

Bioremediation

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Why in news?

- A new technique has been used to fight against pollution.

What is bioremediation?

- Bioremediation is the **use of living microorganisms to degrade the environmental contaminants into less toxic forms.**
- It uses naturally occurring **bacteria and fungi or plants** to degrade or detoxify substances hazardous to human health and/or the environment.
- The **microorganisms may be indigenous** to a contaminated area **or they may be isolated from elsewhere and brought to the contaminated site.**
- Contaminant compounds are transformed by living organisms through reactions that take place as a part of their metabolic processes.
- Bioremediation can be **effective only where environmental conditions permit microbial growth and activity.**
- The application often involves the manipulation of environmental parameters to allow microbial growth and degradation to proceed at a faster rate.
- **Techniques:** There are two types of Bioremediation:
 - **In-situ bioremediation** – If the process of Bioremediation occurs in the same place affected by pollution.
 - Different types are:
 - **Bio-venting** which involves supplying oxygen and nutrients by aqueous solutions through contaminated soils to accelerate naturally occurring microorganisms to degrade organic impurities.

- **Bio-sparging:** It involves the pressurized injection of air below the water table to increase the content of groundwater oxygen concentration and also increase the rate of biological degradation of wastes by naturally occurring microorganisms.
- **Bio augmentation:** It involves the continuous addition of microorganisms (indigenous or exogenous) to the contaminated sites.
 - **Ex-situ bioremediation** – If the process involves deliberate relocation of the contaminated material (soil and water) to a different place.
 - Different types are:
 - **Land farming** – It is a simple technique in which contaminated soil is excavated and then spread over an already prepared bed and at regular intervals tilled until pollutants are degraded.
 - **Composting:** It is a procedure that involves bringing together contaminated soil with non-hazardous organic materials such as manure or agricultural wastes.
 - **Bio piles:** They are a mixture of land farming and composting. Fundamentally, engineered cells are built as aerated compost piles.
 - **Bioreactors** – A slurry bioreactor is a containment vessel and machinery used to create a three-phase (solid, liquid, and gas) mixing

condition to expand the bioremediation rate of soil-bound and water-soluble pollutants.

▪ **Pros of bioremediation:**

- It is cost effective as no construction or additional infrastructure is required.
- These microbes are effective in controlling odour, reducing BOD, oil/ grease accumulation in sewage/ polluted water and solids.
- These microbial consortia exhibit growth at wider temperature range.
- These strains **maintain a satisfactory level of Dissolved Oxygen (DO)** and therefore **aerators**, which consume high power, **can be avoided** or its use can be reduced.
- Controlling the nutrient level in water helps in **controlling the “Eutrophication” process.**
- **The remains of the treatment are generally harmless products** and include products such as carbon dioxide, water, and cell biomass.
- It can **over and over again be carried out on site**, often without causing a major disturbance of normal activities.
- This also gets rid of the need to transport quantities of waste and the possible threats to human health and the environment that can take place during transportation.

▪ **Cons of bioremediation:**

- Restricted to those compounds that are biodegradable.
- There are some apprehensions that the products of biodegradation may be more lasting or toxic than the parent compound.
- Takes much more time than other treatment options, such as pyrolysis or incineration.
- Significant site factors required for success comprise the presence of metabolically capable microbial populations, suitable environmental growth conditions

and suitable levels of nutrients and pollutants.