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Soil Bioremediation and Human Health

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Introduction

Soil bioremediation is another kind of technology to remove or stabilize soil pollutants and improve soil quality through the comprehensive utilization of metabolic activities of animals, plants, and microbes.

How Bioremediation Works. Bioremediation relies on stimulating the growth of certain microbes that utilize contaminants like oil, solvents, and pesticides for sources of food and energy. These microbes convert contaminants into small amounts of water, as well as harmless gases like carbon dioxide.

Different Types of Bioremediations

Microbial bioremediation, Phytoremediation, and Mycoremediation.

In Situ Remediation

In situ bioremediation relies on microorganisms and their activities to detoxify or destroy contaminants in place. The ability of microorganisms to break down contaminants into nontoxic or less toxic forms depends on the availability to microorganisms of nutrients, electron donors, and acceptors.

Options for treating contaminated soil include:

1. Biological treatment/bioremediation uses bacteria to break down substances in the soil.
2. Chemical oxidation converts contaminated soils into non-hazardous soils.
3. Soil stabilization involves the addition of immobilizing agents to reduce contaminants' leachability.

Soils have an impact on human health, both directly and indirectly. Soils supply nutrients essential to overall organisms and human life that are passed up the food chain from the soil through the plant to the consumer and they supply medications from inorganic and organic compounds, and organisms. However, contamination of soil may be a cause of human disease in cases of high exposure to

metals/metalloids, organic chemicals, soil pathogens, and radionuclides. Several recent articles have summarized the ways that soils influence human health.13-16 Despite the progress that has been made in unraveling the linkage between soil contamination and human health, there are still many areas that need additional investigation, such as an enhanced understanding of how chemical mixtures in the environment influence human health, and the linkage between soil ecology and human health via crop production and nutrition, one of the promising ways to address the potential negative effects of soil pollution on human health can be through bioremediation, with/without considering other technologies.

The negative effects of human activity on the Earth's surface have been the most severe in urban, industrial, and agricultural areas. Increased ecological awareness by society plays an increasingly significant role in expanding successful methods of remediating degraded areas. Contaminants, independently of the typology, with adverse effects on the natural environment and human health, have an increasingly global character, though their effect is observed at a local level in many cases. It is very important to seek out innovative solutions regarding polluted areas, where activities connected with bioremediation, which are safer and interfere less with the natural environment than other methods, have been gaining increasing significance. One of the main aims of introducing bioremediation treatments to degraded areas is to prevent the migration of contaminants into the food chain where they could pose a threat to human health. There are many technologies for the bioremediation of contaminated areas.

Bioremediation is an interesting but not really new concept. Also, previous studies have shown that in some cases inorganic pollutant uptake from the soil by plants was much smaller than expected. Uptake was too small to be of practical use in some cases, in order to reach pre-contamination levels over a reasonable amount of remediation time. However, the situation has changed over the last 20 years considering new advances, but it is certainly worth taking a close look at the relevant literature to see that much work is still needed. In general, bioremediation has potential applications in, eg, degradation of organic contaminants, removing potentially toxic or hazardous elements from water and soil, and the extraction/leaching of metals/metalloids from ores, as well as solid, liquid, and gaseous wastes. Among the different techniques of in situ, namely with plants, bioremediation is phytostabilization, which can be used in highly contaminated areas located in distinct climatic conditions and even in the presence of multi-elemental contamination. This technology makes use of plants with/without various

types of amendments, changing the properties of the soil to decrease the bioavailability of toxic elements. The function of plants, in this case, is connected with the absorption and accumulation of toxic elements in roots and/or precipitation or adsorption on the surface of the roots. Moreover, plants can also influence some changes in the chemical form of some trace elements and promote the precipitation and complexation of contaminants by altering soil properties, such as pH or oxidation-reduction potential, for instance by exudation of protons, hydroxyl ions, and/or organic acids.

Phytostabilization is a technology of diminishes the impact of the contaminated areas on the surrounding ecosystem and reduces the introduction of potential contaminants into the food chain. Moreover, plant development can improve other characteristics of the degraded soils such as structure, fertility, microbiota activity, and diversity, and control leaching as well as wind and water erosion. Nonetheless, in some scenarios of soil contamination and/or climatic conditions, the development of the vegetation directly on contaminated soils can be very difficult and the growth very slowly so, the obtaining of positive effects on chemical and biological parameters of contaminated soils can be delayed.