



# Bioleaching

## Contents

- ❖ Introduction
- ❖ History
- ❖ General properties of microorganisms
- ❖ Principles of Microbial Metal Leaching
- ❖ Mechanism of Bioleaching
- ❖ Bacterial attachment on Metal surface
- ❖ Specific organisms
- ❖ Organisms used in Bioleaching
- ❖ Commercial process of Bioleaching
- ❖ Main factors affecting Bioleaching
- ❖ Advantages and disadvantages
- ❖ Bioleaching of Heavy metals
- ❖ Operating cost
- ❖ Future Development
- ❖ References

Bioremediation

Biosorption

Biohydrometallurgy

Bioaccumulation

**Bioleaching**

**Biohydrometallurgy is comprised of different disciplines which are classified according to the interaction between metals and microbes.**

## What is Bioleaching?

**Bioleaching** is a process described as “the dissolution of metals from their mineral sources by certain naturally occur microorganisms” or the use of microorganisms to transform elements so that the elements can be extracted from a material when water is filtered through it.”



Image No-1 Ref-<https://phys.org/news/2014-11-bioleaching-bugs-viable-method.html>

- Bioleaching is the simple and effective technology for metal extraction from low grade ores by using microorganisms.
- Bioleaching is a process based on the ability of microorganism to transform solid compounds into soluble and extractable elements, which can be recovered.

# History

- The role of bacteria in bioleaching was found in 1947.
- In 1950 copper dump leaching was found.
- First industrial gold bioleaching plant in 1980.

## **GENERAL PROPERTIES OF MICROORGANISMS**

- Chemolithotrophic( rock eating)
- Autotrophic
- Acidiphilic ( acid loving)

## Principles of Microbial Metal leaching

- Mineralytic effects of bacteria and fungi on minerals are mainly based on three principles, acidolysis, complexolysis, and redoxolysis. Microorganisms are able to mobilize metals through the following processes:
  1. Formation of organic and inorganic acids (proton formation)
  2. Excretion of complexing agents (ligand formation)
  3. Oxidation and reduction reactions
- Generally, sulfuric acid is the main inorganic acid formed in the leaching environment. It is formed by sulfur oxidizing microorganisms such as thiobacilli. Also, a series of organic acids are formed by bacterial and fungal metabolism resulting in organic acidolysis, and complex and chelate formation.
- Proton induced and ligand-induced mineral solubilization occurs simultaneously in the presence of ligands under acidic conditions.



- The bio oxidation of reduced iron to generate ferric(III) iron by chemolithotrophic bacteria in slightly acidic conditions is a well known phenomenon.
- Ferric ion is a strong oxidizing agent that is responsible for mineral sulfide dissolution. The ferric iron is reduced during the reaction but the effective microbes ensure continuous regeneration of ferric ions. Also, many strains have the ability to reduce ferric (III) ions to ferrous (II) ions in anaerobic conditions.
- The process can be expressed as follows:-

