Biomining :- The process of extracting metals from ores or other solid materials by using micro-organisms is called Biomining.

Low grade ores $\xrightarrow[\text{micro-organism}]{\text{using}}$ Extraction of Metal

Application of Biomining :- Biomining in Copper industry

Problem :- copper mining typically involves conventional methods such as open pit mining and smelting (processes of extraction by heating). This methods produce large amounts of waste, consume significant energy and can have adverse impacts on local ecosystem and communities.

Solution :- Biomining offers a sustainable (not harmful effect on environment) and efficient alternative for copper extraction.

Biomining is an innovative technique that uses micro-organisms (i.e bacteria or fungi) to extract metals from their ores.

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Technology overview

1) **Bioleaching :-** Biomining primarily utilizes a process called bioleaching, where specialized bacteria oxidize metal in the ores, releasing the metal ions into solution.

The ability of micro-organisms to solubilize (or dissolve) metals from insoluble metals (or ores) is known as bioleaching.

$$MS + 2O_2 \xrightarrow{\text{micro-organism}} MSO_4$$

↑ Metal sulphide (Not soluble in water)

↑ Metal sulphate (soluble in water)

The two most commonly used micro-organisms in biomining are :-

i) Thiobacillus thiooxidans
ii) Thiobacillus ferrooxidans

Different Bioleaching Methods :-

i) **slope leaching :-** In slope leaching finely ground ores are dumped in large piles in a slopes & continuously sprinkled with water containing Thiobacillus.

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ii) Heap leaching :- The ore is arranged in large heaps and treated as in slope leaching.

iii) In situ leaching :- In situ leaching ore is subjected to bioleaching in its natural occurrence. Aqueous solution of micro-organisms is pumped through drilled passages with in the ore. The leach liquid collected at the bottom of the ore used for metal extraction.

2) Metal Recovery :- once the metal ions are dissolved, they can be removed from the leach solution using various techniques such as precipitation, solvent-extraction or electro-plating.

Benefits:-

i) simple process
ii) Inexpensive technique
iii) Environment friendly process
iv) Reduce waste generation & harmful pollutants in environment

Disadvantages

i) Time consuming (take 6-24 months or longer
ii) Have a very low yield of minerals.

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Conclusion :- Biomining represents a sustainable and innovative approach to metal extraction, offering environmental, economic and social benefits for the mining industry.

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