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Opinion Article

Application of Microorganisms in Bioleaching of Heavy Metals

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DESCRIPTION

A quick and efficient method for removing metal from low-grade ores and mineral concentrates is bioleaching. *Thiobacillus ferrooxidans* and *T. thiooxidans*, two chemolithotrophic bacteria, are primarily responsible for the conversion of insoluble metal sulphides into soluble metal sulphates, which is the basis for metal recovery from sulphide minerals. Both fungi and heterotrophic bacteria can handle the treatment of non-sulfide ores and minerals. In these situations, the synthesis of organic acids and the release of chelating and complexing chemicals into the environment are the causes of metal extraction. Heap, dump, and in situ leaching are currently used primarily for the recovery of copper, uranium, and gold through bioleaching. For the treatment of refractory gold ores, tank leaching is used. Additionally, bioleaching offers some potential for metal recovery and detoxification of heavy metal-contaminated soil, sewage sludge, and industrial waste products.

Due to industrial, agricultural, and home activities, heavy metal poisoning in soil and water has caused serious environmental problems and is hazardous to human health. Toxic heavy metals must therefore be removed from the soil and water. Heavy metals cannot be chemically or biologically degraded, making their removal from the environment more difficult than that of other environmental pollutants [1]. Toxic heavy metals can be removed from soil and water using a variety of physical-chemical treatment methods, but these methods have certain inherent downsides, such as low capability and high costs. In recent years, several biotechnological methods for removing heavy metals from the environment, such as bioremediation and phytoremediation, have drawn a lot of attention due to their potential industrial applications as well as their scientific origins. The conversion of harmful metal ions to harmless or less toxic metal ions is carried out by sulfur-oxidizing bacteria. It has been years since this procedure began [2]. They are the natural means of purifying the atmosphere. Bioleaching is one of the most effective biotechnological methods for removing heavy metals. Bioleaching is the process of easily extracting metals from sulphide minerals by causing an increase in the production of less harmful metals by uncontrolled bacteria. The Thiobacillus genus includes the bacteria that are heavily utilised in the bioleaching process [3].

For the successful removal of metals from sediment, municipal solid, and sludge, the bioleaching process utilising acidophilic sulphur oxidising bacteria (*Acidithiobacillus ferrooxidans*, *Acidithiobacillus thioosidans*), as well as neutrophilic microorganisms (*Aspergillus niger*), has been extensively investigated. By using elemental sulphur and thiosulfate in the bioleaching process, sulphur oxidising bacteria oxidise and create acid for the solubilisation of heavy metals. The bioleaching method frequently involves parallel bio-oxidation reactions based on direct or indirect oxidation [4]. Therefore, in order for widespread sulphur oxidising bacteria to grow during this solubilisation process of bioleaching, the right circumstances must be present.

A recent invention that has been developing swiftly is bioleaching. It is used all over the world to remove toxic synthetic compounds from old mine locations as well as to recover metals from abandoned old mine wastes. Bioleaching can be thought of as the acceleration of a typical ecological process using bacteria that separate sulphide minerals from metal. Bioleaching is currently being used by businesses to extract copper from low-grade minerals, despite the fact that the process is moderate but has proven to be practical. In terms of recovering major metals, bioleaching is not only taken into consideration for its ability to leach significant metals. There is demand for more reasonably priced and environmentally friendly processes. Advanced development is essential for both organic and specialised features. The final one includes accelerating filtering and increasing the resistance of microorganisms to heavy metals [5]. The improvement of a hereditary framework for *T. ferrooxidans* has seen significant progress in the meantime. Hereditary change of bioleaching microscopic organisms, whether by transformation and choice or by hereditary designing will produce results more quickly than conventional methods like screening and modification. Accordingly, bioleaching is a naturally secure innovation for recovering commercial quantities of metal from metal minerals

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by leaching. There is growing interest in modifying technology to extract heavy metals from robust wastes. However, because of various unique barriers, bioleaching is not yet ready for such applications.

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