Bioremediation of Contaminated Soil

In-situ bioremediation of soil:

- Allows treatment of a large volume of soil at once.
- Mostly effective at sites with sandy soils.
- Can vary depending on the method of supplying oxygen or electron donors to the organisms that degrade the contaminants.
- Three commonly used in-situ methods include:
  - Bioventing
  - Injection of hydrogen peroxide or oxygen releasing compound (ORC) for aerobic treatment
  - Injection of HRC for anaerobic treatment

Ex-situ Bioremediation of soil:

- Involves excavation of the contaminated soil and treating in a treatment plant located on the site or away from the site.
- This approach can be faster, easier to control, and used to treat a wider range of contaminants and soil types than in-situ approach.
- Ex-situ bioremediation can be implemented as:
  - Slurry-phase bioremediation, or
  - Solid-phase bioremediation

Contained Solid Phase | Composting | Land farming

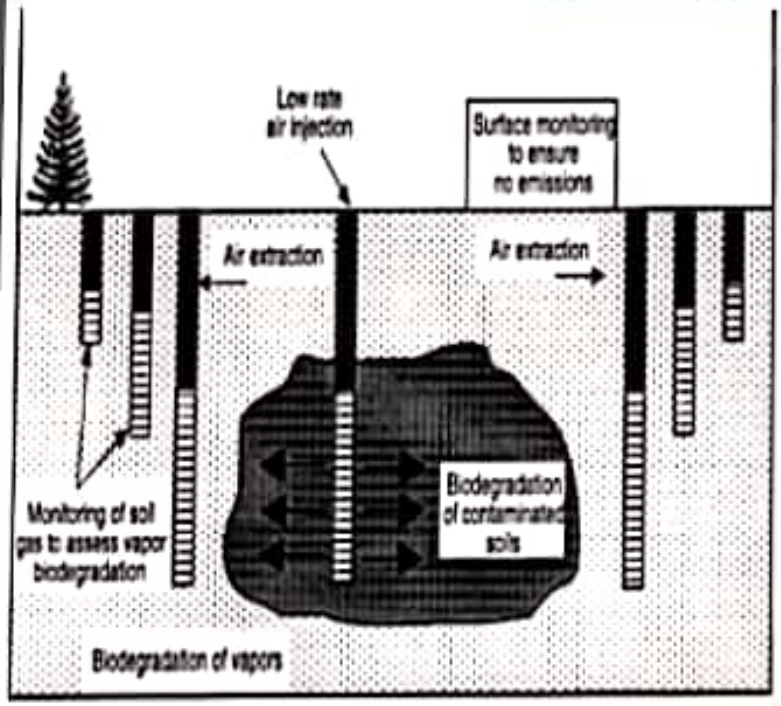


Figure 5. Schematic showing soil-cross section of the bioventing remediation process (USEPA 1992).

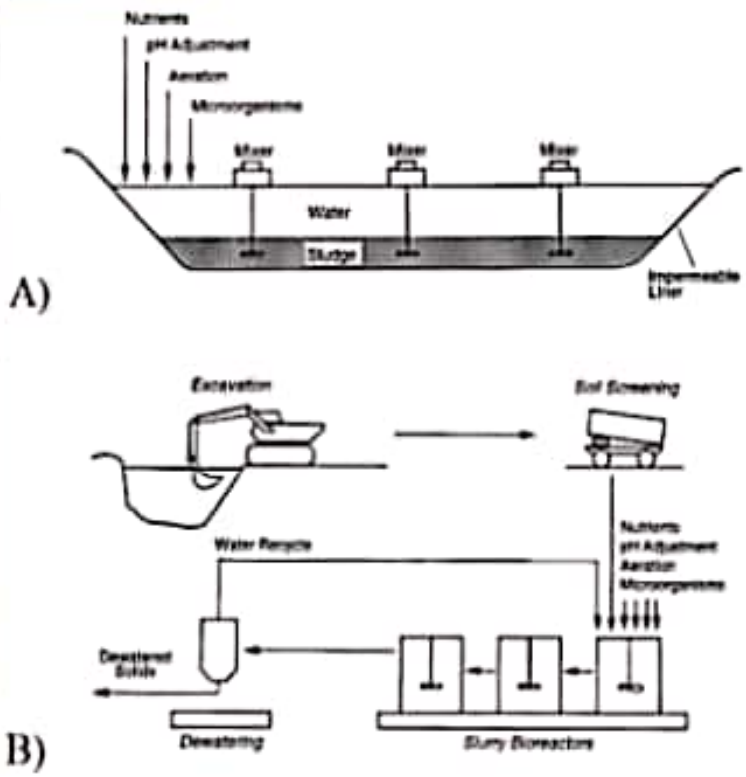
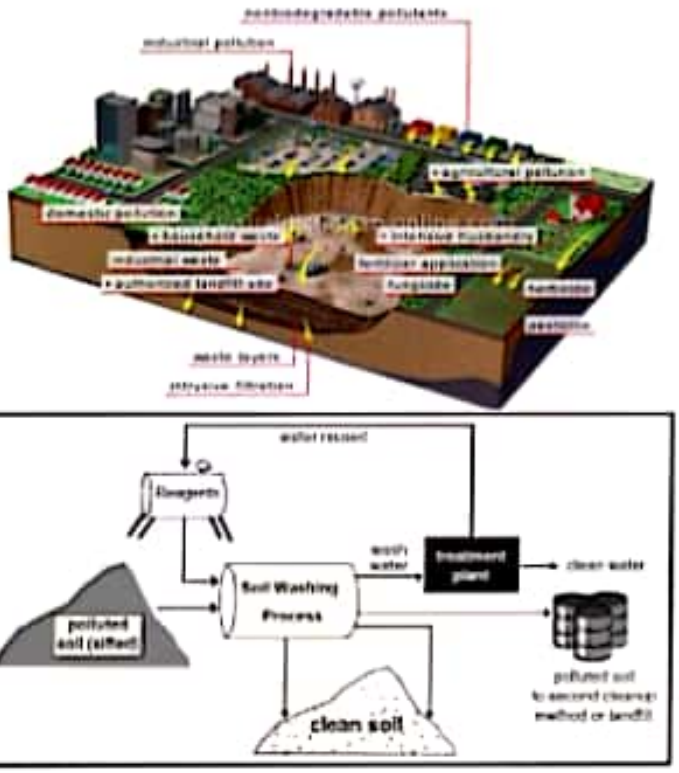


Figure 6. Ex-situ slurry-phase bioremediation in (A) lagoons, and (B) above-ground reactors

Bioremediation of Contaminated Soil



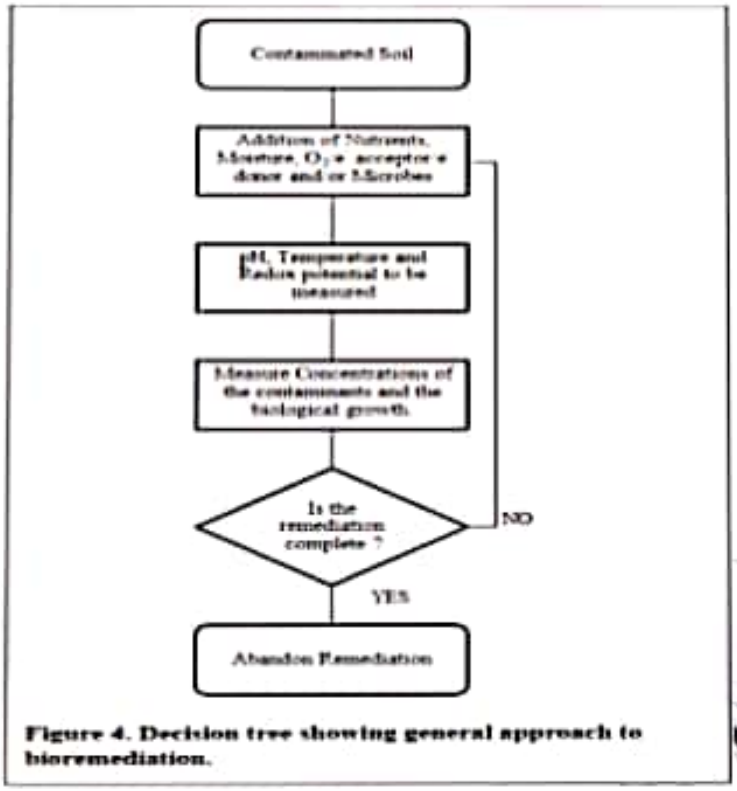
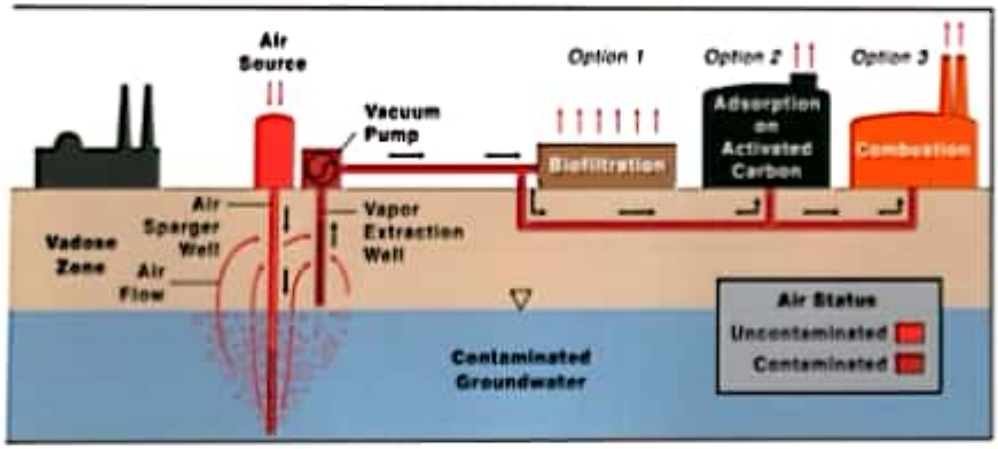


Figure 4. Decision tree showing general approach to bioremediation.

Bioremediation of Aquifer

- In situ bioremediation (ISB) of groundwater involves the encouragement of indigenous bacterial populations to metabolize target contaminants through the addition of various amendments (biostimulation) to the subsurface environment.
- In addition to amendments, select strains of bacteria may be added to the subsurface to help treat some sites (bioaugmentation).
- Bacteria perform coupled oxidation/reduction (redox) reactions to live, and bioremediation exploits these reactions to remove contaminants from contaminated media (groundwater).
- Bacteria can use different electron acceptors (oxidized compounds) and donors (reduced compounds) in the three major oxidation pathways —
  - Aerobic respiration,
  - Anaerobic respiration, and
  - Fermentation.
- ISB can use all of these pathways, and contaminant degradation may occur through
  - Direct metabolism,
  - Cometabolism, or
  - Abiotic transformations that may result from biological activities.

Bioremediation of Aquifer



Bioremediation in groundwater by air sparging. Air is pumped into the contaminated site to stimulate aerobic biodegradation. Volatile contaminants brought to the surfaced are treated by biofiltration, activated carbon, or combustion.

Bioremediation of Aquifer