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TOXIC EFFECTS OF PETROLEUM AND REMEDIATION STRATAGIES BY BACTERIA FOR ERADICATION OF PETROLEUM POLLUTANTS

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Abstract

Petrol consumption has increased in past few decades the increase in demand and supply of petroleum products has increased but regards to that it has also increased a problematic issue that is pollution due to it, the pollution caused by its refining , transport and extraction is a frequent thing occurring. The oil spills accidental leaks and other unintended spills forms a layer over water body as it is non soluble it also is extremely toxic, life forms in ocean and other life forms consuming such are also affected indirectly. Mechanical and chemical methods do not offer 100% eradication of these pollutants thus making it an overall threat to our ecosystem. Eco friendly and biological methods should be brought in action with a very efficient and accurate way of eradicating these pollutants . One of the known method is bioremediation by bacteria's that degrade petroleum by using them as their nutrition source their are many known bacteria species that degrade petroleum but each of them possess a different level of degradation depending on factors and their growth properties . The isolation, characterization, extraction and production of such bacteria's must be done in a large scale also new and powerful hydrocarbon degrading bacteria's should be engineered by genetic engineering methods to overcome this problem. The abstract emphasizes the toxic effects of these hydrocarbons and effectiveness of degrading bacteria in tackling complex petroleum mixtures to deal up the problem.

Introduction

Petroleum was formed from organisms living in the sea. As these organisms died, their bodies settled at the bottom of the sea and got covered with layers of sand and clay. Over millions of years with high temperature, high pressure and in absence of air transformed the dead organisms into petroleum and natural gas. Petrol, also known as gasoline, is a complex mixture of hydrocarbons derived from crude oil. It is a naturally existing liquid comprising mixture of hydrocarbons including alkanes, aromatics, asphaltenes and resins. More than seventeen thousand distinct chemical compounds in crude oil have been identified, making it perhaps the most complicated natural mixture of organic components (Yasin et al., 2013). Petrol has many uses .it is involved in daily life use as fuel oils for heating and electricity generation involved in vehicle and feedstock's for making the chemicals, plastics, and synthetic materials and other forms to produce energy. Thus, the supply demand chain of petroleum has drastically increased is past few decades.

The drastic need has resulted in more and frequent accidental spills and improper disposal of petroleum. It thus pose a significant threat to the environment as petroleum contains carcinogenic components , Frequent exposure to sub-lethal doses of these compounds can cause several physiological impairments, leading to a number of health impacts including liver damage, hemolytic anemia, weight loss, gastrointestinal deterioration, impaired immune system and reduced productivity (Paruk et al., 2016)

Recently, anthropogenic practices such as industrial activities, petroleum and petroleum derivatives (such as gasoline, diesel, and kerosene spills) and incomplete combustion of fossil fuels have caused an accumulation of petroleum hydrocarbons in the environment. In fact, petroleum and derivatives have a major ecological impact on contaminated marine and terrestrial ecosystems (Santos et al., 2011) all petroleum -derived products have adverse impacts on human health and the ecosystem.

Hydrocarbon fractions that are more tightly sorbed onto soil organic matter are more recalcitrant and resistant to degradation compared to volatile or soluble hydrocarbons. This is a very important consideration when designing or applying a strategy for the degradation of contaminated soils as petrogenic hydrocarbons tend to strongly adsorb to the soil (Baboshin & Golovleva, 2012)

As bacteria present in the environment needs carbon and nutrition source for their growth and reproduction they degrade or metabolize most of the petrroleum hydrocarbons they encounter. (Hazen et al., 2010; Kleindienst et al., 2015a).

Most petroleum hydrocarbons encountered in the environment are ultimately degraded or metabolized by indigenous bacteria because of their energetic and carbon needs for growth and reproduction, as well as the requirement to relieve physiological stress caused by the presence of petroleum hydrocarbons in the microbial bulk environment (Hazen et al., 2010; Kleindienst et al., 2015a).

Fortunately, naturally occurring bacteria have evolved the remarkable ability to degrade these pollutants. This review explores the potential of petrol-degrading bacteria for environmental bioremediation.

Literature Review

Petroleum waste's has become a huge menace in the environment. Moreover, the impacts of pollutant's are a threat to living being's these spills can still cause damage, especially if they happen in sensitive environments, like beaches, mangroves, and wetlands. Large oil spills are major, dangerous disasters. These tend to happen while refueling ships , pipelines break, ships and submarine sink, or drilling and other transportations involving petroleum go wrong. Thus this damage to the environment and economy can lead to a huge impact that may last for years and even decades following a large unintented oil leak. Various studies have documented the existence and diversity of bacteria capable of degrading petrol hydrocarbons. These bacteria, belonging to genera like Pseudomonas, Alcanivorax, and Rhodococcus utilize enzymes to break down complex hydrocarbon molecules into simpler forms they can use as energy sources for growth and reproduction . Research suggests that bacteria isolated not only from petrol-contaminated environments but also from unpolluted habitats can show efficient petrol degradation properties.

BIOREMEDIATION AND CLEAN-UP STRATEGIES

According to Nyer (Nyer, 1998), the term "bioremediation" refers to all biochemical reactions of natural attenuation, which includes all biotic and abiotic processes used to reduce contaminant levels. "Biodegradation" is the primary mechanism to reduce biodegradable contaminants. This method offers low risks to contaminated sites, and it is an alternative with a favourable cost-benefit ratio for treatment (Korda et al., 1997) (Crapez et al., 2002).

Bioremediation agents are classified as bioaugmentation agents and bio stimulation agents based on the two main approaches to oil spill bioremediation. Numerous bioremediation products have been proposed and promoted by their vendors, especially during early 1990s, when bioremediation was popularized as "the ultimate solution" to oil spills (Hoff, 1993). Biocatalysis is opening new paths toward improving the development of products and processes to reduce industrial costs and the generation of toxic sub products and, consequently, the impact on the environment. Both enzymatic bioremediation and new clean energy production are contributing to minimising fossil fuel damages (Alcalde et al., 2006)

FACTORS INFLUENCING BIODEGRADATION OF HYDROCARBONS

The key purpose of remediating polluted sites is to diminish the hazard of contaminants to human health as well as the environment through the application of optimal remediation techniques (Perelo, 2010) . As already discussed the application of bioremediation technologies in the actual environment (field) is challenging as hydrocarbon biodegradation in soil is determined by a number of environmental and biological factors varying from site to site (Al-Sulaimani et al., 2010) . Parameters influencing bioremediation include the nature and concentration of the contaminants, type and structure of the soil and the presence and survival of contaminant-degrading microorganisms. Environmental conditions such as the pH of the soil, oxygen availability and nutrient content can also limit the bioremediation process by inhibiting the growth of hydrocarbon-degrading microbes and/or reducing the bioavailability of pollutants to microbial attack.

DISCUSSION

Petrol-degrading bacteria offer a promising and eco-friendly approach to bioremediation compared to other traditional techniques. These bacteria represent a natural solution that can potentially break down pollutants into or less harmful products. Approaches to develop more efficient and strong degrading bacteria's should be brought it action. Existing bacteria's should be genetically modified to absorb and degrade large amounts of oil spills. Moreover, bioremediation using bacteria is often less expensive and disruptive compared to physical or chemical remediation methods.

However, certain limitations need to be addressed. Bioremediation can be a very time-consuming procedure, and the effectiveness can be hindered by factors such as the type of petrol and its refined percentage, weather conditions, and the presence of other contaminants. Further research should primarily focus on inventing and discovering new methods to enhance the efficiency, accuracy and escalating speed of bioremediation using petrol-degrading bacteria. Additionally, exploring the potential of genetically modified bacteria with improved degrading capabilities is an area of ongoing investigation.

CONCLUSION AND RECOMMENDATIONS

Petrol-degrading bacteria hold immense potential for environmental remediation. Bioremediation, the use of living organisms to detoxify contaminated environments. The calibre of petrol-degrading bacteria for environmental clean-up is immense. Understanding the way they work, their diversity, metabolic pathways, adhesion capabilities, optimal growth requirements and conditions is crucial for maximizing their effectiveness. Therefore, by overcoming limitations and harnessing their potential through further research, these tiny allies can play a crucial role in cleaning up our environment, ecological balance of our planet and mitigating the harmful effects of petrol spills and pollution. Furthermore, novel and mutated forms of bacteria can be found from contaminated soils near fuel stations and other places where minor oil spills are seen. This approach might help to counter this problem in a much more effective manner as strong variants of petroleum degrading bacteria can be found over such places. Also, the environmental factors might help to enhance the degradation capabilities of these bacteria.

Future approaches can also be made as bacteria's should be genetically engineered in such a way that the hydrocarbons becomes their primary source of nutrition thus the bacteria will primarily degrade its nutrition source first that will be the petroleum.

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