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BIOLEACHING OF ZINC: ECO FRIENDLY MINING

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ABSTRACT

The research work presented in this paper is on a Biomining The estimated annual demand for zinc in India is approximately 2.41 lakh tones; against this, the present installed capacity in the country for zinc ingots is 1.49 lakh tonnes only. There is, thus still a wide gap in the demand and supply of this metal in the country. Leaching zinc from the waste and low grade ore is required to meet the demand, but is not being explored because of the expensive measures and pollution hazards. Bioleaching is not only an enviro- friendly technology but an actual economical alternative for treating low grade ores and other wastes. The key role is being played by the micro organism - Acidophilus ferroxidans.

KEYWORDS: Bioleaching, Microbes.

INTRODUCTION

The microorganism that is primarily associated with these leaching processes, is able to oxidize ferrous ions and reduced sulphur compounds. The product of oxidation of ferrous ions is ferric ions, which are a strong oxidant capable of oxidizing sulphide minerals. Application of microbial processes by the mineral industry ¬¬- biohydrometallurgy - predates the understanding of the role of micro organisms in metal extraction, commonly referred to as bioleaching.

One of the earliest records of the practice of leaching is from the island of Cyprus. Galen, a naturalist and physician reported in AD 166 the operation of in situ leaching of copper. Surface water was allowed to percolate through the permeable rock, and was collected in amphorae. In the process of percolation through the rock, copper minerals were dissolved so that the concentration of copper sulphate in solution was high. The solution was allowed to evaporate until copper sulphate crystallised. Mineral Biotechnology is an emerging field of research with promising technological potential for mineral industries. Biotechnology has made significant progress in the biomineral processing for extraction of different metal values from a variety of ores and mining wastes. Application of biotechnology can be of industrial significance in bioleaching for metal extraction, bio-beneficiation of low-grade ores, bioremediation of contaminated soil, utilization of solid waste and treatment of effluent and wastewater for metal decontamination. The main advantages of biotechnological process lie in their economic viability and environmental friendliness. In all these processes Thiobacillus ferrooxidans play a key role with physiological characters, growth, development and efficiency contributing to the activity. Mineral biotechnology is a promising area for utilization of minerals, low-grade ores, and other wastes in an ecofriendly and economic

Bioleaching occurs naturally when micro organisms assist in the slow weathering of out-cropping sulphide ore bodies. Thiobacillus ferrooxidans, the microorganism that is primarily associated with these leaching processes, is able to oxidize ferrous ions and reduced sulphur compounds. The product of oxidation of ferrous ions is ferric ions, which are a strong oxidant capable of oxidizing sulphide minerals. In this research study the isolation of mining bacteria, water samples were collected from two different mines. Mine water samples were collected from Gorbi B Mine (District – Singraulli, M.P, India) and Surda mines, Ghatsila (District – Singhbhum, Jharkhand, India). These mine waters were collected in amber coloured bottles (cleaned with liquid soap and rinsed with boiling distilled water) from different locations. These water samples were kept plugged with cotton.

Bioleaching is the extraction of metals from sulphide ores or concentrates, using components found readily within the environment. These components are principally:

- Water
- Air and
- Micro organisms

In chemical terms, the process can best be described as a ferric leach, with the re-oxidation of ferrous back to ferric, being catalysed by micro-organisms. Elemental sulphur is frequently a by-product of bioleaching and micro-organisms are responsible for its oxidation to sulphuric acid. The major areas of metabolism of the micro-organisms are the oxidation of ferrous iron, the oxidation of sulphur and the fixation of carbon dioxide.

A system for the bioleaching of sphalerite is shown in Figure 1.1 below:

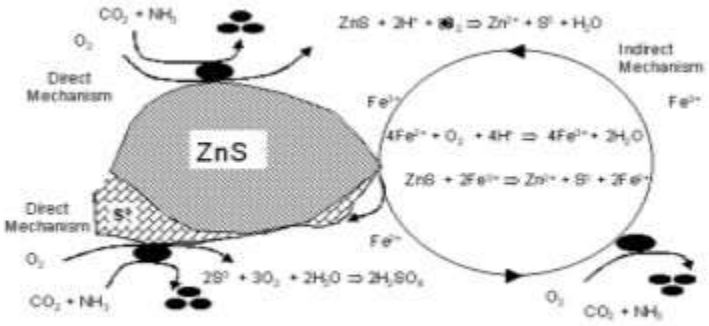

Figure 1.1 Bioleaching of Sphalerite

There are two dominant views on the mechanisms involved in bioleaching. The first view is that the overall leaching process occurs by the microbial oxidation of ferric ions and the chemical leaching of the mineral; it is referred to as the indirect mechanism. The second view envisages the microbial catalysis of the overall dissolution of the mineral. It has been proposed that the micro-organisms interact with the mineral directly, enhancing the rate of dissolution, over-and-above that achieved by chemical leaching. The second mechanism is referred to as the direct mechanism.

Bioleaching occurs naturally when micro organisms assist in the slow weathering of out-cropping sulphide ore bodies. Such micro-organisms can also lead to undesirable situations, brought about by the bioleaching of waste dumps to produce so-called acid mine drainage. When confined in a processing plant, this natural and often undesirable process can be harnessed and used for the extraction of metals from sulphide ores or concentrates. These Tiny miners have shown their efficiency in leaching about 80% of zinc from low grade zinc ore of HINDUSTAN ZINC LIMITED. The same if carried out on large scale can be utilized not only in procuring zinc from waste but also in clearing the land area which is occupied by mine waste .

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