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Commentary

Bioremediation: Using Nature's Microbial Materials for Ecologically Friendly Environmental Cleaning and Restoration

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DESCRIPTION

The growing environmental risks resulting from Pesticide (PST) and Heavy Metal (HM) pollution of soils require the creation of long-term, efficient remediation plans. These pollutants are highly dangerous to human health and the environment because of their carcinogenic qualities and toxicity, even in little doses. Although a range of chemical and physical therapies are used worldwide, their popularity is frequently impeded by long remediation durations, expensive cleanup, and inefficiency in regions with very high concentrations of pollutants. An encouraging new approach to solving this problem is the use of microalgae in the bioremediation.

Bioremediation has become prevalent, particularly in broad regions, to maintain up HM and PST pollution. This thorough analysis sheds light on the use of microalgae in soil pollution mitigation by methodically investigating their bioremediation capacity. The methods by which microalgae cure Heavy Metals (HMs) and Particulate Matter (PSTs) is outlined, along with an analysis of the parameters that affect the process, including temperature, pH, co-existing pollutants, period of exposure, nutrition availability, and intensity of light. They also exhibit how different microalgae strains react to these toxins, how to tolerate them, and how well they can bioaccumulate these contaminants. The ultimate goal is to provide insightful information that will aid in the future development of effective and economically feasible microalgae-based solutions for pollution bioremediation.

Hazardous heavy metals and other pollutants are among the many pollutants found in the wastewater from the textile industry, affecting both the environment and public health. Native bacterial isolates may offer a more environmentally friendly method of purifying tannery effluent; however, genetic analysis is required to ascertain the suitability of these strains for bioremediation. Two new strains of *Bacillus subtillis* and seven new strains of *Enterococcus faecium* that were obtained from effluents from the Southern Tunisian Tannery (STT) were investigated in this study. Phenotypic characteristics are advantageous for bioremediation, such as the formation of biofilms, hydrophobicity, and exoenzyme activity.

Concerns over potential adverse effects of personal hygiene products and cleansers on the environment have been raised by the rising usage of these items in modern culture. These goods include a variety of chemical substances that may linger in waterways and cause pollution and environmental issues. Using microorganism's innate ability to break down or eliminate pollutants, bioremediation is emerging as a viable solution to these problems. In particular, the environmental and sustainability consequences of the existing methodologies used during the bioremediation of detergents and personal care products are examined in this research. Because bioremediation uses living organisms to clean detergents and other everyday goods, it is important for environmental regeneration. Its uniqueness comes from environmentally conscious, sustainable methods that, while avoiding replication, offer eco - friendly answers for eliminating pollution and promoting a healthy earth, examines the application of innovative biotechnological techniques, enzyme-based therapies, and microbial consortiums in the field of environmental restoration. These solutions' long-term sustainability and ecological ramifications are also evaluated. To reduce the negative effects of detergents and personal care products on ecosystems, practical and eco - friendly solutions must take into account the advantages and disadvantages of various bioremediation methods.

The majority of the finest minerals on the planet have already been used. Large amounts of stored tailings are left exposed to the environment in modern mining, which often concentrates on extracting lower-grade ores. Consequently, contemporary mines have become sites for resistance genes and metal (loid) migration, which may be a factor in the impending public health emergency. Consequently, the most difficult problems in environmental ecology are those related to tailings management and cleanup. Mine tailings restoration may benefit from bioremediation, an affordable method for treating multi-element mixed pollution, or co-contamination. The bioremediation solutions created to resolve the problems associated with non-

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ferrous metal mining tailings are the main topic of this review. These technologies tackle both the dangers to human health and the environment associated with multi-element contact to the ecosystem.

It offers an overview and analysis of the most recent bioremediation techniques for mineralizing metal (loid). Additionally covered is the function on plant-microorganisms and their processes in tailings cleanup. "Managing the trash with wastes" is essential to the development of bioremediation methods. This strategy emphasizes how waste products can help with environmental cleanup efforts. In this context, the idea of a circular economy which emphasizes recycling and reuse is relevant. International cooperation is urgently needed. Funding, data accessibility, and policy-making all require cooperation. Data exchange is important to the global expansion of bio-remediation.