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# Bioremediation by Natural carriers

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## Editorial

Currently, the least expensive and damaging way to remove xenobiotics from the environment is by bioremediation of contaminated soil or groundwater. Microorganisms that can degrade particular toxins can be immobilised, which promotes bioremediation procedures, lowers their costs, and enables the use of biocatalysts many times. Due to its ease of use and lack of toxicity, adsorption on surfaces is the most popular way of immobilisation among developed methods used in bioremediation [1]. A successful bioremediation depends on the carrier of choice. The type of procedure, the type of pollutants, and the characteristics of immobilised microorganisms must all be taken into account. Due to these factors, the article provides a summary of recent scientific studies on the effectiveness, the carrier's effect on microbes and pollution, as well as the type of research being done The twentieth century is remembered as a time of extraordinarily rapid technological and civilisational growth [2]. There are numerous methods for these contaminants to reach the ecosystem. For instance, the release of millions of barrels of crude oil into the environment was one of the main effects of the military confrontation between Iraq and Kuwait [3]. Scientists launched a number of experiments after the war to remove of oil from the polluted surroundings. Oil spills that are unintentional are another source of crude oil in ecosystems. One of the worst marine disasters ever occurred in Mexico in and caused the British Petroleum oil rig Deepwater Horizon to spill around million barrels of crude oil into the water. Another significant contaminant found in soils is pesticides. According to the USEPA, million tonnes of pesticides were used worldwide for agricultural reasons in. Because pesticides are hazardous to non-target organisms as well, these substances, when employed in large quantities for extended periods of time in a small region, induce significant diseases in local microflora and people [4]. In addition, many of the hazardous byproducts of pesticide biodegradation are priority pollutants. For instance, p-nitrophenol and dichlorophenol, respectively, are the main metabolites of the biodegradation of parathion and -dichloropenoxy acetic acid. Numerous bacteria have been found to be capable of biodegrading a variety of contaminants. The physiological status of the microorganisms, which are susceptible to a variety of environmental influences, determines the biodegradation rate. It is understood that immobilisation increases microbial resistance to harmful environmental effects. This review's main goal is to present and debate the most recent data regarding the role of natural carriers in bioremediation procedures involving immobilised cells. Immobilization techniques for bioremediation are also presented in the article [5]. Habitat, permits ecological restoration, and facilitates hazardous substance detoxification because only around 10% of the total population of soil microorganisms are capable of degrading substances; the removal of contaminations through natural attenuation is a lengthy process. The bioaugmentation technique, in which specialised degraders are introduced into the soil, may be used to boost bioremediation efficiency in situ. When the local microflora cannot degrade pollutants or when there are insufficient numbers of microorganisms that can do so, this approach is used [6]. Microorganisms put into the polluted environment as a free or immobilised inoculum should be able to decompose specific contaminants and survive in a foreign and unfriendly habitat in order for the process of bioaugmentation to be successful. Microorganisms can be isolated from contaminated soil in advance and multiplied, or their functional capacity can be increased in a lab. Additionally, non-native strains or genetically altered microorganisms may be added to the remedied soil. However, due to competition, particularly for nutrients, the outcome of bioaugmentation depends on the interaction between external and native populations of microorganisms. By altering the physical and chemical properties of the soil, biostimulation is utilised to speed up in situ bioremediation processes. To do this, substances are added to the soil, such as nutrients (such as biogas slurry, manure, wasted mushroom compost, rice straw, and corncob) or electron acceptors. It is challenging to foresee the outcome of remediation of contaminated areas since in situ processes are out of control. By regulating the physico-chemical parameters, ex situ technologies enable more effective pollution removal, which reduces the overall reclamation time. Ex situ procedures provide benefits that outweigh their drawbacks, which include increased costs and the risk of contamination spreading during transfer. Ex situ methods involve moving contaminated medium to the process site via excavation or extraction. In artificial wetlands, liquids can be clean, while semi-solid or solid wastes can be treated in slurry bioreactors. Through land farming, composting, and biopiles, solid contaminants are decomposed. By regulating the physico-chemical parameters, ex situ technologies enable more effective pollution removal, which reduces the overall reclamation time. These benefits exceed the drawbacks of ex situ procedures, such as increased these systems use naturally occurring microbes or strains with particular metabolic capacities to change harmful substances. Because they operate under carefully regulated circumstances, slurry bioreactors are among the best utilised technologies used in the bioremediation of contaminated soils. It enables the stimulation of microbial activity. One of the most popular methods for soil bioremediation is land farming. With this procedure, excavated polluted soils are dispersed on the ground's surface in a thin layer. By aerating the soil and adding minerals, nutrients, and moisture, aerobic microbial activity is increased. Landfarming is a reasonably simple process, but it only works well and costs little for toxins that break down quickly.

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## Conflict of Interest

None

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