microorganisms, but the cost of nutrients such as glucose, and

other refined sugars, makes their application prohibitively expensive [5].

### 3. Conclusion

So bioleaching is extensively useful process for recovery of valuable metal from ore. It is widely used in extraction of copper, uranium, germanium, manganese etc. since it is slow process it can be used for Low grade ore.

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