ENVIRONMENTAL BIOTECHNOLOGY

Topic: Bioremediation

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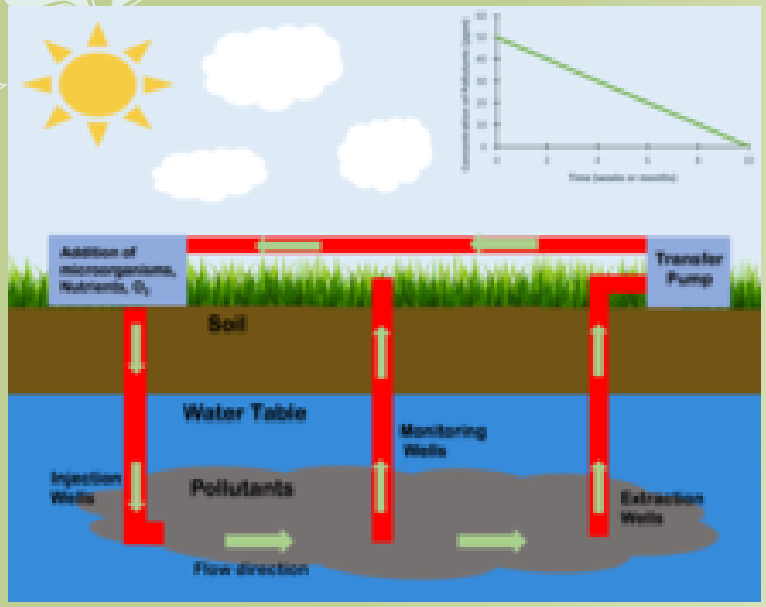
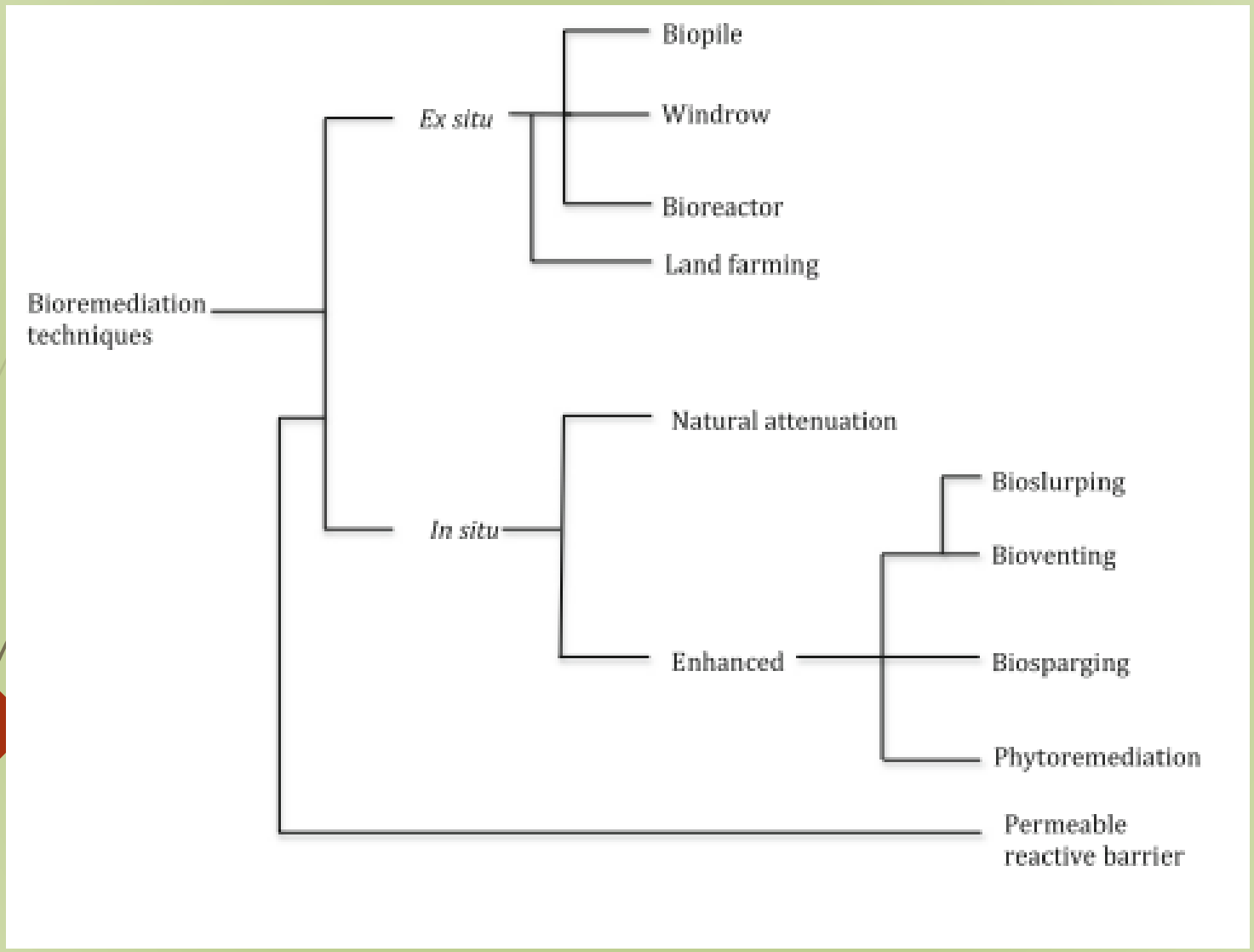
Bioremediation

broadly refers to any process wherein a biological system (typically bacteria, microalgae, fungi, and plants), living or dead, is employed for removing environmental pollutants from air, water, soil, flue gasses, industrial effluents etc., in natural or artificial settings.

Xenobiotic compounds are chemical compounds found in an organism but it are not normally produced or expected to be present in it.

Cometabolism: in this process the microorganism produces an enzyme to utilizes its nutrients, but by chance this enzyme can degrade a pollutant




Biopile
Ex situ
Windrow
Bioreactor
Land farming
Bioremediation techniques
Natural attenuation
Bioslurping
In situ
Bioventing
Enhanced
Biosparging
Phytoremediation
Permeable reactive barrier

Bioremediation techniques:

(1) In-situ (without excavation).

(2) Ex-situ (with excavation).

Only ex-situ processes allow an efficient optimization of incubation parameters (biostimulation), including:

- pH,
- Aeration,
- Agitation,
- Moistening
- nutrients,
- solvents or surfactants.

In addition to addition of microorganisms (bioaugmentation)

The Ex-situ Technique Includes:

❖ Biopile

Biopile-mediated bioremediation involves above-ground piling of excavated polluted soil, followed by nutrient amendment, and sometimes aeration to enhance bioremediation by basically increasing microbial activities. The components of this technique are: aeration, irrigation, nutrient and leachate collection systems, and a treatment bed.

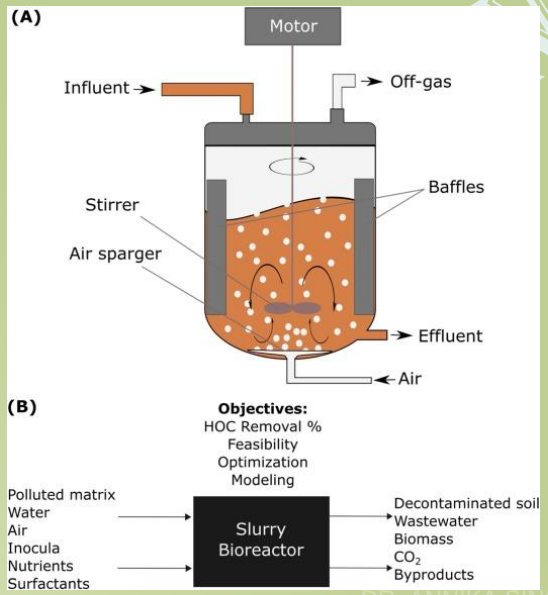
❖ Windrows

windrows rely on periodic turning of piled polluted soil to enhance bioremediation by increasing degradation activities of indigenous and/or transient hydrocarbonoclastic bacteria present in polluted soil.

The periodic turning of polluted soil, together with addition of water bring about increase in aeration, uniform distribution of pollutants, nutrients and microbial degradative activities, thus speeding up the rate of bioremediation, which can be accomplished through assimilation, biotransformation and mineralization

❖ Bioslurry reactor

- There are different operating modes of bioreactor, which include: batch, fed-batch, sequencing batch, continuous and multistage.
- The choice of operating mode depends mostly on market economy and capital expenditure.
- Polluted samples can be fed into a bioreactor either as dry matter or slurry; in either case, the use of bioreactor in treating polluted soil has several advantages compared to other ex situ bioremediation techniques.
- Excellent control of bioprocess parameters (temperature, pH, agitation and aeration rates, substrate and inoculum concentrations) is one of the major advantages of bioreactor-based bioremediation.



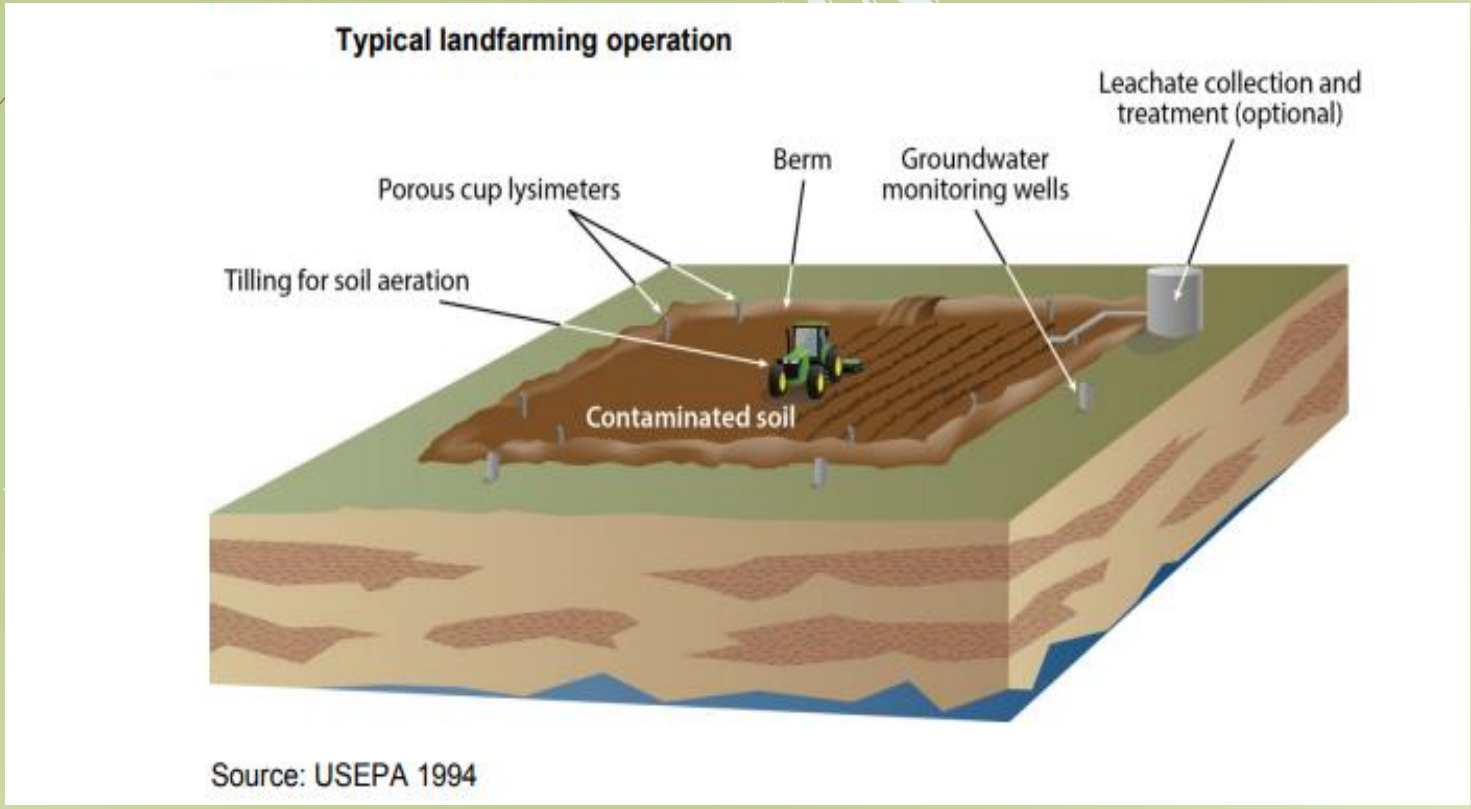
Land farming

Land farming is amongst the simplest bioremediation techniques owing to its low cost and less equipment requirement for operation

it could be ex situ bioremediation or in situ bioremediation technique.

Pollutant depth plays an important role as to whether land farming can be carried out ex situ or in situ.

In land farming, When excavated polluted soil is treated on-site, it can be regarded as in situ; otherwise, it is ex situ bioremediation techniques.



Factors Affecting Land Farming

Oxygen It is crucial to balance the aeration of landfarmed soils so that it is sufficient to promote optimal microbial degradation of contaminants, but low enough to prevent excessive volatilisation of compounds, such as BTEX (UK EA 2002).

Temperature To promote biological activity which is regulated by soil temperature, temperature should ideally be kept within the range of 10–45° C (US EPA 2003).

pH pH should ideally range between 6 and 8 to facilitate bacterial growth (UK EA 2002).

Microbial population density Microbial population densities in typical soils range from 104 to 107 colony-forming units per gram (CFU/g). According to US EPA (1994), 'For landfarming to be effective the minimum heterotrophic plate count should be 103 CFU/g.'

Nutrient balance Applying additional nutrients, such as manure or complete chemical fertilisers, may be necessary to optimise biodegradation processes as the major nutrients limiting it are nitrogen and phosphorus.

Time Mixing (aeration) should be performed at regular intervals, such as between one and four weeks, according to site conditions and contamination characteristics.

Contaminant load

Moisture

Soil texture

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