

Oil degrading bacteria: history of and processes



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Oil Degrading Bacteria

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 of pollutants is a sustainable way to clean up contaminated environment which is strived by the humans. The oil degrading bacteria eliminates a range of pollutants and waste from the environment that are broad and extensive. For the sustainable development the biological process is required which has low environmental impact hence plays a significant role for the removal of contaminants (Hazen, et, al, 2010). 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 take nourishment from various compounds that are present in the oil are well developed and diverse as they always have the efficiency for the degrading the oil. For the treatment of waste and waste water the use of the oil degrading bacteria has been strongly applied in controlled systems (Hazen, et, al, 2010).

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

in fact it has been studied by many Microbiologists in 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 degrading bacteria several research studies have recently been performed for oil-spill cleanup in freshwater, seawater and terrestrial areas and also the coastal environments which has been contacted by the oil spills as this technique has the potential for the wider applications in freshwater and terrestrial environments for the treatment of the polluted oil and different substances by using soils and sediments (Chavan, & Mukherji, 2008).

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 a major line of defense (Chavan, & Mukherji, 2008). 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 may include the following:-

- Location
- Duration
- What is the form of an oil spill?

- How quickly and strongly the process of biodegradation will occur?

Biological processes

The oil degrading bacteria degrades the petroleum hydrocarbon as they have the enzymatic characteristics where as other microorganisms have the capability for degrading aromatic compounds, alkanes, aromatic hydrocarbons as well as the paraffinic hydrocarbons. The normal alkanes that range from C₁₀ to C₂₆ can be degraded quickly, but as compare to the aromatic compounds which have low molecular weight like benzene, xylene and toluene are listed as the toxic substances which are present in petroleum (Yakimov, Timmis, & Golyshin, 2007). The structures that are complex shows more resistance to biodegradation which means that the lesser microorganisms have the capability to degrade the structures meaning that fewer microorganisms can degrade those structures that are made up of simple hydrocarbon chains that are found in petroleum (Yakimov, Timmis, & Golyshin, 2007).

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 (Kostka, et, al, 2011).

Chemical Process

The major metabolic pathways are well known for biodegradation of hydrocarbon. The beginning steps of hydrocarbons degradation by the oil degenerating bacteria that contains the oxygenases which involve the oxidation of the substrate and ultimately the alkane are converted to

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carboxylic acids which are then further biodegraded by the process of β -oxidation. The aromatic hydrocarbon rings are hydroxylated to form diols. The oil degrading bacteria are the dominant hydrocarbon degraders mainly because of the ability of aromatic hydrocarbon biodegradation that subsequently results in the detoxification of the toxin and does not produce potential carcinogens (Hassanshahian, Emtiazi, & Cappello, 2012).

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 the matrix that is thick 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 (Al-Saleh, Drobiova, & Obuekwe, 2009).

Chemical nature of oil:-

The biodegradation rate of the bacteria particularly depends on those hydrocarbons that usually 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. As the greater the structure of hydrocarbon chain is complex then the higher will be the number of aromatic rings, methyl branched substituents and hence subsequently the slower will be the rates of degradation (Rojo, 2009).

Availability of nutrients:

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These bacteria's have many nutritional requirements which includes nutrients along with some chemical elements that can phosphate and nitrogen. 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 (Rojo, 2009).

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 (Atlas, & Hazen, 2011).

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 (Atlas, & Hazen, 2011) .

Conclusion

With the extreme changes of temperature, pH, salinity and various different conditions the function of the bacteria is particularly selected. The oil degrading bacteria are mostly common in sea water all over the world and are particularly plays an efficient role in addressing the polluted water as quickly as possible so to prevent the fishery damages as the contamination can affect the fishes and also the health of those organisms that are consumed by the humans. The staying power of the bacteria is a proof of <https://assignbuster.com/oil-degrading-bacteria-history-of-and-processes/>

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 the environmental parameters and almost especially in all coastal environments that are actually affecting the rate of degradation. Finally, there are many advantages has been gained from the oil degrading bacteria's from a quick cleanup of an oil spill.

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