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Marine Bioremediation - A Sustainable Biotechnology of Petroleum Hydrocarbons Biodegradation in Coastal and Marine Environments

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Bioremediation is now the best successful initiative to mitigate and to recover sites contaminated with hydrocarbons and has been the preferred process for clean-up contamination around the oceans of the world. The advantages of marine microorganisms in the removal of petroleum hydrocarbons, exemplifies the eco-sustainable bioremediation that can be achieved in sensitive marine environments and probably until now the only approach for biodiversity rich and fragile environments. The use of bio-surfactants to protect the marine environment is particularly attractive since a number of marine bacteria and microalgae strains can produce bio-surfactants during growth on hydrocarbons. Moreover, according to recent results, marine microorganisms, exhibit the maximum yield and surface-active property compared to terrestrial species. Because Petroleum-derived products are the major source of energy for industry and societies. The transport of petroleum across the world represents a frequent and potential for oil spills in the marine environment. Actually, it is widely recognized that petroleum hydrocarbons contamination has impacted, and damaged the world oceans, seas and coastal zones and represent a constant threat to the planet Earth health sustainability.The recent catastrophe and sequels remnants after approximately 600,000 tons of crude oil hydrocarbons released by the Deep-water Horizon explosion in the Gulf of Mexico, has increased the volume of petroleum enters the marine environment each year (~ 1.3 million tons). That scenario and the past oil spill accidents in oceans at large scale and the continuous anthropogenic negligence in coastal seas and Bays, has also contributed to renovate the world public awareness on the magnitude of the environmental damage.

At small scale, productive environments and biota are highly impacted, especially in low-energy habitats, such as lagoons and salt marshes. Marine biotechnology is a technology of the Century to contribute to the sustainable development of our planet. The growing pressure on our natural resources by the increasing population growth and pollution also has impacted the planet on water and land resources. Contaminated coastal and marine environment, generally result from the continuous carelessness and negligence of anthropogenic activities on the former unlimited abundance of land and marine resources of early times. The increasing need to remedy adverse effects of anthropogenic activities on estuarine, coastal and marine ecosystems, has prompted the development of effective bioremediation strategies. Nevertheless, probably one of the main interests of bioremediation is its compatibility with the major natural biogeochemical cycles and recycling routes of the earth and marine ecosystems, which make bioremediation a sustainable and environmentally eco-friendly approach for cleanup-polluted environments. Moreover, given the difficulties of the level and the scale in marine areas, very little practical of the interest to find ecofriendly solutions for the bioremediation and biodegradation of petroleum hydrocarbons in the marine environment, the use of marine microorganisms and their respective bio-surfactants is preferable to that non-marine and of synthetic origin. The aim of this review is to integrate the advantages of marine bioremediation coupled to hydrocarbon removal from marine environments. This alternative of bioremediation is a natural process of waste treatment, relatively cost-effective than other remediation approaches that are used for clean-up of hazardous waste in coasts, seas and oceans that can be adaptable to variable environmental conditions, viz, estuarine, coastal and marine pollution and is widely accepted by the society.

bioremediation and restoration has been carried out for open marine systems. The physical, chemical and mechanical technologies to remove petroleum hydrocarbons from contaminated marine environments in most of the cases are unsustainable and can be expensive. Bioremediation is a cost-effective and sustainable biotechnology for the treatment of contaminated coastal and marine sites. This biotechnology utilize living cells or biological components to complete biodegradation of complex organic contaminants to other simpler organic compounds into carbon dioxide, water, inorganic compounds, and cell protein. The objective of this review is to update the current status and potentials of marine bioremediation as a sustainable alternative for impacted fragile and sensitive marine environments.

Conclusion

From the analysis of this review, we conclude that bioremediation is an effective eco-friendly treatment tool for the cleaning of certain oil-contaminated estuaries, shoreline, seas and oceans. Because of the natural processes that are encouraged by bioremediation, ensures a lower environmental impact compared with mechanical, physical and chemical removal approaches of oil in the sea. It is expected that combined and integrated studies on microbial populations and respective production of biosurfactants will enhance the biodegradation approaches of spilled-oil at the sea. The complex composition and toxicity of the oil spill could be attenuated by reducing and converting the many components from hydrocarbons into innocuous and recyclable products such as carbon dioxide, water, and biomass. New innovative bioremediation products which are tailored to specific contaminated environments are required as well as degradative microbial strains, specifically designed to biodegradate or detoxification of pollutants in saline environments. A well designed microbial consortium will have complementary catabolic pathways, as well as the potential to disperse and

make the hydrocarbons readily bioavailable. Therefore, novel microorganisms should be bioprospected and screened for bioremediation and biodegradation approaches on complex mixtures of pollutants without causing adverse effects. The possibilities of production of biosurfactants from microorganisms grown on petroleum hydrocarbons will effectively improves the bioremediation potentials on oil pollutants, particularly oil polluted in marine environment and exemplifies the eco-sustainable bioremediation that can be achieved in sensitive marine and fragile environments.