



Sengamala Thayaar Educational Trust Women's College

(Affiliated to Bharathidasan University)

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Sundarakkottai, Mannargudi-614 016.

Thiruvarur (Dt.), Tamil Nadu, India

III B.Sc., Microbiology

SEMESTER VI

MAJOR BASED ELECTIVE

MICROBIAL BIOTECHNOLOGY AND BIOETHICS-16SMBEMB3

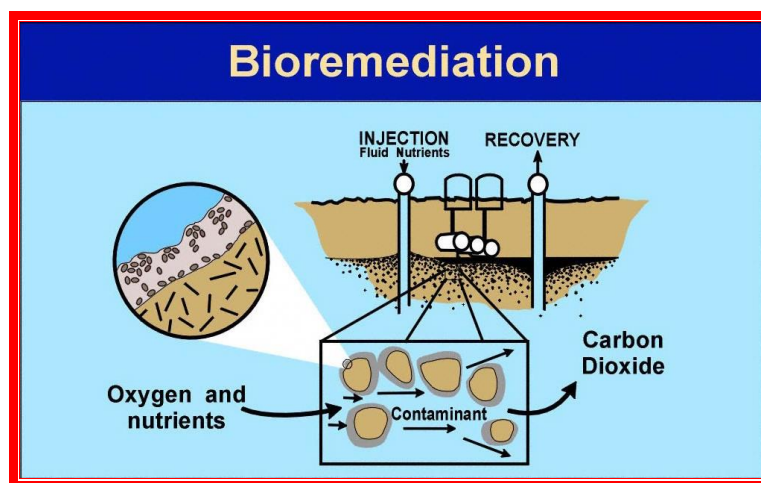
Dr.N.UMA MAHESWARI,

ASSISTANT PROFESSOR AND HEAD,

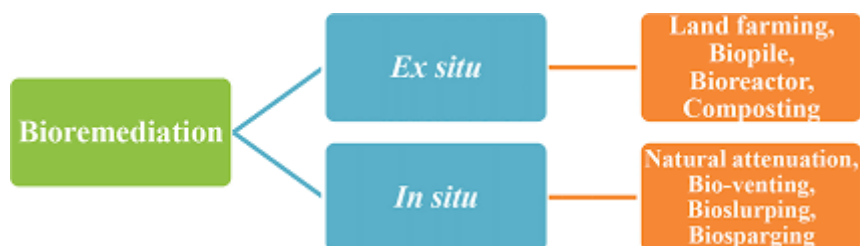
P.G RESEARCH DEPARTMENT OF MICROBIOLOGY

BIOREMEDIATION

Bioremediation, is the use of microorganisms to degrade contaminants that pose environmental and human risks. This means **microbiology** can be applied to multiple uses, ranging from decaffeinating waste water to containing oil spill contamination. To clean up oil spills, bacteria are introduced to the area of the spill where they break down the hydrocarbons of the oil into carbon dioxide; this is an example of bioremediation. It remove oil, some pesticides, fertilizers, and toxic chemicals, such as arsenic, from the environment. **Bioremediation** is a naturally occurring **process** where very small living organisms called microbes, clean up contaminated soil, ground water and surface. **Bioremediation** stimulates the growth of certain microbes that use contaminants as a source of food and energy. **Bioremediation** technology using microorganisms was reportedly **invented** by George M. Robinson.



TYPES OF BIOREMEDIATION:



In situ bioremediation :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.). In situ bioremediation has been successfully applied for clean-up of oil spillages, beaches etc. There are two types of in situ bioremediation-intrinsic and engineered

Advantages of in situ bioremediation:

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

Disadvantages of in situ bioremediation:

Time consuming process

Microbial degradation 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

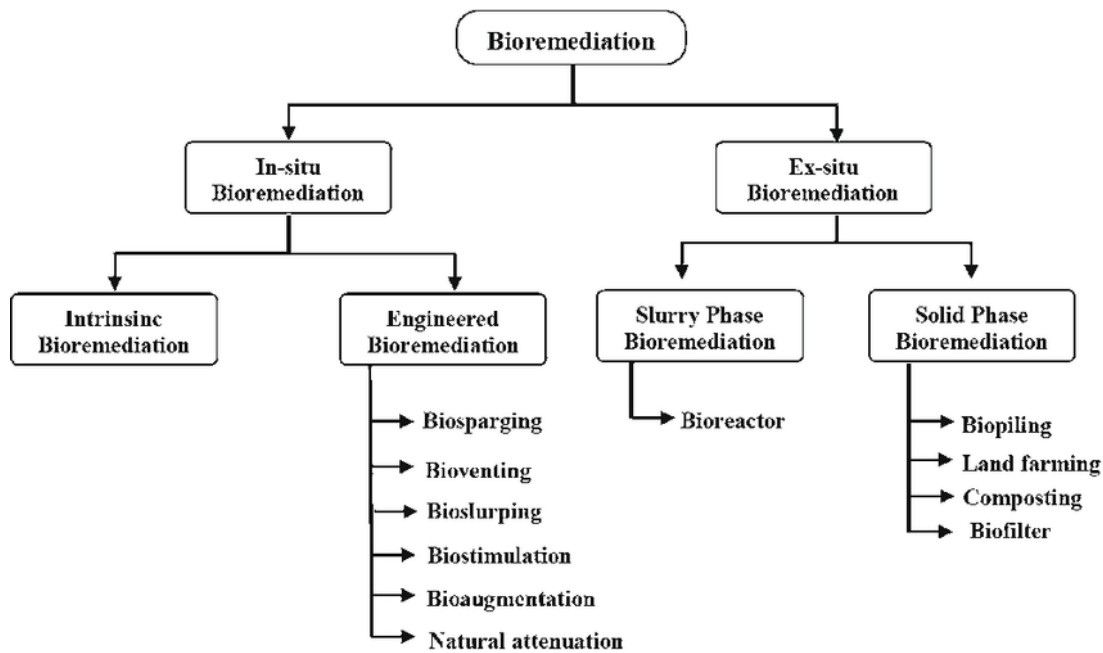
Advantages of ex situ bioremediation:

Better controlled and more efficient process.

2. Process can be improved by enrichment with desired microorganisms.
3. Time required in short.

Disadvantages of ex situ bioremediation:

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



Types of Reactions in Bioremediation:

Aerobic bioremediation:

Aerobic biodegradation involves the utilization of O₂ for the oxidation of organic compounds. These compounds may serve as substrates for the supply of carbon and energy to the microorganisms. Two types of enzymes namely mono-oxygenases and di-oxygenases are involved in aerobic biodegradation.

Anaerobic bioremediation:

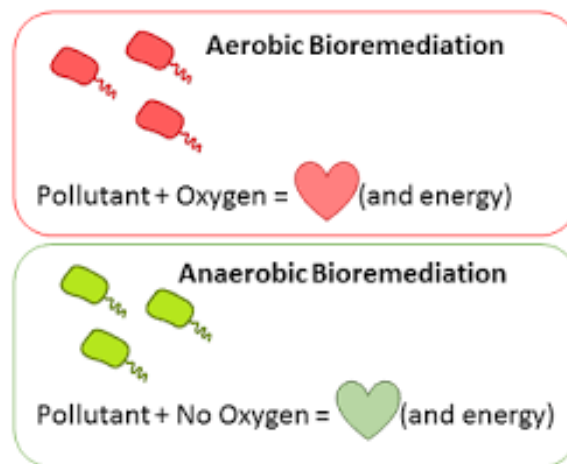
Anaerobic biodegradation does not require O₂ supply. The growth of anaerobic microorganisms (mostly found in solids and sediments), and consequently the degradation processes are slow.

Hydrogenation and dehydrogenation

Carboxylation and decarboxylation

Some of the most common **types of bioremediation** are microbial **bioremediation**, phytoremediation, and mycoremediation. However, the word **bioremediation** has evolved in recent years to include biohazard removal and crime scene cleanup services.

The microorganisms decompose dead organic wastes of plants and animals converting them into simple substances. These substances are again used by other plants and animals. Thus, **microorganisms** can be used to degrade **the** harmful and smelly substances and thereby cleans up **the environment**.



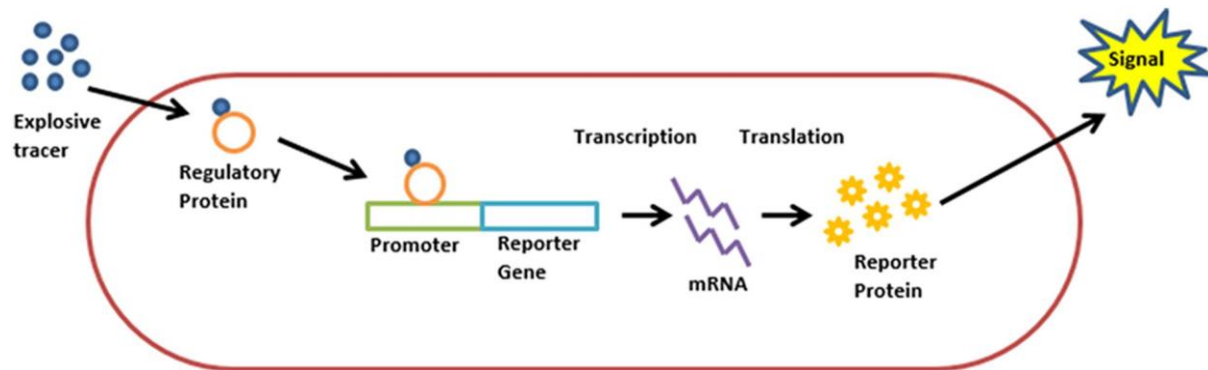
Microbes in bioremediation.

- *Pseudomonas putida.*
- *Bacillus*
- *Dechloromonas aromatica.*
- *Deinococcus radiodurans.*
- *Methylibium petroleiphilum.*
- *Alcanivorax borkumensis.*
- *Phanerochaete chrysosporium.*
- *Aspergillus*
- *Candida*
- *Cladosporium*
- *Penicillium*

Genetically Engineered Microorganisms (GEMs)

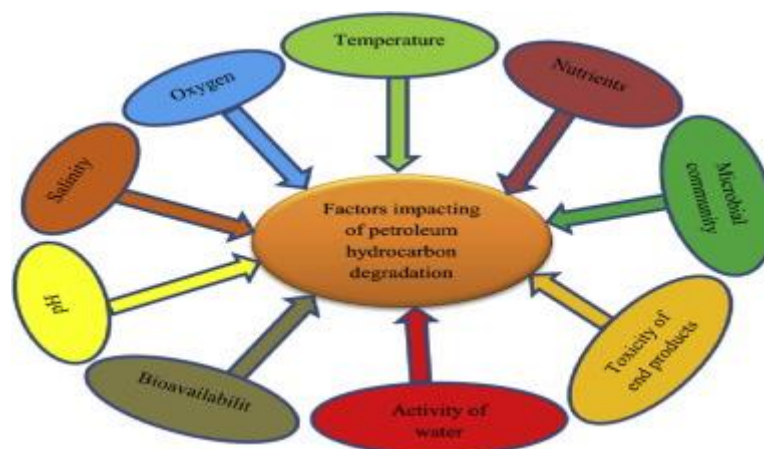
Genetically engineered microorganism is a microorganism whose genetic material has been already changed by applying genetic engineering techniques inspired by natural otherwise artificial genetic exchange between

microorganisms. These kind of artistic work and a scientific procedure is mainly termed as recombinant DNA technology.



- **Advantage of GEMs in bioremediation:** The major function is speed up the recovery of waste polluted sites, increase substrate degradation, displays a high catalytic or utilization capacity with a small amount of cell mass, create safe and purified environmental conditions by decontamination or neutralizing any harmful substances.
- **Disadvantage of GEMs in bioremediation:** The major drawbacks are never carried out in traditional procedure, in some case the death of cells are happened.

Factors affecting microbial bioremediation



Land farming is a technique for the bioremediation of hydrocarbon contaminated soils.

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- *Cladosporium*
- *Penicillium*

Advantages of Bioremediation:

Bioremediation has been successfully used to clean up pollutants including crude oil, gasoline, pesticides, sewage, and chlorinated solvents used in cleaning supplies. The benefits of bioremediation include lower costs and less disruption of the contaminated **environment** when compared to other clean up methods.

Disadvantages of bioremediation : If the process is not controlled it is possible the organic contaminants may not be broken down fully resulting in toxic by-products that could be more mobile than the initial contamination.

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Terms relates with Bioremediation

Bioremediation : (biochemistry) the use of biological organisms, usually microorganisms, to remove contaminants, especially from polluted water .

Bioaugmentation : Use of microorganisms to help decompose pollutants.

Biostimulation : The addition of limiting nutrients to support microbial growth

Bioleaching : Extaction of metals from ores using microbes

Bioventing : Biodegrade oraganic pollutants in ground water systems

phytoremediation : Bioremediation by use of plants constitutes