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Opinion Article

Challenges of the Use of Microorganisms for Bioremediation

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DESCRIPTION

A biological process called bioremediation transforms wastes into a form that can be used and reused by other species. Environmental contamination is a problem that the globe is now dealing with. Microorganisms are necessary for a critical alternative approach to problems. Due to their astounding metabolic activity, microorganisms may dwell in a wide variety of environmental conditions and can survive anywhere on the biosphere. Microorganisms have a wide range of dietary requirements, which makes them useful for bioremediation of environmental contaminants. Through the all-encompassing active action of microorganisms, bioremediation is heavily involved in the degradation, eradication, immobilization, or detoxification of various chemical wastes and physically dangerous elements from the environment. Degrading and changing pollutants, including hydrocarbons, oil, heavy metals, pesticides, dyes, and others, is the basic idea. That is accomplished enzymatically through metabolizing, so it has a significant impact on the resolution of numerous environmental issues. The biotic and abiotic conditions are two different sorts of factors that affect the pace of degradation. Different techniques and approaches are currently being used in the domain in various parts of the world. For instance, common ones include biostimulation, bioaugementation, bioventing, biopiles, and bioattenuation. Because each bioremediation technology has a unique application, each has advantages and disadvantages of its own.

Natural attenuation and artificial bioremediation are two categories of bioremediation. If the environmental circumstances are right, natural attenuation can occur without human intervention, but engineered bioremediation involves the addition of chemicals that encourage the microbes.

Petroleum molecules are broken down by environmental microbes as a source of carbon and nutrients for development and proliferation. The degradation of bacteria is extremely cost-effective and efficient as a dissipation method for breaking down complex organic chemicals into simpler ones when compared to chemical and physical processes. Normal secondary products of the bioremediation process include CO, water, and cell biomass, all of which are non-toxic. The greatest obstacle to biodegradation efficacy is the scarcity of contaminants that may be attacked by microbes. Improved bioavailability of hydrocarbons can be achieved with the help of surfactants. They emulsify hydrocarbons, allowing microorganisms to access them. Surfactants can be produced synthetically or naturally.

The kind of synthetic surfactant and the dose used at the contaminated site are two elements that affect whether they are successful or not. The biodegradation of hydrocarbons inside the soil is controlled by a number of ecological and biological characteristics that differ from location to location, making it difficult to apply bioremediation procedures in the real world. In order to select the best strategy for enhancing the biodegradation process, it is necessary to analyze the factors that restrict biodegradation.

Through the use of bacteria, fungi, and plants, bioremediation involves removing, modifying, immobilizing, or detoxifying different chemicals and physical pollutants from the environment. Through their enzymatic pathways, microorganisms function as biocatalysts and speed up the biochemical reactions that destroy the intended contaminant. Only when microorganisms have access to a variety of materials molecules that can assist them produce energy and nutrients to grow more cells they begin to act against pollution. The chemical makeup and quantity of the contaminants, the physicochemical properties of the environment, and their accessibility to microorganisms are only a few of the variables that affect how effective bioremediation. The lack of contact between bacteria and contaminants is the main factor affecting the rate of deterioration. Additionally, the distribution of bacteria and contaminants in the environment is not constant. Due to a variety of circumstances, regulating and optimizing bioremediation processes is a complex system. The presence of a microbial population capable of degrading the pollutants, the accessibility of contaminants to the microbial population, and environmental conditions are all considered here (type of soil, temperature, pH, the presence of oxygen or other electron acceptors, and nutrients).

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In comparison to other methods of treating polluted soil, such as landfilling or cremation, bioremediation has a variety of advantages (cost, ecologically friendly means of disposal, etc.). Large regions of the planet include contaminated land, which is dangerous for both the environment and human health. By using the natural microbial population to clean the contaminated site, bioremediation gives us the chance to put the pollutants' constituent parts back into the natural nutrition cycle. However, each application differs depending on the pollutants and ambient factors, therefore there is no one "off the shelf" treatment that works for all applications. The natural microbial community often outperforms any added microorganisms when it comes to pathogenic hydrocarbons. Non-genetically modified halo respiring organisms have been successfully added to an environment to reduce chlorinated hydrocarbons in both North America and Europe. Non-genetically modified halo respiring organisms have been successfully added to an environment to reduce chlorinated hydrocarbons in both North America and Europe. While there is a market for microbial inoculate, it has not yet been realized how useful and applicable genetically modified organisms could be. Social acceptance is one of the biggest barriers to using this technology. By using the PACT to study bioremediation, shortcomings in the conventional, one-dimensional approach frequently employed to promote technology adoption are exposed.