AgriCos e-Newsletter
ISSN: 2582-7049
AgriCos e-Newsletter
Open Access Multidisciplinary Monthly Online Magazine
Volume: 05 Issue: 04 April 2024 Article No: 11

Bioremediation: A Sustainable Tool for Environmental Management

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SUMMARY

Rapid industrialization, military activities and changed agricultural practices have led to the widespread use of hazardous organic compounds and the subsequent increase in contaminant concentrations in the environment. These contaminants can accumulate and persist for long periods of time. They are spread through air or water into the ground, which has led to a variety of serious environmental and health problems throughout the world. Many researchers have stepped up efforts to find more sustainable and cost-effective alternatives to using hazardous chemicals and treatments to remove existing harmful pollutants. Environmental biotechnology, such as bioremediation and phytoremediation, is a promising field that utilizes natural resources including microbes and plants to eliminate toxic organic contaminants.

INTRODUCTION

The word bioremediation, Bio means living organism and Remediate means to solve a problem. Thus bioremediation is the use of biological organisms to solve an environmental problem. According to the EPA (2008), Bioremediation is a "treatment that uses naturally occurring organisms to break down hazardous substances into less toxic or non-toxic substances". The Bioremediation technologies can be generally classified as *in situ* or *ex situ*. Insitu bioremediation involves treating the contaminated material at the site. It involves Intrinsic bioremediation and engineered in situ bioremediation. Intrinsic bioremediation deals with stimulation of indigenous or naturally occurring microbial populations by feeding them nutrients and oxygen to increase their metabolic activity. Engineered approach involves the introduction of certain microorganisms to the site of contamination. Engineered in situ bioremediation accelerates degradation process by enhancing the physico-chemical conditions to encourage the growth of microorganisms.

Objectives bioremediation

- Reduction of organic content (i.e., reduction of BOD).
- Removal or reduction of trace organic compounds that are recalcitrant to biodegradation and may be toxic or carcinogenic.
- Removal or inactivation of pathogenic microorganisms and parasites.

Bioremediation using microorganisms

Aerobic bacteria: These microbes degrade hydrocarbons and they use the contaminant as the sole source of carbon and energy. Example- *Pseudomonas, Alcaligenes, Rhodococcus, and Mycobacterium.*
Anaerobic bacteria: they are used for bioremediation of polychlorinated biphenyls, trichloroethylene and chloroform.
Methylotrophs: Are the aerobic bacteria that grow utilizing methane for carbon and energy.
Fungi: Able to degrade a diverse range of persistent or toxic environmental pollutants.

Advantages of microbial remediation

- Requires low-cost
- No chemicals required
- Natural process, it is environmental safe
- It is self-sustaining
- The residues are harmless (CO_2, water, cell biomass)
- It can be carried out in situ

Limitations of microbial remediation

- Needs more time.

- Limited to biodegradable compounds.
- Considerable experience and expertise may be required.

Phytoremediation

Phytoremediation is a rapidly developing method that uses plants to reduce, degrade, assimilate and metabolize environmental pollutants. Bioremediation through the use of plants which mitigate the environmental problem without the need to excavate the contaminant material and dispose it elsewhere is known as phytoremediation. Some of the plants used are blue green algae, Duck weed, *Eichhornia sp.*, Rye grass, Alfalfa, Bermuda grass etc. Plant roots take contaminants from the ground into the "body" of the plant. The rhizosphere supports large populations of diverse microorganisms. Chemicals exuded by plant roots which provide carbon and energy for microbial growth. This combination of plants and microorganisms appears to increase the biodegradation of compounds.

Advantages

- Requires low cost and energy
- Eco friendly
- *In situ* treatment can be done
- works on a variety of organic and inorganic compounds
- High efficiency and easy operation
- Plants also have complementary interaction with microbes for further remedies.

Limitations

- Affected by the growing environment.
- Risk of release of contaminants from tissues later if not harvested.
- Longer time for remediation.
- High concentrations of hazardous materials can be toxic to plants.
- Possibility of toxicants to enter food chain.
- Shallow plant roots - effectiveness is limited to zone of influence of plant roots.

Bioremediation using Earthworms

Vermifiltration using waste eater earthworms is a newly conceived novel technology. The body of the earthworms works as a biofilter and they are found to remove the 5 days BOD by over 90%, COD by 80–90%, total dissolved solids (TDS) by 90–92%, and the total suspended solids (TSS) by 90–95% from wastewater by the mechanism of ingestion and biodegradation of organic wastes, heavy metals, and solids from waste water and absorption through their body walls. There is no sludge formation in the process which requires additional expenditure on landfill disposal. Earthworms increase the hydraulic conductivity and natural aeration of the organic particles by granulating the organic particles into small particles.

CONCLUSION

Over 80% of waste water is released untreated into the environment, cleaning that water and recycling it for use in agriculture could cut down the pollution. Microbes, Aquatic plants and worms can be used to treat sewage water. Microorganisms play a significant role in the treatment of domestic sewage. Bioremediation through the use of plants helps to mitigate the environmental problem without the need to excavate the contaminant material and dispose it elsewhere. Bioremediation using waste eater earthworms is a newly conceived novel technology. Thus, bioremediation is the technology that accelerates natural processes for degrading or detoxifying harmful chemicals in waste water. Bioremediation improves the quality of water by reducing COD, BOD, TSS, heavy metals etc. The bioremediated sewage water can be used for irrigation of field crops which gives better growth and quality parameters.

REFERENCES

Anusha, V. and Sundar, K. S., (2015) Application of Vermifiltration in domestic wastewater treatment. *International Journal of Innovation in Research in Science, Engineering Technology.* 4(8):7301-7304.

Jamuna, S. and Noorjahan, C., (2009) Treatment of sewage waste water using water hyacinth-*Eichhornia* sp and its reuse for fish culture. *Toxicology International.* 16(2):103-106.

Merugu, R., Prashanthi, Y., Sarojini, T. and Badgu, N., (2014) Bioremediation of waste waters by the anoxygenic photosynthetic bacterium *Rhodobacter sphaeroides* SMR 009. *International Journal of Research in Environmental Science and Technology*. 4(1):16-19.

Sinha, R. K., Bharambe, G. and Chaudhari, U., (2008) Sewage treatment by vermifiltration with synchronous treatment of sludge by earthworms: a low-cost sustainable technology over conventional systems with potential for decentralization. *The Environmentalist.* 28(4):409-420.

Suhendrayatna, M., Andriani, R. and Fajriana., (2012) Removal of municipal wastewater BOD, COD, and TSS by phyto-reduction: A laboratory-scale comparison of aquatic plants at different species *Typha latifolia* and *Saccharum spontaneum*. *International Journal of Engineering and Innovative Technology.* 2(6):333-337.