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Bioremediation of Contaminated Soil

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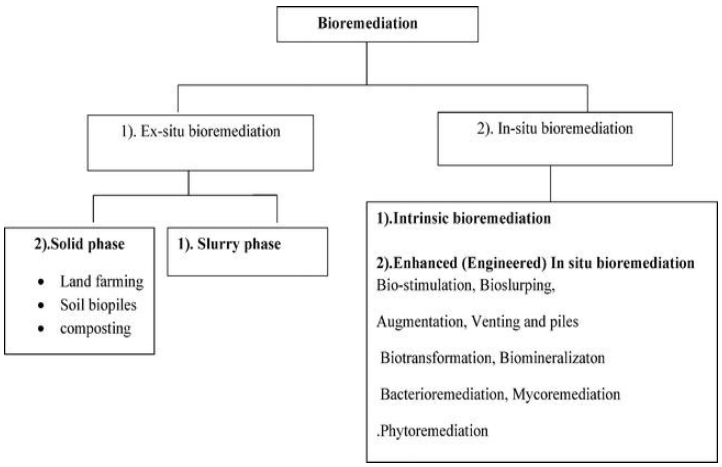
Bioremediation refers to cleaning of polluted lands using biological processes. Bioremediation is defined as use of biological processes to degrade, break down, transform, or remove contaminants from soil and water. It is an eco-friendly and highly economical method of remediating polluted soils and water. Biological method of remediation of polluted sites uses living organisms, which could be plant or microorganisms to abate or clean up pollutants.

Bioremediation is a natural process which relies on bacteria, fungi, and plants to alter contaminants as these organisms carry out their normal life functions. The mechanisms of bioremediation degrade, mineralize, transform, or detoxify the pollutants thereby reducing the concentration of the pollutant to safer state. Metabolic processes of these organisms are capable of using chemical contaminants as an energy source, rendering the contaminants harmless or less toxic products in most cases.

Soil pollutants of environmental and health concern include hydrocarbons, heavy metals, chlorinated compounds, pesticides, dyes and organic solvents.

Types of bioremediations

Based on the place of application or where the process is carried out, bioremediation techniques can by grouped into Ex-situ and In-situ Bioremediations.



In-situ bioremediation

Bioventing

It is an in-situ remediation technique that uses microorganisms to degrade organic constituents adsorbed on soils. This technique involves regulated stimulation of airflow for increasing oxygen to unsaturated zone for enhances the bioremediation, by increasing activities of indigenous microbes.

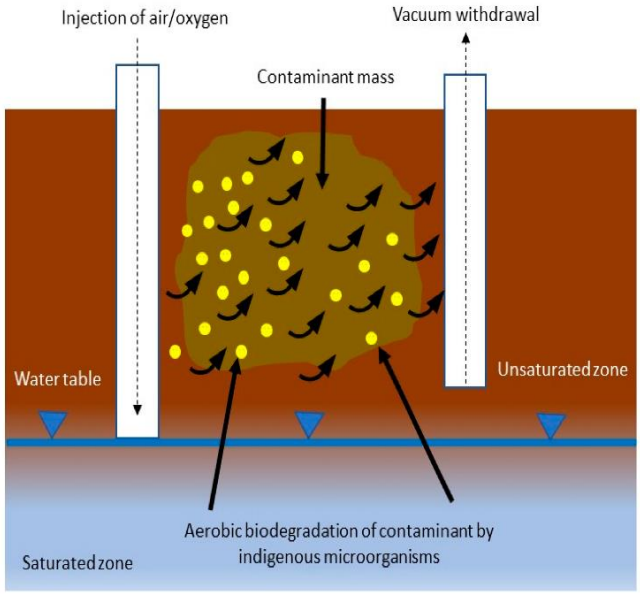


Fig 1: Bioventing

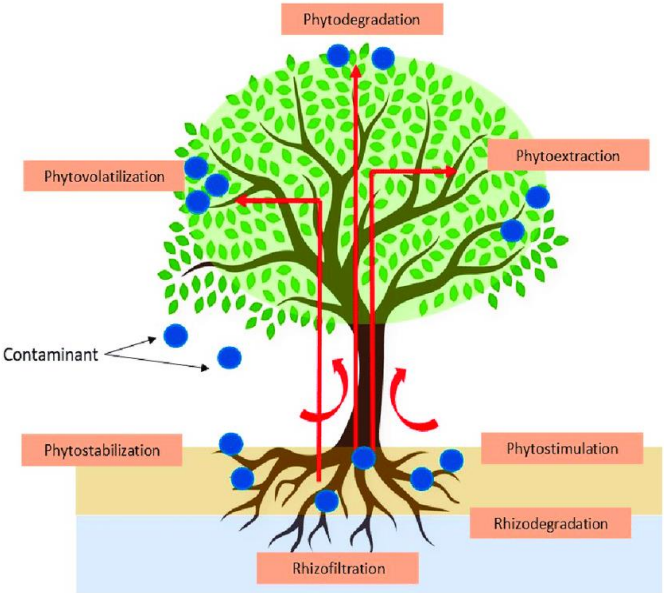


Fig 2: Phytoremediation

Bioslurping

This technique involved the combination of bioventing and vacuum-enhanced free product recovery methods for remediation of contaminated soil and groundwater.

Biosparging

It is a biological approach which removes the aromatic compounds contamination like benzene, toluene, ethylbenzene, xylene and naphthalene from an area. This process involves the loading of specific aerobic bacteria to break down the mineral oil and aromatic compounds into simpler and useful safer form. In biosparging air is injected at the saturated zone, which can cause upward movement of volatile organic compounds to the unsaturated zone to promote biodegradation

Bioaugmentation

It is arrangement to enrich the existing microorganism population and make it more effective in reducing the level of contamination. This technique refers to the addition of organic culture to the contaminated soil and make environment of the site similar to a bioreactor

Phytoremediation

The direct use of green plants to stabilize or reduce contamination in soils, sludge, sediments, surface water, or ground water is defined as Phytoremediation. Depending on pollutant type (elemental or organic), there are several mechanisms (accumulation or extraction, degradation, filtration, stabilization and volatilization) involved in phytoremediation.

Mycoremediation

It is a technique of using fungus as a bioremediator. This biotechniques uses particular fungi that release enzymes which can degrade several pollutants and found to be promising strategies in the removal of contaminant with in a site.

***Ex-situ* bioremediation**

Land farming

This technique basically stimulates biodegradation through indigenous microorganisms and facilitate aerobic degradation of contaminates. It is done by a simple methodology technique in which contaminated soil is excavated and spread over a prepared bed and regularly until pollutants are degraded.

Soil biopiles

This biodegradation technique used for the remediation of excavated soil contaminated with petroleum contents. This technology involves the accumulation of contaminated soil into piles and the stimulation of microbial activity either aerobically or by adding nutrients, minerals or moisture.

Composting

It involves mixing the contaminated soil with a biomass such as straw, hay, or corncobs which make it suitable to deliver the optimum levels of air and water to the microorganisms.

Factors affecting bioremediation

Moisture Content

All soil microorganisms require moisture for cell growth and function. Availability of water affects diffusion of water and soluble nutrients into and out of microorganism cells.

pH

Soil pH is important because most microbial species can survive only within a certain pH range. Furthermore, soil pH can affect availability of nutrients.

Temperature

Soil temperature influences rate of biodegradation by controlling rate of enzymatic reactions within microorganisms and speed up enzymatic reactions in the cell.

Nutrient Availability

Carbon, nitrogen, phosphorus, potassium, and calcium are the basic requirement for the growth of microorganisms, the concentration of the nutrient availability directly affects the degradation of the contaminants.

Oxygen availability

It is a very important factor to determine the extent and rate of biodegradation of contaminants. Aerobic biodegradation is much faster than anaerobic biodegradation. For the aerobic respiratory

breakdown of organic contaminants, oxygen availability plays a significant role**.**

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