Journal of Bioremediation and Biodegradation

kaur, J Bioremediat Biodegrad 2022,12:7

Opinion Open Access

# An Introduction to a Bioremediation

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**Received**: December 01, 2021; **Accepted**: December 15, 2021; **Published**: December 22, 2021

**Citation:** Kaur S (2021) An Introduction to a Bioremediation. J Bioremediat Biodegrad Open Vol 12:491.



## Description

Bioremediation is a method of treating contaminated media, such as water, soil, and subterranean material, by modifying environmental conditions to encourage the growth of microorganisms that breakdown the contaminants. Enzymes found in microbes detoxify these hazardous chemicals. The bioremediation processes involve oxidation-reduction reactions, in which an electron acceptor (typically oxygen) is added to stimulate the oxidation of a reduced pollutant (e.g. hydrocarbons) or an electron donor (typically an organic substrate) is added to reduce oxidised pollutants (nitrate, perchlorate, oxidised metals, chlorinated solvents, explosives and propellants). Bioremediation is a technique for reducing the impact of anthropogenic byproducts such as those produced by industrialization and agricultural processes. Bioremediation is often less expensive and more long-lasting than other cleanup options. Thermal desorption, vitrification, air stripping, bioleaching, rhizofiltration, and soil washing are some of the other remedial procedures. Bioremediation, or biological treatment, is a comparable technique to treating wastes such as wastewater, industrial waste, and solid waste. Bioremediation's ultimate purpose is to remove or minimise hazardous substances in order to improve soil and water quality.

The treatment location determines how bioremediation approaches are categorised. *Ex situ* procedures frequently need the contaminated site to be excavated, which raises expenses. *In situ* approaches treat polluted places in a cost-effective, non-destructive manner. Additional nutrients, vitamins, minerals, and pH buffers may be added to both of these ways to improve the microbes' circumstances. Biostimulation (the addition of specialised microbial cultures to accelerate biodegradation) is sometimes used.

Anthropogenic activities and natural processes both contribute to the presence of heavy metals in the environment. Industrial pollutants, electronic trash, and ore mining are examples of anthropogenic activity. Mineral weathering, soil erosion, and forest fires are examples of natural causes. Heavy metals such as cadmium, chromium, lead, and uranium are not biodegradable, unlike organic substances. Bioremediation procedures, on the other hand, have the potential to minimise the mobility of these materials in the subsurface, lowering the risk of human and environmental exposure. Heavy metals from these sources are primarily found in water sources as a result of runoff, where they are absorbed by marine life and vegetation.

Certain metals, such as chromium (Cr) and uranium (U), have different mobility depending on the oxidation state of the substance. By converting hexavalent chromium, Cr (VI), to trivalent Cr, microorganisms can be employed to minimize chromium toxicity and mobility (III). The more mobile U(VI) oxidation state of uranium can be reduced to the less mobile U(IV) oxidation state. Because the reduction rate of these metals is generally slow unless catalysed by microbial interactions, microorganisms are used in this process. Efforts are also being made to create ways for removing metals from water by boosting metal sorption to cell walls. This method has been tested for cadmium, chromium, and lead removal. Processes like phytoextraction concentrate pollutants in biomass for later removal.

Aerobic and anaerobic heterotrophs, such as *Flavobacterium* spp. and *Arthrobacter* spp., have shown to be efficient against a variety of herbicides and other chemicals. Organophosphates and non-chlorinated chemicals are best handled by aerobes. Chlorinated structures (most often DDT, DDE (dichlorodiphenyldichloroethylene), heptachlor, dieldrin, and chlordane) are difficult to detox completely, whereas triazines and organophosphates (such as malathion and parathion) are much easier to discover a remediator for. This is particularly useful for atrazine, which was previously known for its persistence.