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BIOREMEDIATION

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Review Article

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ABSTRACT

Bioremediation is the use of naturally occurring organism to break down the harmful or toxic substances into less harmful or non-harmful substances. Not all type of contaminants are easily treated with bioremediation, like heavy metals are not easily absorbed by the microbes. Bioremediation can occur on its own or it may require any fertilizer or additional substance which will enhance the growth of the bacteria. Bioremediators are the microbes which takes part in the process.

INTRODUCTION

The use of biological organism for the removal of the contamination is the general definition for bioremediation. "Bio-remediate" the word itself suggests to solve an environmental problem such as contaminated soil or groundwater with the help of biological organisms. We can remove waste with the technique of Bioremediation that involves the use of organisms to remove or abate pollutants from a contaminated site.

Bioremediation is generally classified as in situ or ex situ ^[1,2].

1. In-situ bioremediation involves treatment of the contaminated material at its site of origin
2. Ex-situ involves the removal of the contaminated material to be treated elsewhere.

Types of bioremediation technologies are phytoremediation, bioventing, bioleaching, landfarming, bioreactor, composting, bioaugmentation, rhizofiltration, and bio stimulation.

Bacteria live virtually everywhere and also they are major players in bioremediation. Microorganisms do the task contaminant removal perfectly because the enzyme which is present in them makes them to use environmental contaminants as food and because of the size they can contact contaminants easily. For billions of years microorganisms have served in nature ^[3-5]. Microbes get energy from the contaminants by breaking chemical bonds and transferring electrons from the contaminants to an electron acceptor, such as oxygen. They "invest" the energy, along with some electrons and carbon from the contaminant, to produce more cells. If the microbes will not be working the dirt literally be covered the whole earth They have the power to breakdown the complex human, animal, and plant wastes so that life can continue from one generation to the next. Life would not be possible without microorganism. Whether microorganisms will be successful in destroying man-made contaminants in the subsurface depends on three factors: organism's type, contaminant type, and the geological and chemical conditions at the contaminated site.

Basic terms Used In Bioremediation

Co-metabolism

Technique used when the substrate is non-biodegradable [6,7]. The primary energy source of an organism is different substance while it is doing transformation of a chemical Reductive and Hydrolytic.

Dehalogenation

If chlorine or any other halogen is present in the contaminants it can take so much time to degrade that's why the halogen compound is replaced by hydrogen [8].

Fermentation

It is a process in which the organic compounds breaks down in many small particles.

CLASSIFICATION OF BIOREMEDIATION

As mentioned above, Bioremediation is generally classified as in situ or ex situ.

In situ

Treatment of the contamination is done on its site of origin [9-11]. This is cost effective. In this case there is no need to transport the contaminants from one place to another place the process of biodegradation will take place in the contamination site. Mostly soil and water comes under this classification because it is not possible to transport soil and water from one place to another place. It is more convenient then ex situ.

Ex situ

Treatment of the contamination is not possible on its site of origin. It has to be removed from its origin and transported to the place where bioremediation is possible. It is little more expensive then In situ process. This process also require removal of soil prior [12,13]. This technique is more able to treat wide range of contaminants.

ADVANTAGES OF BIOREMEDIATION

- Bioremediation is natural way of removing contaminants [14].
- Supervision is not required
- Cost is very less
- No use of equipment
- Chemicals which are toxic are removed from the environment.

DISADVANTAGES OF BIOREMEDIATION

- Time taking process.
- Heavy metals removal can be difficult.
- Only few types of contaminants can be removed.
- Process is not controllable [15,16].

MICROBIAL ROLE IN BIOREMEDIATION

The whole process of bioremediation depends on the activity of the microbes on the contaminated site. It is our responsibility to enable them to destroy the contaminants. We can use nutrients and other chemicals to stimulate microorganism whether the microbes are native or newly introduced to the site, it is very critical to understand that how they destroy contaminants [17]. The nutritional supplements which are required for the cleanup will be dictated by the types of microbial processes, by which we can get the idea what can be employed in the cleanup. After bioremediation is successful we can get the indication by the byproducts of microbial processes.

MICROBIAL ACTIVITY TO DESTROY CONTAMINANTS UTILIZATION OF PRIMARY SUBSTRATE

Microorganisms have the property to use the contaminants for their own growth. Utilization of substrate takes place when a microbe transforms the contaminant and uses it as a carbon source [18-25]. Organic contaminants provide carbon source (helps in new cell formation) and also they provide energy in the form of electron. Electron acceptor is the basic need of this process [26-30]. If the reaction is aerobic (presence of the oxygen) the reaction will be fast, and if the reaction is anaerobic (absence of the oxygen) the reaction will be comparatively slow. Breakage of the bond causes release of the electron which is accepted by electron acceptor, microorganism use the energy along with some carbon atom to reproduce.

FACTORS WHICH AFFECT THE RATE OF BIODEGRADATION

pH, temperature, moisture, carbon sources, soil texture, if the reaction is aerobic or anaerobic, the number of substituents, and the pollutant concentration are the physical factors [31-35]. Sometimes the condition can change according to microorganism. What's nutrient to some microbes is a toxic to others, what might be a beneficial pH to some is damaging to others [36,37]. Rate of reaction heavily depends on the condition if the condition is aerobic or anaerobic condition. If it is aerobic condition the degradation will be slow for a greater amount of substitutes, but if the condition is anaerobic degradation will be fast [38-40]. Molecules with the higher chlorination might take more time due to steric hindrance preventing access to necessary enzymes. Pore size of the soil having small pore size take years to degrade because of the decrease in bioavailability.

CONCLUSION

Bioremediation is a natural process which is used to remove the contamination from the environment. It may not be useful sometimes but if we have the area and time this is the best possible way to go, because it does not require many tools or continuous supervision or any kind of manual work, and also it is not very expensive. Bioremediation can of many types; all of them are cheap and natural way to clean our environment.

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