

## Bioremediation-A Tool for Environmental Cleaning

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### **Abstract**

*Today when we are living in a highly contaminated environment, may it be aerial, terrestrial or aquatic, bioremediation seems to be a magnificent tool for cleaning the contaminated environment. Bioremediation refers to the process that has been carried out to clean the contaminated environment with the help of microorganisms by applying various technologies of Genetic Engineering. Thus, environmental bio- technology plays an important role in decontamination of the environment. A number of microbes like viruses, bacteria and fungi play an important role in bioremediation. Here, an attempt has been made to discuss the role of microbes in cleaning the environment.*

### **Keywords**

*Bioremediation, Environmental Biotechnology, Microbes, Environmental cleaning.*

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## **Introduction**

Today when the world is facing a great problem of environmental contamination in terms of pollution, a number of valuable techniques are evolved to clean the environment. New research is carried out and efforts have been made to cope with the problem of decontamination.

It goes without saying that pollution in terms of contamination has a deleterious effect on the morphological and genetic constitution of animals and plants. Further, climate change is a big problem causing loss of habitat in a number of plants and animals. In such conditions environmental biotechnology is proved to be a boon for cleaning the environment. The word bioremediation that envisages cleaning of the environment with the help of microbes naturally or by applying the various techniques of biotechnology. Thus, an attempt has been made to gather the existing data and discuss the role of microbes in the environmental cleaning by applying the techniques of Biotechnology. Robinsons first applied the technique of bioremediation to clean up the oil spills, leach fields and sewage (<http://usmicrobics.web.com>).

## **Bioremediation**

Bioremediation, as name indicates, refers to the process that envisages environmental cleaning or decontamination of the environment with the help of living organisms, especially microorganisms (bacteria, virus and fungi etc).

It has been reported that the Bioremediation technique using the microbes was first applied by George M. Robinson, in 1960 in Santa Maria, California, U.S. ([www.microbicsliquisearch.com](http://www.microbicsliquisearch.com)) during his experiment with dirty jars.

The process of Bioremediation may have its history since the Roman period, but proper study by microbiologists came into existence in 1940. Importantly speaking, the genesis of bioremediation came into existence in 1989. The Exxonvaldez oil spill in Prince William sound, Alaska had the global attention regarding the bioremediation (<http://docs.google.com/viewer>) Before 1989, the period was dedicated to research. During the 1970s and 1980s a number of articles and research papers were published on Bioremediation. The process is confirmed by laboratory research by measuring oil degradation in the environment in major oil spills like the Amoco Cadiz spill. (<http://docs.google.com/viewer>).

During the period 1989-1990 the process has become a topic of interest for the researchers. A great example of these was the oil spills of Exxon Valdez in 1989 that revolutionized the process of Bioremediation.

The process of bioremediation was well recognized in the 1970s when Anand Chakrabarty, a hydrocarbon biotechnologist, University of Illinois Medical

Center, Chicago, USA discovered many strains of bacteria by isolating species of *Pseudomonas* through DNA recombinant technology. These bacteria are able to degradation some components of crude oil (<http://www.amriathuerapeutics.com/html/chakrabarti.html>) (<http://sciencery.com/biology/ecology/bioremediation-and-gl-spills/>)

**Ex-situ Bioremediation-** Ex-situ Bioremediation refers to the process when applied at the site of treatment.

**In-Situ Bioremediation-** It refers to the use of Bioremedial technology at the site of contamination itself.

**Phytoremediation-** As name indicates phytoremediation is the use of plants and related microorganisms to clean up contaminated soil, air and water, (Reichenauetz and Germida, 2008). Phytoremediation proved to be useful as plants accumulate heavy metals such as cadmium and lead in their parts above the ground. Such parts were then removed ( US environmental protection Agency, 2013) and these removed parts incinerated or recycled for industrial use.

#### **Application of Bioremediation in Environmental Cleaning**

Researches have shown that a range of microorganisms are used for bioremediation. They are largely used in the removal of Toxic substances from the environment. The nature of the environment plays an important role in modulating the evolutionary process in microorganisms for new genes which have degradative properties resulting in biodegradability of synthetic compounds. (Daubaras and Chakrabarty, 1992). Further, if the pollutants are new to the environment, the microorganisms may not have the capability to degrade that pollutants, due to lack of biodegradative genes not have evolved. (Daubaras and Chakrabarty, 1992). so it became mandatory to have the naturally occurring microbes with better kinetics of degradation with a capability to attack a wide range of contaminants. Roberto Orellana *et. al.* (2018) described the extremophiles in Chile in a wide range of extreme environments like geothermal spring geysers located in the Altiplano and cold mountains in central Chile and ice fields. They described the molecular and physiological capabilities of extremophiles that may be advantageous for bioremediation processes and waste treatments. They described various types of extremophiles with potential biotechnological applications.

Thermophiles	Methanofollis,tationis from Tatio Geysers,
Acidophiles	Acidithiobacillusferrooxidans,Leptospirillumferriphilumfrom Central Chile copper ores and Atacama desert
Halophiles	Shewanellasp Asc-3 from Altiplano, Streptomyces sp HKF-8 from Patagonia
Alkaliphiles	Exiguobacteriumsp SH31 from Altiplano
UV and Gamma resistant bacteria	Deinococcusperaridilitoris from Atacama Desert
Psychrophiles	Pseudomonas putida ATH-43 from Antarctica

Table showing some extremophiles found in different zones of Chile (As described and reviewed by Roberto Orellana et. al. 2018)

Genetically modified microbes have been produced for degradation of various pollutants under defined conditions (Nezha Tahri Joutey et. al., 2012). These pollutants may involve complex chlorinated hydrocarbons such as dioxins: However environmental, ecological and regulatory constraints are the major problems for testing these genetically modified microbes (Men et. al., 2008).

#### **Some important Applications of Microbes for Bioremediation.**

Methanogens are the most diverse group of microbes growing in anaerobic environments and help in waste water treatment. Shu-ying-zhanget. al. (2011) investigated the bacterial community structure and showed that *Methylophilus methylotrophus*, *Mesorhizobium* and *Terrimonas* are related to anthracene biodegradation. They further suggested that a consortium of bacteria played an active role in waste management. Components of crude oil (including polycyclic aromatic hydrocarbon (PHA) compounds and ether derivatives used as gasoline additives can be degraded by *Pseudomonas* isolates (Kilbane et. al. 1982, Folsom et. al. 1990; Krumm et. al. 1993; Bhat et. al. 1994; Tom Coenye and Peter van damme 2003).

**Use of microbes in mining-** Use of microbes in mining known as biomining. *Thiobacillus ferrooxidans* was reported to be used in leaching of copper for mine. Its use has improved recovery rates and reduced operating costs. It allows extraction from low grade ores (Kundu et. al., 2014).

#### **Conclusion**

The main objective of this article is to gather the data depicting the process of bioremediation and role of microbes in cleaning the environment. Microbes are of

great importance in solid waste management, water waste management, biomining, oil spills and other biodegradation processes. These above all processes help in decontamination thus environment biotechnology has a great deal and further research must be carried on for cleaning the environment.

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