Oil degrading bacteria | evaluation

Introduction

Oil degrading bacteria are considered as the dominant hydrocarbon which helps in degrading the aquatic systems such as oceans. These bacteria's are capable of diverse metabolic pathways which enable them to utilize most *recalcitrant petroleum hydrocarbons* that are not present in fungi. In recent years the microbial biodegradation ofpollutantsis a sustainable ways to clean up contaminated environment which is strive by the humans. The oil degrading bacteria eliminates a wide range of pollutants and wastes from theenvironment. Biological processes is requires to promote a sustainable development of our society with low environmental impact that plays a major role in the removal of contaminants. The bacteria are capable of degrading hydrocarbons proliferate quickly whenever there is a spill of crude oil or refined oil.

Over hundreds of millions of years the microorganisms use oil as their source of energy and collectively feeds on all the different compounds contained in the oil is well established and diverse as they always have the capability of degrading oil always seem to be present. The use of the oil degrading bacteria has been successfully applied for the treatment of waste and wastewater in controlled systems.

History of the oil degrading bacteria

The oil degrading bacteria and other microorganisms degraded the chemical substance this process is termed as bioremediation. It is not a new concept many Microbiologists have studied the process since the 1940s but however, it became known in late 1980s as a technology for cleaning up of shorelines which are contaminated with spilled oil. For investigating the use of oil

degenerating bacteria several research studies have recently been performed for oil-spill cleanup in freshwater, seawater and terrestrial areas as this technique has been found to have a potential for broad applications in terrestrial and freshwater environments for treating soils and sediments contaminated with oil and other substances, as well as for coastal environments impacted by oil spills.

The Biological and Chemical Processes of Oil degrading bacteria

The oil degrading bacteria results in the biodegradation which is a naturally occurring process where a large component of oil weathering organic molecules are broken down or alter in to other substances resulting to produce fatty acids and carbon dioxide. For preventing from the ecological damage the process may not be considered as fast enough but it does the immediate removal of the oil which is therefore an important first line of defense. The oil degrading bacteria's are found everywhere but their presence doesn't mean that only environmental conditions are ideal for them along with it the others are the location, duration, and form of an oil spill strongly affect how quickly biodegradation will occur.

Biological processes

The oil degrading bacteria possess the enzymatic capability to degrade petroleum hydrocarbons where as some microorganisms degrade alkanes, others aromatics, and others both paraffinic and aromatic hydrocarbons. The normal alkanes that ranges from C_{10} to C_{26} are viewed as the most readily degraded, but low-molecular-weight aromatics, such as benzene, toluene and xylene, are among the toxic compounds found in petroleum, are also very readily biodegraded by the bacteria's. The complex structures are more

resistant to biodegradation, meaning that fewer microorganisms can degrade those structures and the rates of biodegradation are lower than biodegradation rates of the simpler hydrocarbon structures found in petroleum. Therefore it means that the greater will be the complexity of the hydrocarbon structure which means the higher the number of methyl branched substituent's or condensed aromatic rings are present the slower will be the rates of degradation by the bacteria's.

Chemical Process

The major metabolic pathways for hydrocarbon biodegradation are well known. The initial steps in the biodegradation of hydrocarbons by the oil degenerating bacteria involve the oxidation of the substrate by oxygenases and subsequently the alkane are converted to carboxylic acids that are further biodegraded via ß-oxidation. The aromatic hydrocarbon rings are hydroxylated to form diols. The oil degrading bacteria are the dominant hydrocarbon degraders mainly because of the biodegradation of aromatic hydrocarbons results in detoxification and do not produce potential carcinogens. The complete biodegradation of hydrocarbons produces the non-toxic end products carbon dioxide and water, as well as cell biomass which can be safely assimilated into the food web.

Factors that affect the oil degrading bacteria

Following are the important factors that affect the oil degrading bacteria:-

Physical nature of oil:-

If the oil is heavy and viscous then the biodegradable components must first diffuse through that thick matrix to the oil-water interface so that the

bacteria’s can access them and if the oil is lighter than the faster will be the diffusion the faster this diffusion.

Chemical nature of oil:-

The biodegradation rate of the bacteria depends on the depending on the particular hydrocarbons that make up the spilled oil. Those hydrocarbons in which carbons chains are unbranched they can degrade quickly where as the branched structure of the hydrocarbon are arranged in multiple rings making it more difficult to biodegrade. The greater the complexity of the hydrocarbon structure, i. e., the higher the number of methyl branched substituent’s or condensed aromatic rings, the slower the rates of degradation.

Availability of nutrients:

These bacteria’s have many nutritional requirements which includes nitrogen, phosphate and other nutrients. These substances are found in nature but may be present in limiting quantities. When the food levels are high the bacteria’s can degrade the hydrocarbons quickly where as when the nitrogen and phosphate level are very low then the biodegradation takes place slowly.

Availability of oxygen:

Due to the presence of the oxygen the enzymatic process of breaking down oil is usually most rapid and even the degradation rate could be slow if a spill is occurred in a location where oxygen levels are low.

Water temperature:

The oil degrading bacteria degrades the oil more rapidly in warmer waters. The problem is not where as the colder water have the physical effects on the speed of degradation as the oil evaporates more slowly leaving more oil left in the water for the oil degrading bacteria's .

Conclusion

The bacteria's are selected to function in particular habitats with extremes of pH, temperature, salinity, or other conditions. The oil degrading bacteria are mostly common in sea water all over the world and are particularly essential to address oil polluted waters as soon as possible as the contamination can have the potential to damage fishery resources and affect the health of those animals and humans that consume contaminated fish. The persistence of these bacteria is proof of their ecological competitiveness for the development biotechnological solutions for oil pollution. The underlying idea of bioremediation is to accelerate the rates of *natural* hydrocarbon biodegradation by overcoming the rate-limiting factors. However it has also been observed, that oil degrading bacteria's have the capacity to degrade oil in nearly all coastal environments, and that environmental parameters besides nutrients will affect actual degradation rates in the field. Finally, there are many advantages has been gained from the oil degrading bacteria's from a quick cleanup of an oil spill.

References

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