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اسم المادة: التقنيات الاحيائية
عنوان المحاضرة : Environmental biotechnology
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Environmental biotechnology

Environmental biotechnology is the branch of biotechnology that addresses environmental problems, such as the removal of pollution, renewable energy generation or biomass production, by exploiting biological processes.

1.Application of Biotechnology in Environment

the application of biotechnology in environmental remediation can be expressed as follows:

- Effective removal of harmful contaminants from the environment using filter-feeder (microorganisms and plants)
- Removal of oil pollutants using oil-eating bacteria
- Removal of industrial pollutants such as heavy metals
- Removal of toxic chemicals and pesticide
- Production of biodegradable plastics using vegetable proteins
- Production of environmentally friendly chemicals
- Production of non-fossil fuels
- Reduction of air, soil and water pollution

2.Bioremediation

Bioremediation is a process in which microorganisms, green plants or their enzymes for the remediation of contaminated environments.

2.1.Bioremediation techniques:

There are three classifications for environmental remediation:

1- Biotransformation: transformation and conversion of pollutant molecules to molecules of low risk or no risk

2- Biodegradation: a chemical or biological process which breaks organic matter into smaller organic molecules or inorganic

3- Mineralization: complete biodegradation of organic matter to inorganic compounds such as CO2 or H2O

2.2. **Phytoremediation:** refers to the natural ability of plants to maintain, demolish or dismantle the toxic chemicals and pollutants from soil.

Phytoremediation of organic compounds and metal pollutants in contaminated areas is performed through one of the following methods:

2.2.1.Rhizofiltration

This method is applicable to the removal of pollutants from surface water and groundwater. In this process, the root absorbs pollutants directly from the environment.

2.2.2.Phytotransformation

In this process, plants absorb soil and ground water pollutants and break down chemicals through the metabolic processes

2.2.3.Phytostabilization

In this method, plants maintain soil and water pollutants or they reduce the movement of the pollutants in the soil environment. This is done by surface adsorption or absorption through the roots.

2.2.4.Phtoextraction

It includes pollutants absorption by roots and their accumulation in the shoots. These plants are mostly harvested and destroyed as herbaceous biomass. The inner parts of the plants are not broke down and deformed

2.2.5.Phytovolatilization

It is the absorption of pollutants by plant roots, transferring them to the leaves and their evaporation through stomata

2.2.6.Rhizosphere Bioremediation

In this method, plants act as stimulus for the growth of microorganisms that are spherically around the roots. Microorganisms such as yeast, fungi and bacteria – break down the pollutants through metabolic processes.

3.Removing pollutants from polluted environments

3.1. Wastewater

Wastewater compounds may be physical, chemical or biological, and cause environmental impacts including changes in aquatic habitat and its special structure, and the change in biodiversity and water quality.

Three basic groups of biological processes in aquatic environments include aerobic processes, anaerobic processes or a combination of both of them.

The main objectives of wastewater treatment processes can include:

- Reduction of biodegradable organic content (BOD5).
- Removal of toxic and heavy metals.
- Removal or reduction of nitrogen and phosphorus-containing compounds.
- Removal or inactivation of pathogenic microorganisms and particles.

3.2. Bioremediation of contaminated soil

In this method, the soil is cleaned up by insemination and reproduction of microorganisms which are effective in the decomposition a particular type of contaminant. There are two main ways to remediate contaminated soil:

- Remediation of contaminated site:
- Off-site remediation of contaminated soil

3.3. Clearing the air.

Most common minerals which have unpleasant odor are hydrogen sulfide and ammonia and the most common volatile organic compounds with low molecular weight are mercaptans. The emission of pollutants in the atmosphere causes problems such as depletion of the ozone layer.

4. Other applications of biotechnology

4.1. Bioleaching

Bioleaching is the interaction between metals and microbes with the aim of converting insoluble metal sulfides into soluble metal sulfides.

4.2. Bioenergetics

Biofuels are the major source to replace fossil fuels. Generally, the primary sources of biofuels are wood waste, agricultural waste, sugar cane, corn, herbal and vegetable oil, oil residues (such as chicken fat and cooking oil used in restaurants), fresh vegetable oil (such as soybean oil) and non-food products (such as algal oil).

4.3. Bio plastic

Production of new materials such as bio plastics using sugars, fats, proteins, fibers and other natural ingredients extracted from plants would prevent the use of renewable resources such as fossil fuels and it will lead to less energy, more limited resources and reduction of greenhouse gas emissions. Germs can produce necessary enzymes to convert plant material into structural materials for the biodegradable plastics.

4.4. Biological Fertilizer

The biological fertilizer contains living cells and different types of microorganisms which have the ability to convert chemical food complexes into simpler forms through chemical processes, and to prepare them for absorption by plants.

References

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