Hello students, this lecture series is for FYBSc

Microbiology semester one paper code M IG101 paper titled

Introduction and scope of Microbiology which is a Generic

elective paper so Unit 5 microbes and human health and

Environment Model name is Bioremediation e.g. hydrocarbons in oil spills.
Module number

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outline of the series includes Introduction of hydrocarbons & Bio-remediation

Types of bioremediation

Methods of bio-remediation

Microorganisms involved in bio-remediation

Advantages of bio-remediation

Disadvantages of bio-remediation

So in the learning outcomes for

students will be able to

explain the term bio-remediation and hydrocarbons.

State the advantages of bio-remediation.

State the disadvantages of bio-remediation.

write a short note on the microorganisms involved in bio-remediation.

explain methods of bio-remediation.

. So coming to the introduction part

Introduction of hydrocarbons and bio-remediation

Hydrocarbons - compounds made of carbons and hydrogen.Hydrocarbons found on Earth naturally occur in crude oil, they are major energy source in today's world. Increase in industrialization & development has seen an increased used of hydrocarbon containing fuel like petroleum and its products, diesel, natural gas.Due to this unprecedented increase in using fuels, accidents and pollution related to this is increasing at an alarming pace. Hydrocarbon pollution -they have toxic, fatal and disastrous effect on the aquatic, terrestrial as well as on the atmosphere. major reasons -Oil spills in oceans, leakages in pipelines carrying crude oil & gas exploration activities, and accidents during production, refining, transport and storage of petroleum and its by- products. leakages - threaten the aquatic or marine life all over.Land pollution due to effluents from industries; untreated, toxic waste from refineries are one of the main causes of ground water contamination, overall reduced productivity of agricultural land.

There are Types of bioremediation

In Situ Bioremediation

involves a direct approach for the microbial degradation of xenobiotics at the sites of pollution (soil, ground water). Addition of adequate quantities of nutrients at the sites promotes microbial growth. When these microorganisms are exposed to xenobiotics (pollutants), they develop metabolic ability to degrade them.The growth of the microorganisms and their ability to bring out biodegradation are dependent on the supply of essential nutrients (nitrogen, phosphorus etc.).

Two types of in situ bioremediation

Intrinsic bioremediation

The inherent metabolic ability of the microorganisms to degrade certain pollutants is the intrinsic bioremediation.In fact, the microorganisms can be tested in the laboratory for their natural capability of biodegradation and appropriately utilized.

Engineered in situ bioremediation

The inherent ability of the microorganisms for bioremediation is generally slow and limited.by using suitable physicochemical means (good nutrient and O_2 supply, addition of electron acceptors, optimal temperature).

Advantages of in situ bioremediation

- Cost-effective, with minimal exposure to public or site personnel.
- Sites of bioremediation remain minimally disrupted.

Disadvantages of in situ bioremediation

- Very time consuming process.
- Sites are directly exposed to environmental factors (temperature, O_2 supply etc.)
- Microbial degrading ability varies seasonally.

Ex Situ Bioremediation

The waste or toxic materials can be collected from the polluted sites and the bioremediation with the requisite microorganisms (frequently a consortium of organisms) can be carried out at designed places. This process is certainly an improvement over in situ bioremediation, and has been successfully used at some places.

Advantages of ex situ bioremediation

- Better controlled and more efficient process.
- Process can be improved by enrichment with desired microorganisms.
- Time required in short.

Disadvantages of ex situ bioremediation

- Very costly process.
- Sites of pollution are highly disturbed.
- There may be disposal problem after the process is complete.

Bioremediation Techniques

Bioaugmentation

The addition of bacterial cultures to a contaminated medium used frequently in in situ processes. Two factors limit the use of added microbial cultures in a land treatment unit:

(a) nonindigenous cultures rarely compete well enough with an indigenous population to develop and sustain useful population levels .

(b) most soils with long-term exposure to biodegradable waste have indigenous microorganisms that are effective degraders if the land treatment unit is well managed.

Bio filters

· The use of microbial stripping columns used to treat air emissions.

Bioreactors

· The use of biological processes in a contained area or reactor for biological treatment of relatively small amounts of waste. This method is used to treat slurries or liquids.

Biostimulation

· The stimulation of the indigenous microbial populations in soils and/or ground water.

· This process may be done either in situ or ex situ.

Bioventing

· The process of drawing oxygen through the contaminated medium to stimulate microbial growth and activity.

Composting

- is a technique that involves combining contaminated soil with non hazardous organic amendments such as manure or agricultural wastes.
- The presence of these organic materials supports the development of a rich microbial population and elevated temperature characteristic of composting

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Landfarming/Land Treatment/Prepared Bed

· is a simple bioremediation technique in which contaminated soil is excavated and spread over a prepared bed and periodically tilled until pollutants are degraded.

Biopiling

- are a hybrid of landfarming and composting.
- Essentially, engineered cells are constructed as aerated composted piles.
- Adding compost to contaminated soil enhances bioremediation because of the structure of the organic compost matrix.

Microorganisms involved in Bio-remediation

Many microorganisms can degrading crude oil. They first attack these organic chemicals by the enzymatic apparatus acquired during the cycle of enrichment, when they are exposed to these specific or structurally related compounds.Presence of these pollutants in the environment either induces or depresses the enzymatic function of microorganisms.biodegradation of complex hydrocarbon usually requires the assistance of more than a single species. single microorganisms lonely cannot mineralize most hazardous compounds into water and CO2 as final product. for better bio-degradable, the method of cooperation between the microorganisms can be utilized. Most bioremediation systems runs under aerobic condition, but running a system under anaerobic condition may permit microbial organisms to degrade otherwise recalcitrant molecules.microorganisms that carry out biodegradation in most different environments are identified as active members of microbial consortiums.microorganisms include *Moraxella , Aeromonas,Beijerinckia, Pseudomonas, Flavobacteria, chrobacteria, Nocardia Atinetobacter, Burkholderia Brevibacterium, Mycobactena, ,Modococci , Streptomyces, ,Corynebacteria, Bacilli, Gordonia ,Arthrobacter,Aeromonas, Aspergillus ,Cyanobacteria, , Mucor, Penicillium, Fusarium, Rhodotorula, Sporobolomyces* and *Candida.*Microorganism need carbon and macronutrient like nitrogen and phosphorous to ensure effective degradation of the oil.

Advantages of Bioremediation

- Bioremediation is a natural process, it is widely accepted by public as a effective way to remove hydrocarbon waste.
- The biodegraded compounds are harmless and can be incorporated in the environment (carbon dioxide, water and biomass).
- Bioremediation helps to degrade the pollutants on the site without causing additional hazard.
- It is relatively inexpensive than other techniques used for clean-up of hazardous waste products.

Disadvantages Of Bioremediation

- Bioremediation process is limited to compounds that are biodegradable.
- Growth of microorganisms for the bioremediation of the pollutant site is often very specific and demanding Sites containing many different types of contaminants in various phases (solid, liquid ,gas) which needs special treatment.
- It is time consuming process and may need extra pre-treatment before they can be degraded by microorganisms (excavation, incineration) Which makes this process tedious.

References and Credits

According to

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Thank you