

Bioremediation

Bioremediation is the use of biological systems in the reduction of pollution from air, water and soil. Microorganisms and plants are the biological systems which are generally used. Microorganisms can **break down** most compounds for their growth and/or energy needs.

■ Applications

Bioremediation is applied to:

- **waste water and industrial effluents** – microorganisms in sewage treatment plants remove the more common pollutants from waste water before it is discharged into rivers or the sea. New methods include aerobic, anaerobic and physico-chemical processes in fixed-bed filters and in bioreactors. Most anaerobic waste water treatment systems produce useful biogas.
- **drinking and processed water** – a very important aspect of biotechnology is its potential for the **reclamation** and purification of waste waters for re-use. In many agricultural regions of the world, animal wastes and excess fertilisers **result in** high levels of nitrates in drinking water. Biotechnology has provided successful methods by which these compounds can be removed from processed water before it is **delivered** to **customers**.
- **air and waste gases** – biotechnological research has produced methods such as bioscrubbers, in which the pollutants are **washed out** using a cell suspension, and **biotrickling filters**, in which the pollutant is degraded by micro-organisms immobilised on an inert matrix and **provided** with an aqueous nutrient film **trickling** through the **device**.
The selection of microorganisms that are more efficient at metabolising pollutants has also **led** to better air and gas purifying biofilters.
- **soil and land treatment** – both *in situ* and *ex situ* methods are **exploited** for the clean-up of soil and the associated groundwater. *In situ* treatments may include the introduction into the ground of microorganisms



(bioaugmentation), ventilation and/or addition of nutrient solutions (biostimulation). *Ex situ* treatment involves removing the soil and groundwater and treating it above ground. Phytoremediation (bioremediation using plants) is presently already used to remove metals from contaminated soils and groundwater and is being **further** explored for the **remediation** of other pollutants. The combined use of plants and bacteria may also be possible.

- **solid waste** – domestic solid wastes are a major problem in our consumer society. They are made up mostly of readily biodegradable organics. Bio-wastes can be converted to a valuable resource by composting or anaerobic digestion. In particular, anaerobic digestion permits the recovery of substantial amounts of high-value biogas together with a high-quality stable organic residue.

biotrickling filter: a filter over which sewage flows and causes the growth of a layer of microbial slime, called biofilm
to break down: to decompose
customer: consumer, client
delivered: distributed
device: tool
effluents: emissions

exploited: used
further: more
to lead (led-led): to bring, to drive
provided: furnished
reclamation: recuperation
remediation: elimination
to result in: to cause
to trickle: to drop
washed out: removed (with a liquid)



NEW FRONTIERS IN BIOREMEDIATION

The principle underlying bioremediation is that microorganisms (mainly bacteria) can be used to destroy hazardous contaminants or transform them into less harmful forms. Today, only a few of the countless microbial processes that could be used in bioremediation are applied in practice. As novel biotransformations become better understood at ecological, biochemical and genetic levels, new strategies will become available for bioremediation. A recent example is microbial dechlorination of polychlorinated biphenyls (PCBs), compounds once thought to be undegradable. Anaerobic microbes in the sediments can transform highly chlorinated PCBs to lightly chlorinated PCBs, which can be degraded completely by aerobic microbes.

Bioremediation after the Exxon Valdez oil spill disaster in 1989



1 Write question from the prompts and answer them.

1. What / bioremediation / be?
2. What organisms / in bioremediation / be used?
3. What / the function of microorganisms in waste water treatment / be?
4. What / nitrates in water / derive from?
5. What methods / to remove pollutants from air and waste gases / be used?
6. What / the usual *in situ* land treatment techniques / be?
7. What / phytoremediation and what / be / be used for?
8. What methods / to treat bio-wastes / can be used



2 Many words in this Unit are made with the prefix '*bio*', which means *life*. Choose from the following the words which complete the definitions when joined with '*bio*':

augmentation • conversion • film • filter • gas • plastics • reactor • remediation • stimulation • wastes

1. Bio is the use of living things to break down or remove toxins and harmful substances from soil and water.
2. Bio is the addition of selected microorganisms to digest contaminants.
3. Bio is the addition of nutrients to stimulate the growth of microorganisms that favour degradation.
4. Bio is a mixture of carbon dioxide and methane produced by the biological breakdown of organic matter.
5. Bio, made from renewable materials, are a 'green' alternative to traditional plastics.
6. Bio..... are the biodegradable parts of municipal, agricultural and industrial wastes.
7. A bio..... is a thin layer of microorganisms that form on and coat various surfaces.
8. A bio is a bed of organic matter that removes air pollutants as waste air passes through.
9. A bio is used for growing microorganisms for the bioconversion of organic waste.
10. Bio is the transformation of organic materials into usable products or energy sources by biological processes or agents.