Microbial Bioremidiation of Plastics and Pollutants

Presented by - Shreya Singh (MB2)
Faculty coordinator - Dr. Sarita Agrahari

Microbial Bioremidiation

Bioremediation broadly refers to any process wherein a biological system living or dead, is employed for removing environmental pollutants from air, water, soil, fuel gasses, industrial effluents etc., in natural or artificial settings.

Micrbial bioremidiation uses aerobic or anaerobic microorganisms to remove or neutralize environmental pollutants through their natural metabolic pathways.

Bioremediation of plastics

How plastic is harmful to environment?

Threat to wildlife

Climate change and greenhouse effect

Non biodegradable

Microplastics in food

Use of Microbes in bioremediation of plastics

General process

ATTACHMENT
Microbes form a biofilm on the plastic surface

SUEFACE WEAKENING
Bio-deteretion through acids and enzymes

DEPOCYMERISATION
Enzymes like PETase break down polymers

MINERSCISATION
monomers further converted into C02 and biomass

Use of Microbes in bioremediation of plastics

Different microbes used

MICROBES	PLASTIC TYPE	ENZYME INVOLVED
Ideonella sakaiensis	PET (Polyethylene terephthalate)	PETase, MHETase
Pseudomonas putida, Brevibacillus borstelensis	PE (Polyethylene)	Oxidases, Laccases
Pseudomonas citronellolis	PVC (Polyvinyl chloride)	Dehalogenase
Rhodococcus ruber,	PS (Polystyrene)	Styrene monooxygenase

Microbial bioremediation of other pollutants

Major types of pollutants

HYDROCARBONS

Example- oil spills in ocean
Microorganisms- Pseudomonas putida
Enzyme- oxygenases, dehydrogenases

Oil slick in gulf of mexico

SEWAGE

Example- Organic waste, sludge
Microorganisms- Nitrobacter, Methanogen
Enzyme- Methanogenesis enzymes

Sewage plant

HARD METALS

Example- Lead (Pb), Mercury (Hg), Cadmium (Cd), Arsenic (As)
Microorganisms- Ralstonia metallidurans, Pseudomonas aeruginosa
Enzyme- Reduction enzymes

PESTICIDES AND HERBICIDES

Example- DDT, Atrazine, Glyphosate
Microorganisms- Flavobacterium sp., Pseudomonas sp., Alcaligenes sp.
Enzyme- Dehalogenase, Hydrolase

INDUSTRIAL WASTE

Example- Phenol, Benzene, Toluene
Microorganisms- Acinetobacter sp., Pseudomonas fluorescens
Enzyme- Monooxygenase, Dioxygenase

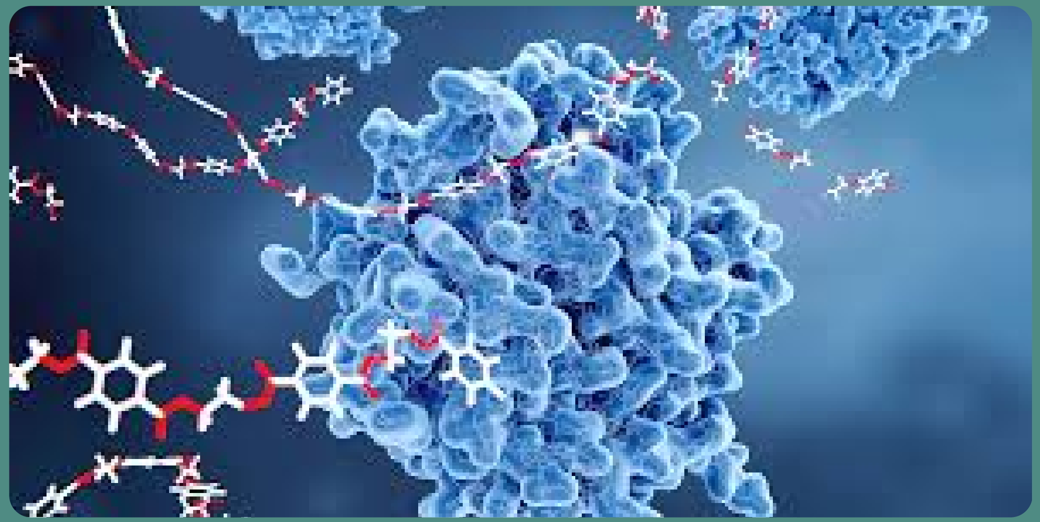
Limitations and benefits of bioremediation

limitation	Benefits
1. Slow process 2. Dependent on environmental conditions: pH, temperature, nutrients, and oxygen. 3. Production of toxic intermediates: Partially degraded compounds may be harmful. 4. Limited microbial range: Specific microbes required 5. Difficult monitoring: Requires constant observation to ensure microbes are active and effective. 6. Site limitations: Ineffective in extremely polluted, cold, or oxygen-deprived environments.	1. Environmentally friendly: producing minimal secondary pollution. 2. Cost-effective 3. In situ treatment: applied directly at the contaminated site without excavation 4. Versatile: Effective for a wide range of contaminants 5. Restores natural balance. 6. Socially acceptable: Safe and sustainable, gaining community support for environmental restoration.

Possible Improvements in Bioremediation

1. Genetic Engineering of Microbes

2. Use of Enzyme Technology



3. Real-time Monitoring Systems- Using biosensors and AI-based tracking to monitor microbial activity and pollutant degradation progress

REFERENCES

https://www.scienceabc.com

https://www.nextias.com

https://www.news-medical.net

https://www.greenly.earth

https:/www.Google.com

https://soil-environment.blogspot.com

Microbial bioremediation

"Restoring nature, through nature"

THANK YOU