TSU Applied bioscience and biotechnology
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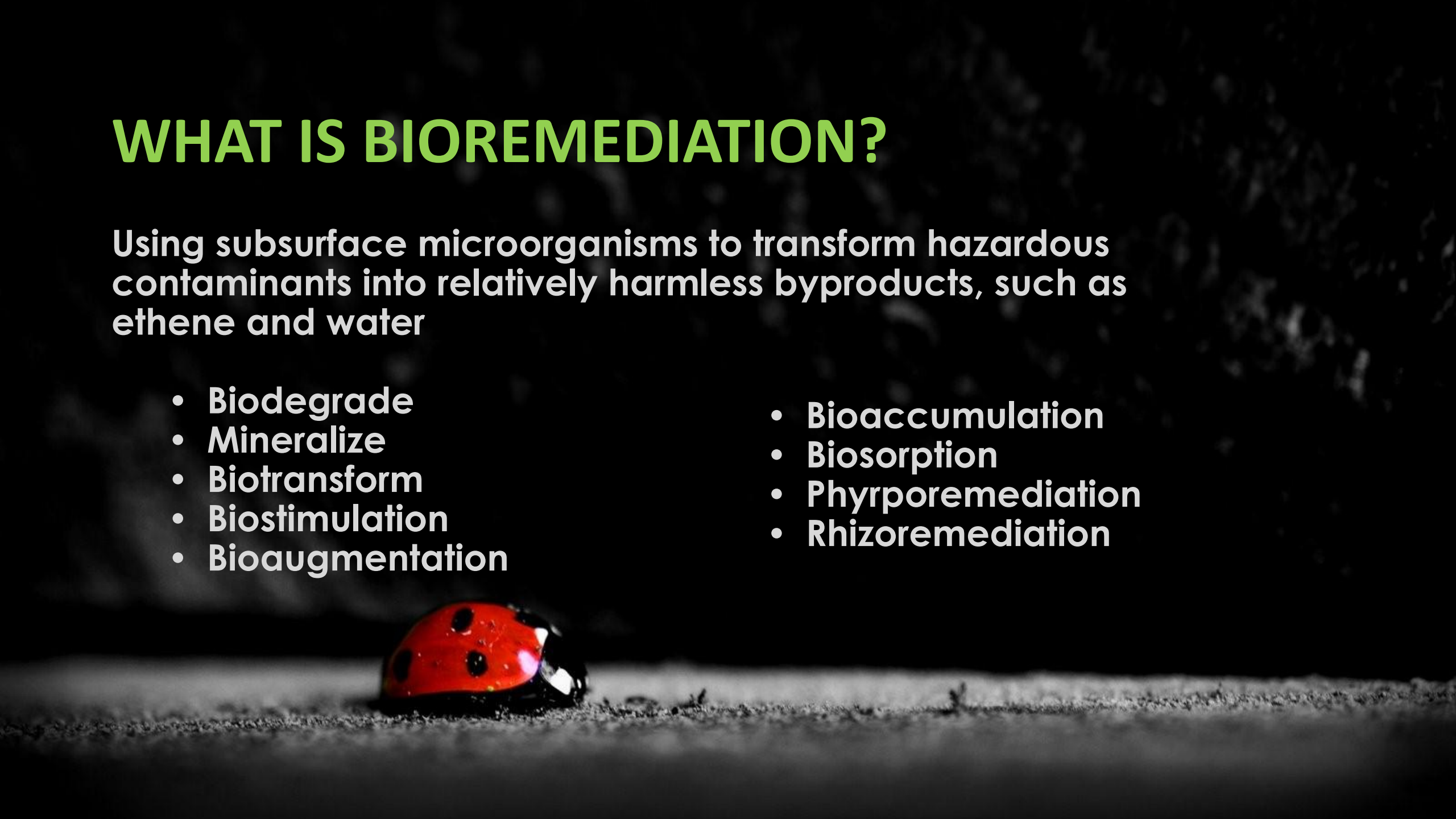
BIOREMEDIATION

WHAT IS BIOREMEDIATION?

Using subsurface microorganisms to transform hazardous contaminants into relatively harmless byproducts, such as ethene and water

- Biodegrade
- Mineralize
- Biotransform
- Biostimulation
- Bioaugmentation

- Bioaccumulation
- Biosorption
- Phyrporemediation
- Rhizoremediation

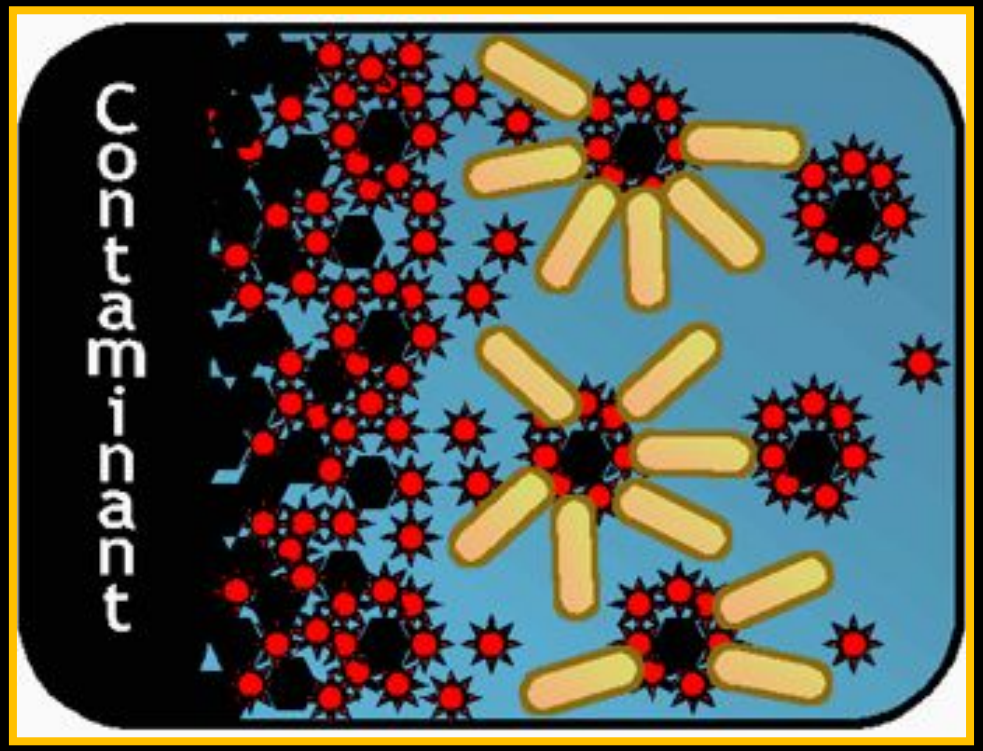


EXAMPLES OF BIOREMEDIATION TECHNOLOGIES

- Phytoremediation
- Bioventing
- Bioleaching
- Landfarming
- Bioreactor
- Composting
- Bioaugmentation
- Rhizofiltration
- biostimulation

PRINCIPLE OF BIOREMEDIATION

For bioremediation to be effective, microorganisms must enzymatically attack the pollutants and convert them to harmless products.

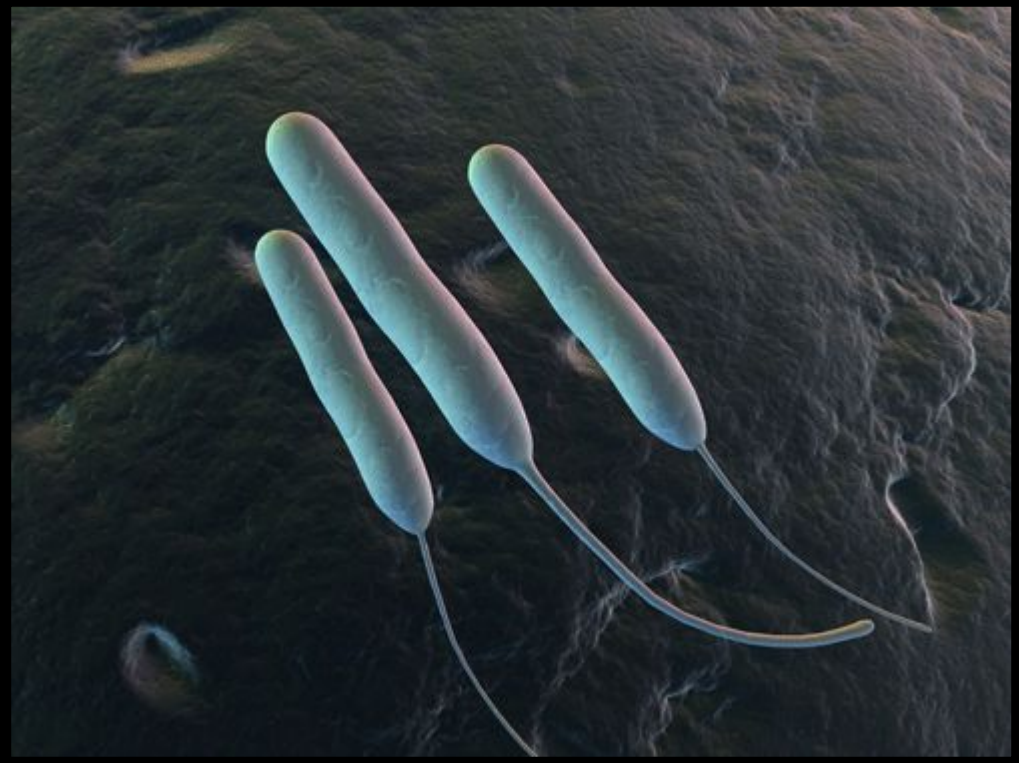


FACTORS OF BIOREMEDIATION

Factors	Condition required
Microorganisms	Aerobic or Anaerobic
Natural Biological processes of microorganism	Catabolism and Anabolism
Environmental Factors	Temperature, pH ,Oxygen content, Electron acceptor/donor
Nutrients	Carbon ,Nitrogen ,Oxygen etc
Soil Moisture	25-28% of water holding capacity
Type of soil	Low clay or silt content

MICROORGANISM GROUPS:

Aerobic. **In the presence of oxygen. Examples of aerobic bacteria recognized for their degradative abilities are *Pseudomonas*, *Alcaligenes*, *Sphingomonas*, *Rhodococcus*, and *Mycobacterium*. These microbes have often been reported to degrade pesticides and hydrocarbons, both alkanes and compounds. Many of these bacteria use the contaminant as the sole source of carbon and energy.**



Pseudomonas Aeruginosa

MICROORGANISM GROUPS:

Anaerobic. **In the absence of oxygen. Anaerobic bacteria are not as frequently used as aerobic bacteria. There is an increasing interest in anaerobic bacteria used for bioremediation of polychlorinated biphenyls (PCBs) in river sediments, dechlorination of the solvent trichloroethylene (TCE), and chloroform.**

Enterobacter

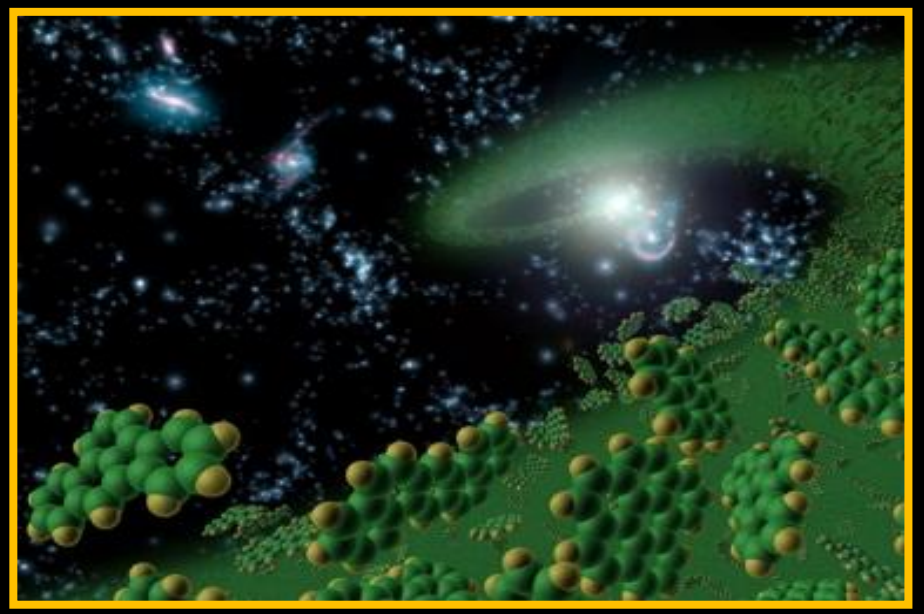
MICROORGANISM GROUPS:

Ligninolytic fungi. **Fungi such as the white rot fungus *Phanaerochaete chrysosporium* have the ability to degrade an extremely diverse range of persistent or toxic environmental pollutants. Common substrates used include straw, saw dust, or corn cobs.**

Phanaerochaete chrysosporium

MICROORGANISM GROUPS:

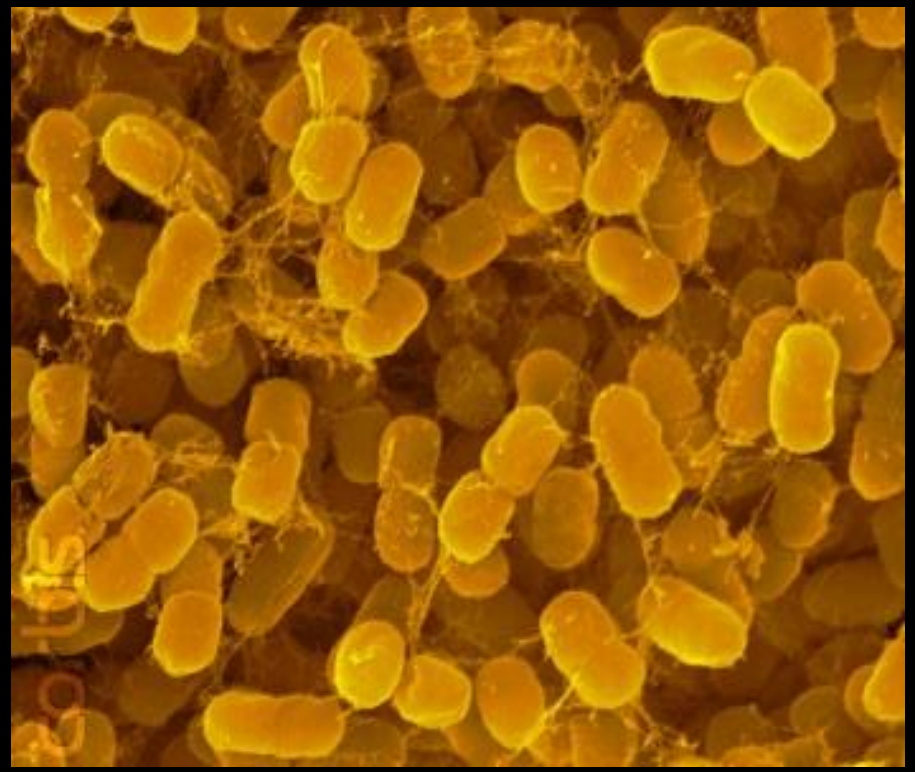
Many of the higher molecular PAHs (five or more rings) are considered to be mutagenic and carcinogenic.



White-rot fungi have been found to posses a good potential for PAH-contaminated soil bioremediation due to their ligninlytic exoenzymes e. g. lignin peroxidases, manganese peroxidases (MnPs) and laccases.

MICROORGANISM GROUPS:

Methylotrophs. **Aerobic bacteria that grow utilizing methane for carbon and energy. The initial enzyme in the pathway for aerobic degradation, methane monooxygenase, has a broad substrate range and is active against a wide range of compounds, including the chlorinated aliphatics trichloroethylene and 1,2-dichloroethane.**



BIOREMEDITION STRATEGIES

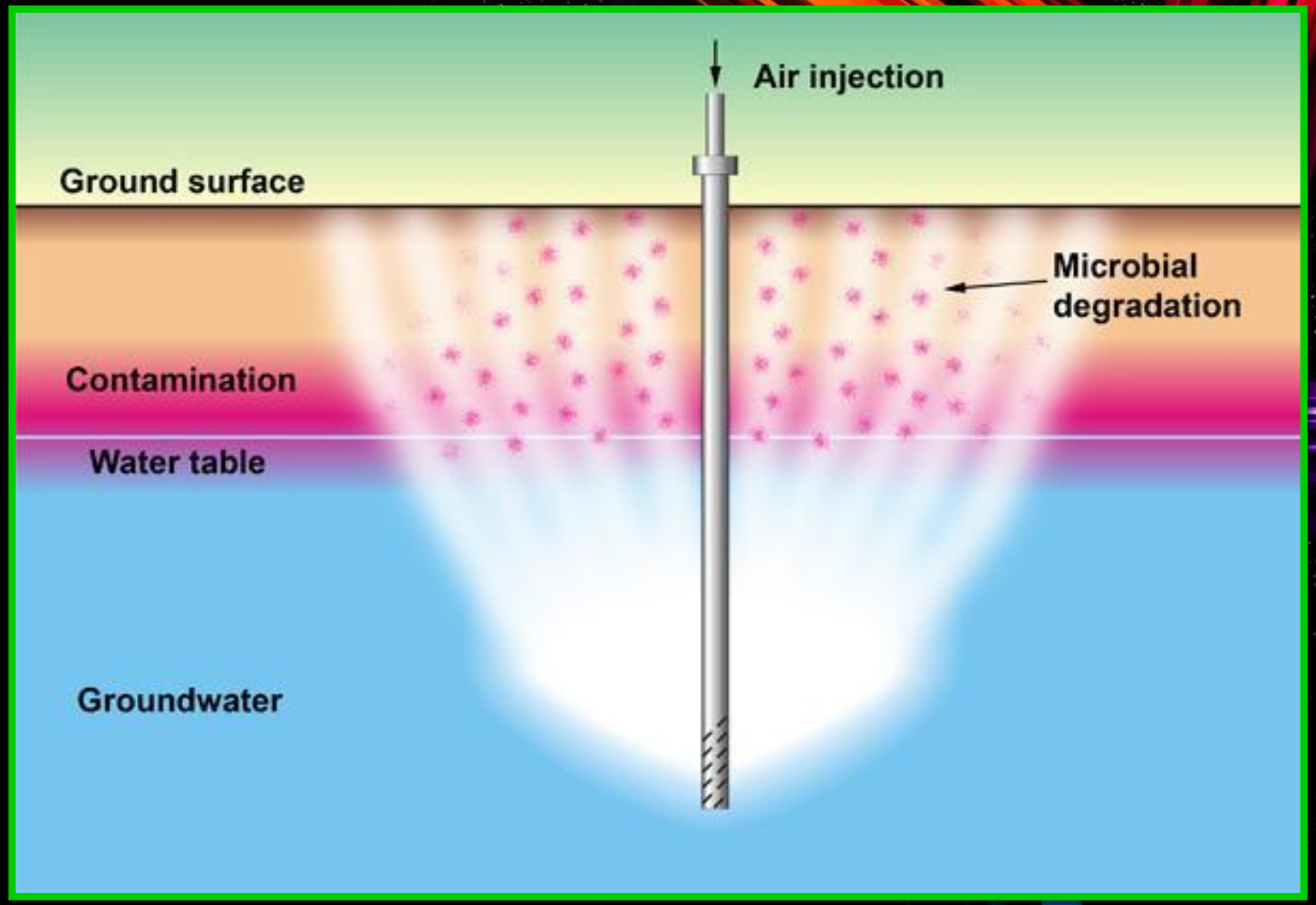
In-Situ Bioremediation

In situ bioremediation is the application of biological treatment to the cleanup of hazardous chemicals present in the subsurface.

- Biosparging
- Bioventing
- Bioaugmentation
- Biopiling

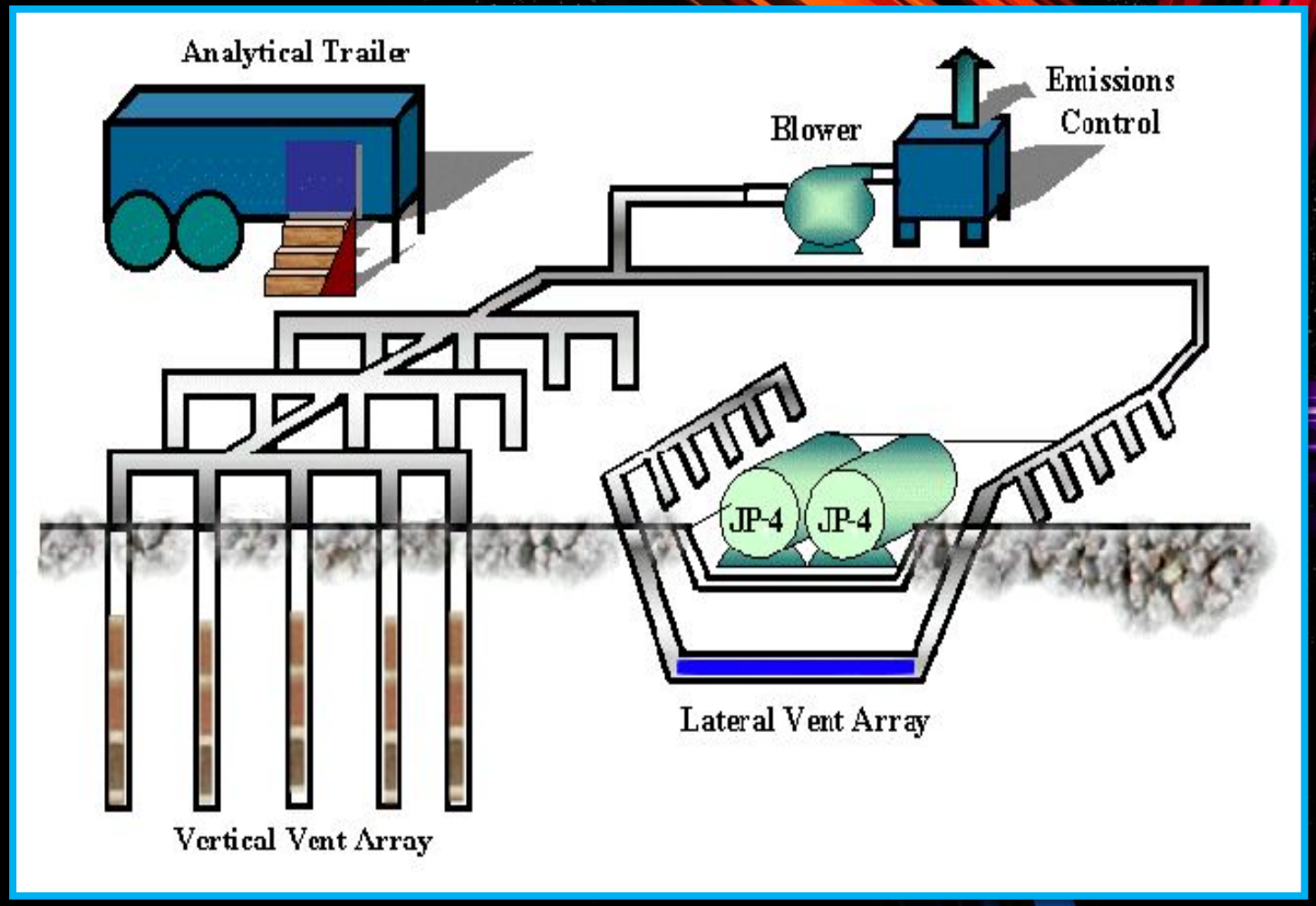
BIOSPARGING

Involves the injection of air under pressure below the water table to increase groundwater oxygen concentrations and enhance the rate of biological degradation of contaminants by naturally occurring bacteria.



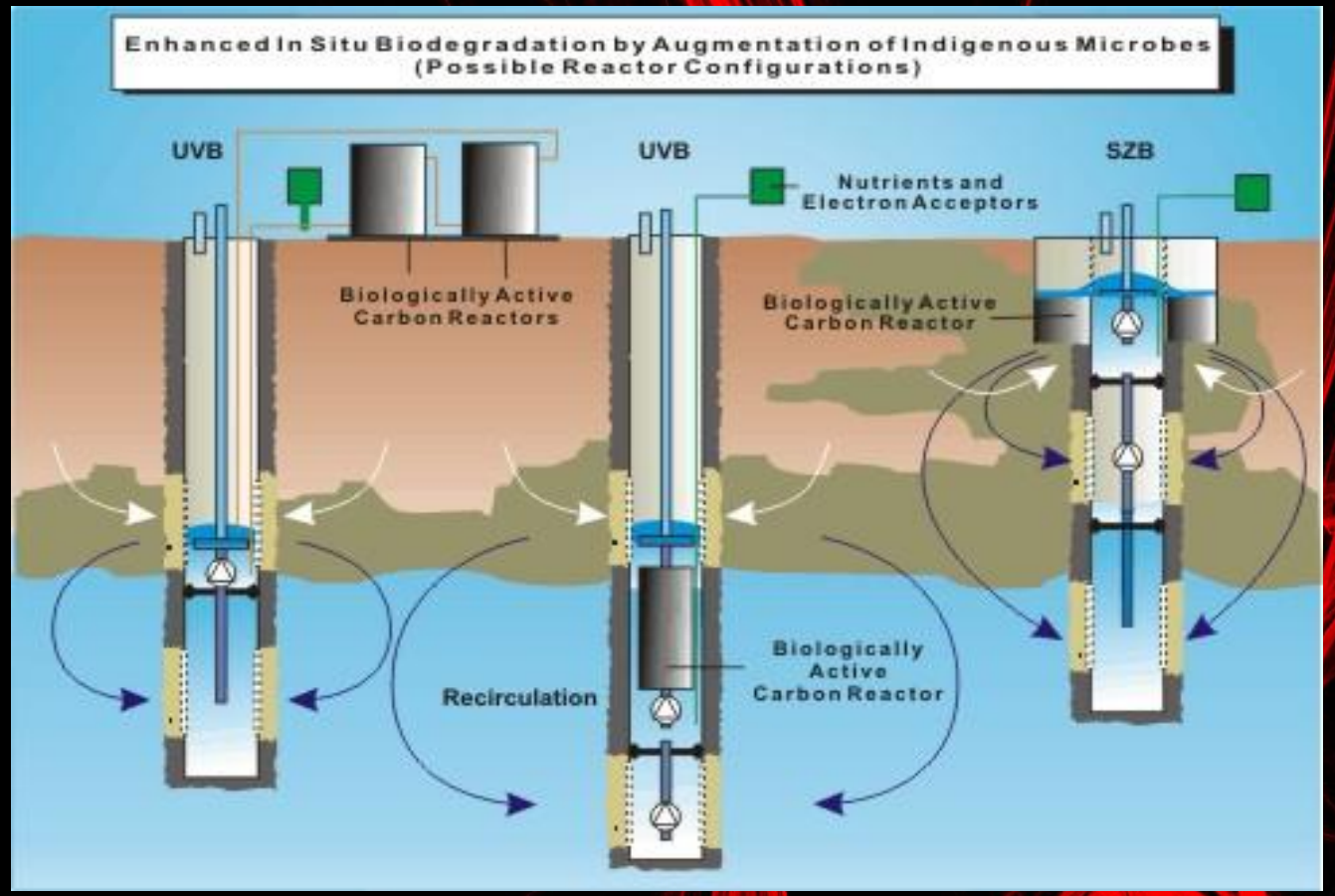
BIOVENTING

Bioventing is a technology that stimulates the natural in-situ biodegradation of any aerobically degradable compounds in NAPL within the soil by providing oxygen to existing soil microorganisms.



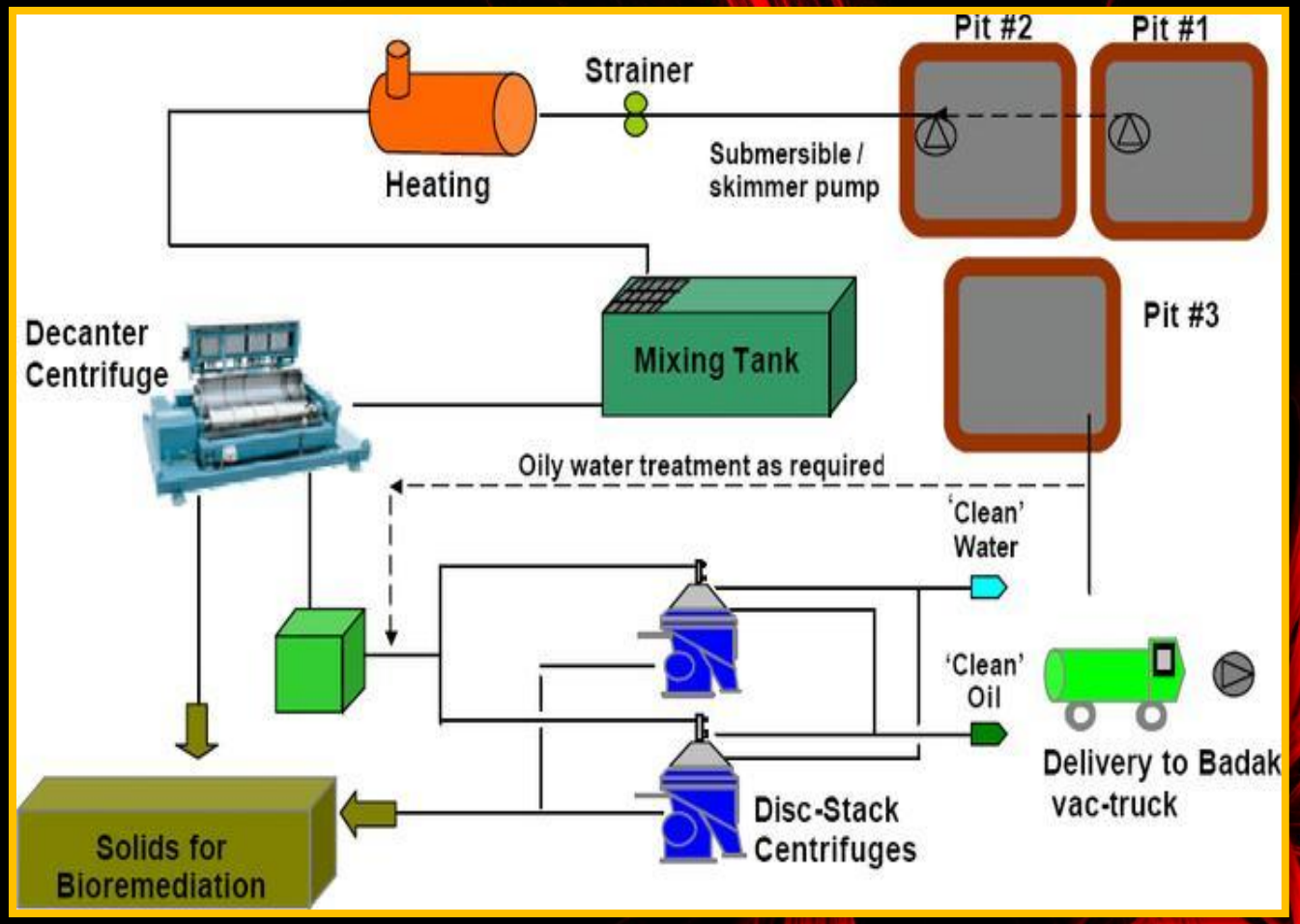
BIOAUGMENTATION

Is the introduction of a group of microbial strains to treat contaminated soil or water.



BIOPILING

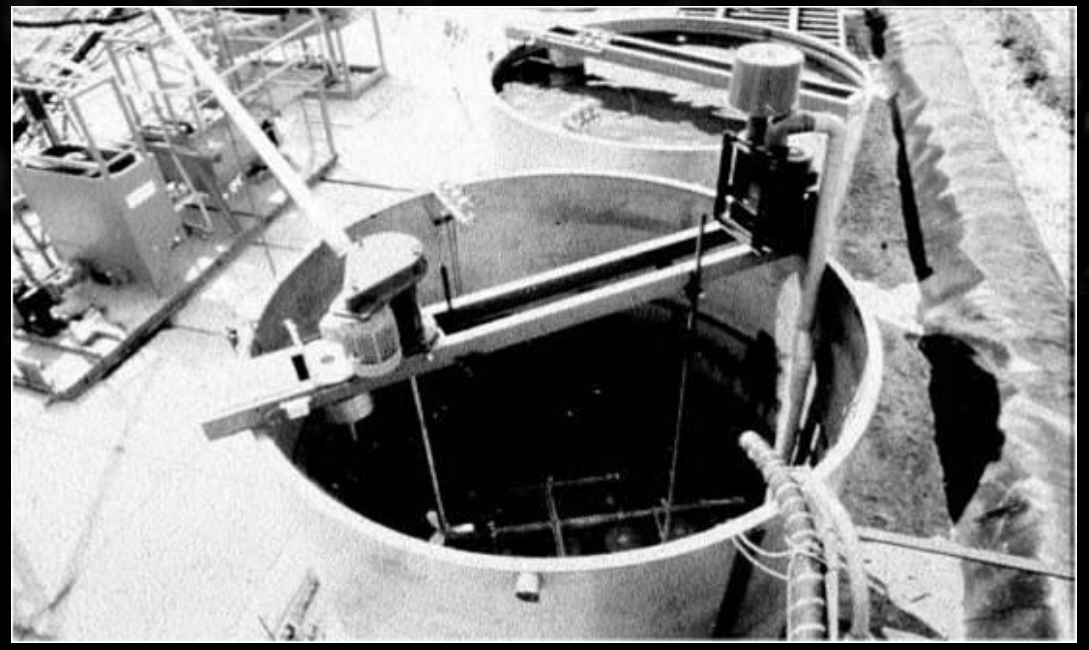
Treatment is a full-scale technology in which excavated soils are mixed with soil amendments, placed on a treatment area and bioremediated using forced aeration.



BIOREMEDITION STRATEGIES

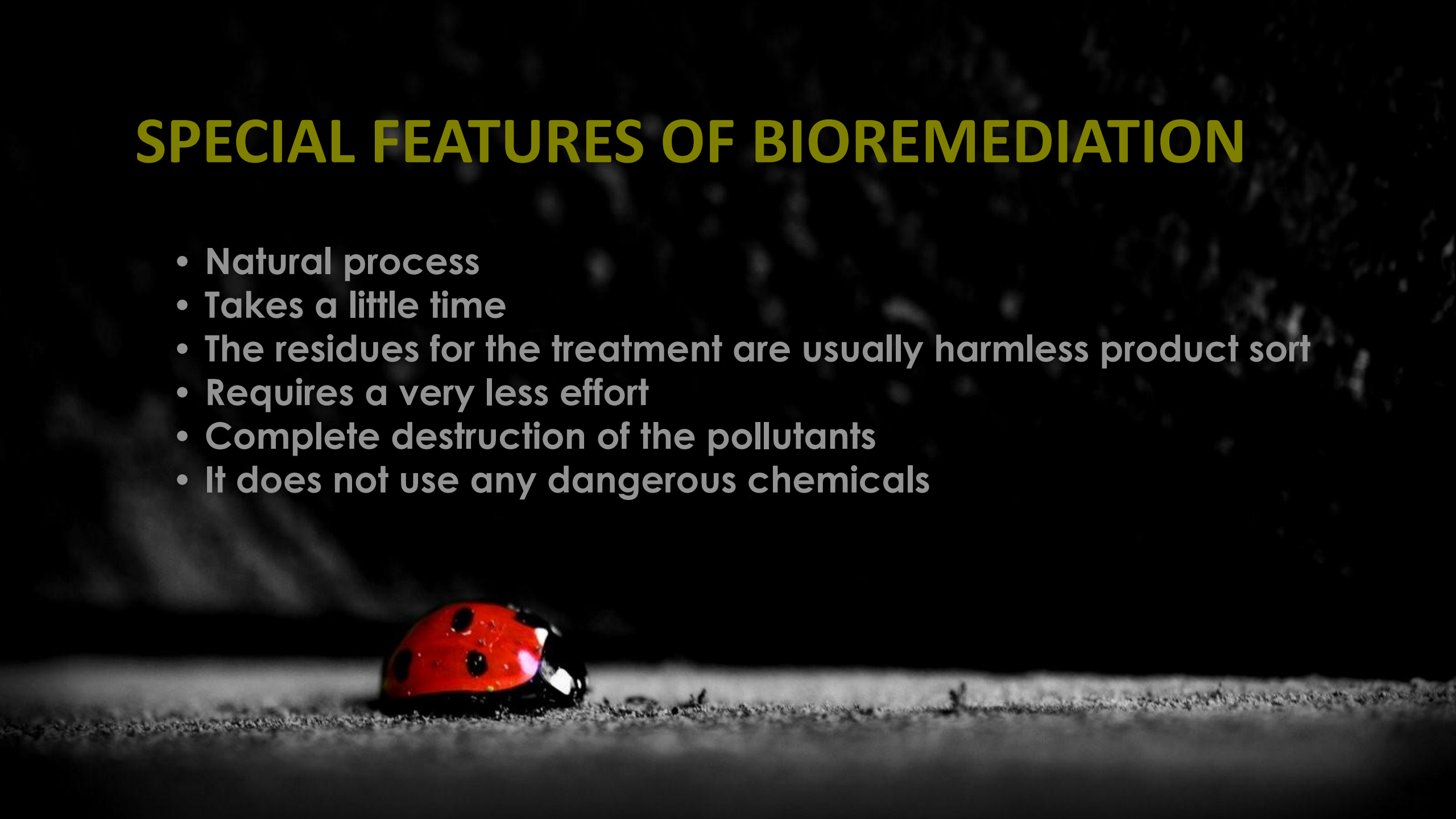
Ex-Situ Bioremediation

Bioreactors. Slurry reactors or aqueous reactors are used for ***ex situ*** treatment of contaminated soil and water pumped up from a contaminated plume. Bioremediation in reactors involves the processing of contaminated solid material or water through an engineered containment system.



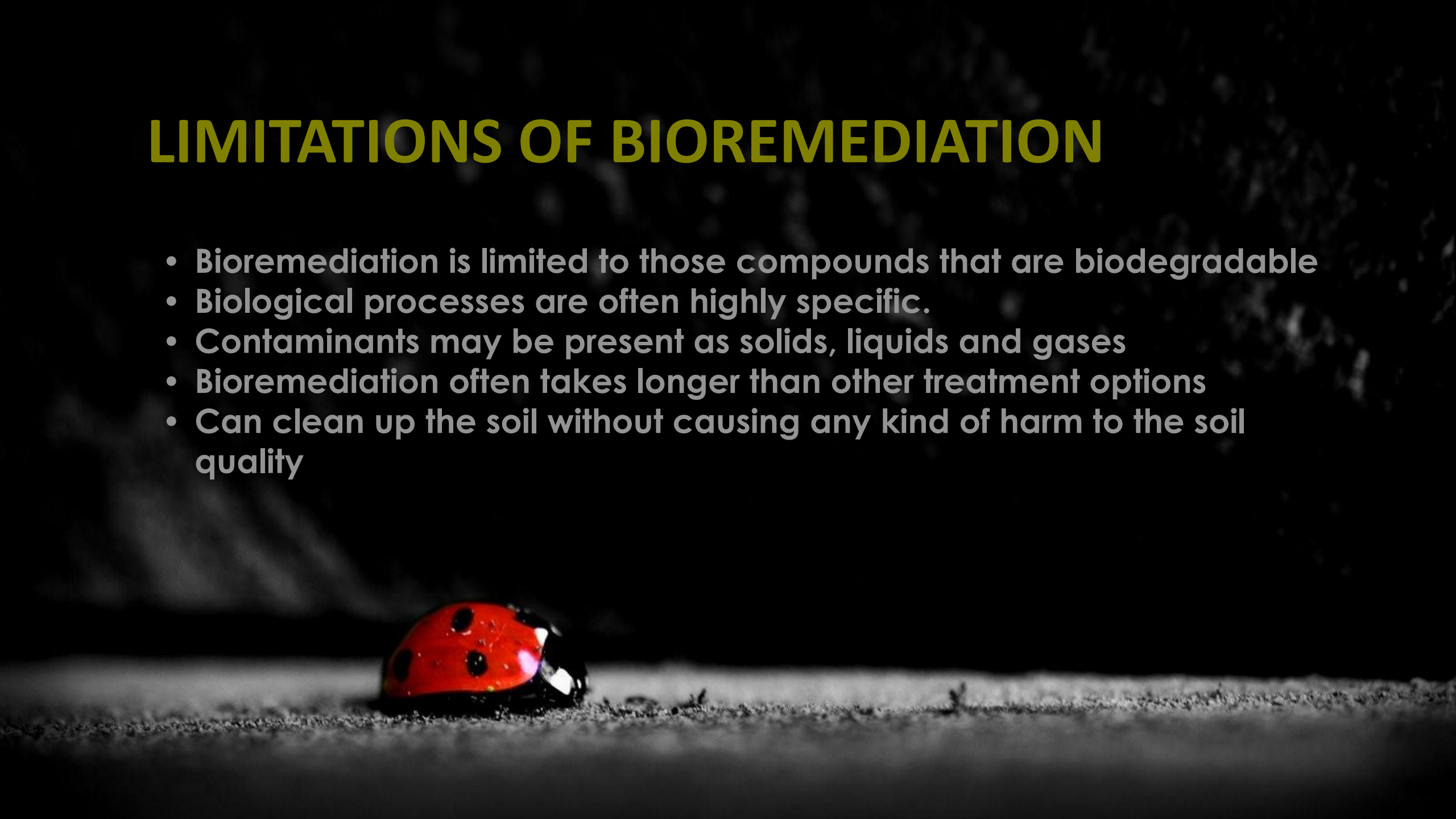
SPECIAL FEATURES OF BIOREMEDIATION

- Natural process
- Takes a little time
- The residues for the treatment are usually harmless product sort
- Requires a very less effort
- Complete destruction of the pollutants
- It does not use any dangerous chemicals



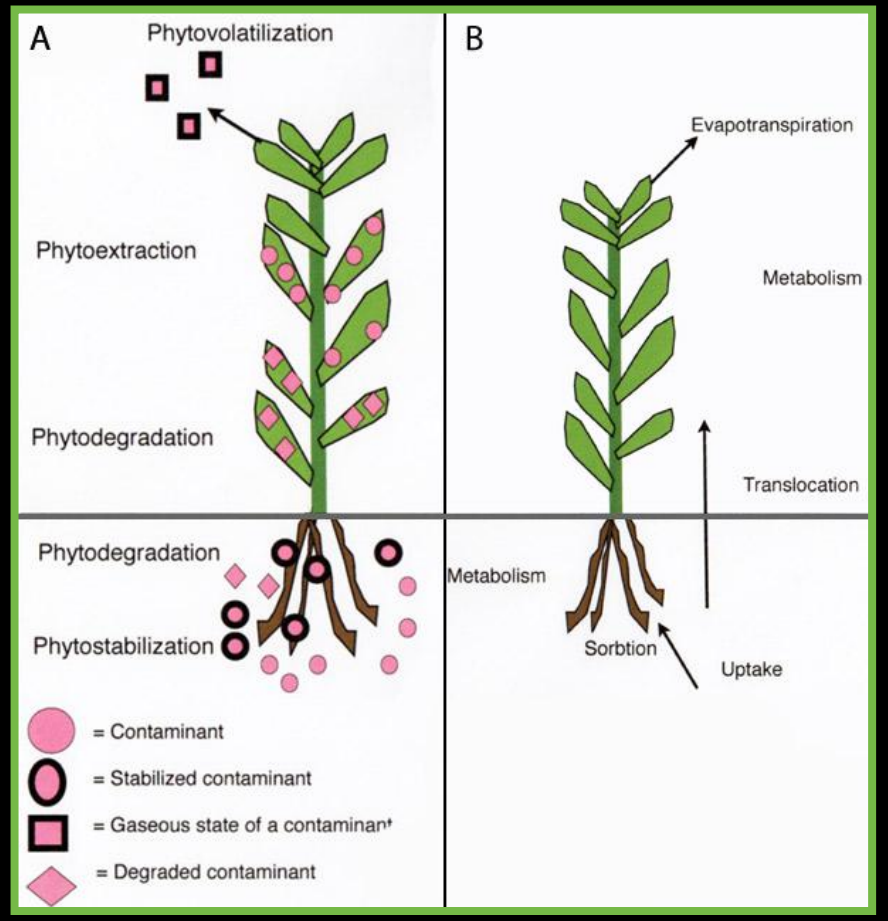
LIMITATIONS OF BIOREMEDIATION

- Bioremediation is limited to those compounds that are biodegradable
- Biological processes are often highly specific.
- Contaminants may be present as solids, liquids and gases
- Bioremediation often takes longer than other treatment options
- Can clean up the soil without causing any kind of harm to the soil quality



TYPES OF PHYTOREMEDIATION

- Phytoextraction
- phytotransformation
- Phytostabilization
- Phytodegradation
- Rhizofiltration



ADVANTAGES OF PHYTOREMEDIATION

- Lower cost than that of traditional processes both *in-situ* and *ex- situ*.
- The plants can be easily monitored
- The possibility of the recovery and re-use of valuable products.
- It uses naturally occurring organisms and preserves the natural state of the environment.
- The low cost of phytoremediation (up to 1000 times cheaper than excavation and reburial) is the main advantage of phytoremediation

THANKS FOR YOUR ATTENTION!