COMPILED AND CIRCULATED BY ARPITA CHAKRABORTY,STATE AIDED COLLEGE TEACHER, DEPARTMENT OF BOTANY, NARAJOLE RAJ COLLEGE.

BIOREMEDIATION OF CONTAMINATED SOIL-

It is a branch of biotechnology that deals with the environmental problems such as pollution, exploitation of natural resources, biomass production, exploitation of biological processes etc. The following processes or tools or processes are used in the field of environmental biotechnology to assess hazards caused by various agents.

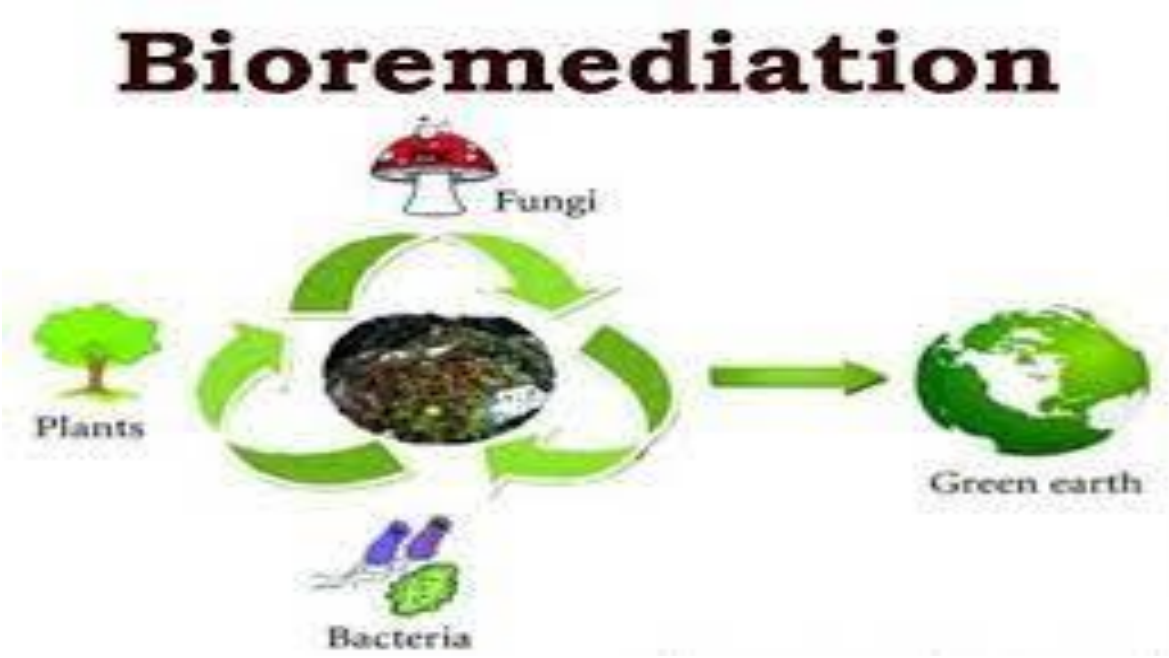
Bioremediation-

It is a waste management technique that involves the use of organisms to remove or neutralize pollutants from a contaminated site. According to EPA, bioremediation is a treatment that uses naturally occurring organisms to breakdown hazardous substances into less toxic or non-toxic substances.

In this type of waste management, toxic chemicals are not used, although it may use an organism that can be harmful under certain environmental conditions or circumstances. At sites filled with organic waste material, various microorganisms such as bacteria, fungi, protists etc breakdown the organic matter into its simpler form or into inorganic CO_2 and H_2O.

In the process of bioremediation these microbes are provided with optimum conditions, fertilizers, stimulators etc. so that they can breakdown the organic matter into its simplest form.

Concept of bioremediation



Types of Bioremediation-

Bioremediation technology has made it possible to decontaminate soil, ground water, oils, spills in oceans and other environmental disaster. The types of bioremediation are microbial bioremediation, phytoremediation, In-situ remediation and Ex-situ remediation.

In-situ Remediation-

It refers to when contaminated waste is treated right at its point of origin eg. Instead of removing the contaminated soil from its place, it is treated right where it is present. In-situ bioremediation method prevents the spread of contamination during the displacement and transport of contaminated material.

Role of Plants for In-situ remediation-

Several plants are being identified and trialed to be used in Phyto-remediation. Some plants are listed below-

1. Bermuda grass (*Cynodon dactylon*)
2. Bahia grass (*Paspalum notalium*)
3. Rhodes grass (*Chloris guyana*)
4. Tall wheat grass (*Thynopyron elongatrum*)

These are the plants with high salts and toxicity tolerance and have excessive root binding system. These plants play key role in cleaning up soils contaminated and polluted with various form of hydrocarbon compounds.

Role of microbes for In-situ remediation-

It uses microorganisms to breakdown contaminants present in the environment. These contaminants are used as a source of food by these microbes thus in this process they are removed from soil or water bodies.

The process could be anaerobic whose end products are methane, hydrogen gas, sulphide, elemental Sulphur or de nitrogen gas. When it occurs in the presence of oxygen, it is an aerobic process which results in the formation of CO_2, H_2O and salts.

For example, *Pseudomonas putida* is a hydrocarbon degrading bacterium which degrades oils spills in water, thus cleans sea water.

Mushrooms and enzymes present in them makes them a tool to be used in myco remediation of environmentally persistent pollutants. These have ability to transform industrial and agro-chemical waste into products. These organisms used different methods like bio-degradation, bio-absorption and bio-conversion of pollutants.

Soil bio-remediation involves the removal of high molecular weight, heavy compounds and metals by using microbes.

Trichomonas sp. in gut of animals degrades cellulose of plant products.

Ex-situ remediation-

In this type of method waste is removed from origin and carried to treatment site. Benefits of this method are that it allows the space to be re-used and bioremediation products formed during treatment can be controlled and limited.

Role of microbes for Ex-situ remediation-

The microbes are used as bio-remediation agents to remove contaminated soil or water from environment. Ex-situ bioremediation used the microbes and added nutrients to speed up the breakdown of the environmental pollution samples in bio-reactors. These are open used in bio piling places to speed up decomposition of pollutants mainly solid wastes.

The white rot fungi have a broad substrate specificity and have been implicated in transformation and mineralization of organic pollutants with structural similarities to lignin, *Alternaria, Aspergillus, Penicillium, Trichoderma* have been identified to bio transform TNT (Tri Nitro toluene).

Role of plants for Ex-situ remediation-

Ex-situ technologies are advantageous for bio remediation when safe and effective intervention is required. These are useful in land forming, soil bio-remediation. Alfa-Alfa plant is used for Ex-situ soil bioremediation to enhance the fertility of soil.

The line stabilization and drying of bio-solids ensure creating unfavorable characters to the vectors and pH contents in bio solids. Few terms related to bio-remediation-

1.Bioventing- It refers to blowing air through soil to increase oxygen rate in the waste. This is an effective way to neutralize certain oxygen sensitive methods or chemicals

2. Bio-leaching- It refers to removing metals from soil using living organisms. Certain types of organisms draw the heavy metals and other contaminants and absorb them. Fish bones are found to attract and hold heavy metals such as lead and cadmium.

3. Land-forming- It refers to turning contaminated soil for aeration and sitting to remove contaminants or deliberately depleting a soil of nitrogen to remove nitrogen-based organisms.

4.Bio-reactor- These are specially designed chambers to hold the waste and to treat it with microbes at a much faster rate.

5.Composting- In this type of method, natural process of decomposition to decay the organic matter is used.

6. Bio-augmentation- In this type of method specific hybrid microorganisms are added to the contaminant sites to remove the contaminant.

7.Bio-stimulation- In this type of method microbes are stimulated by adding nutrient and more microbes in order to decontaminate the area.

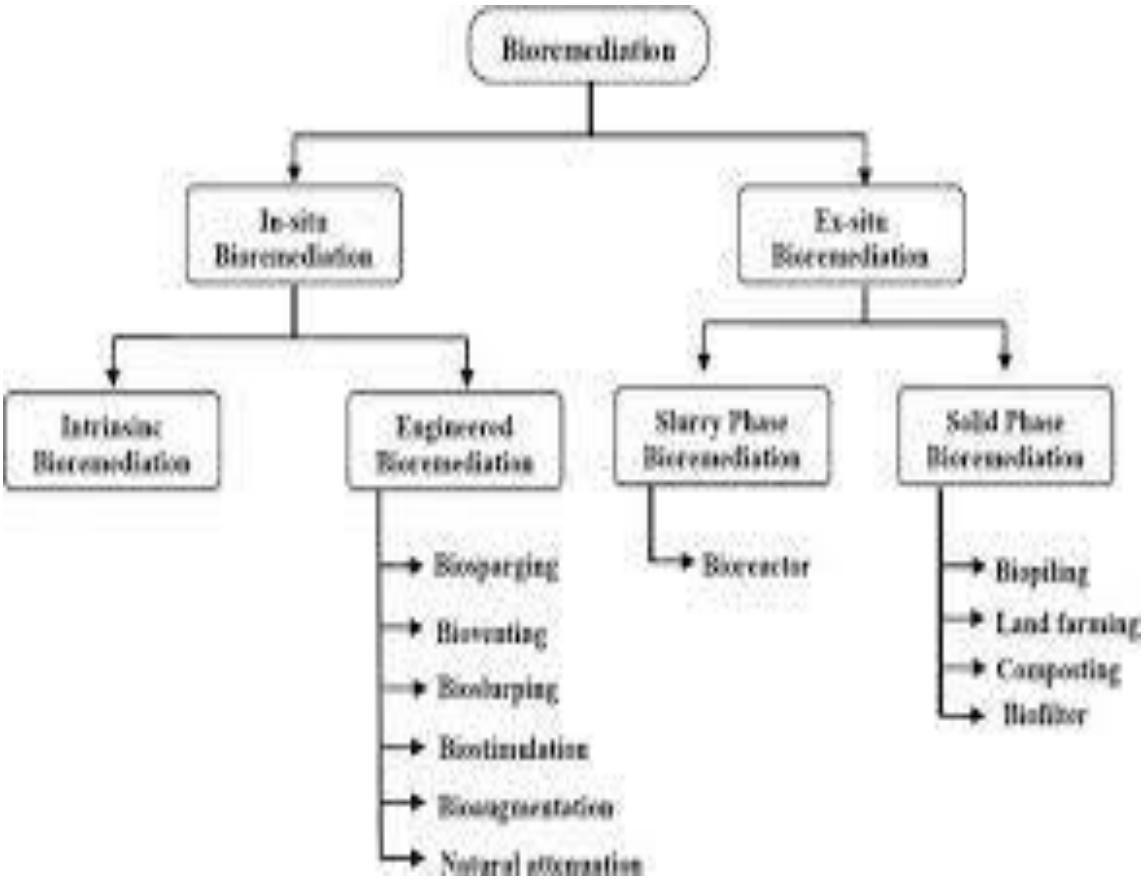


Fig: Types of bio-remediation

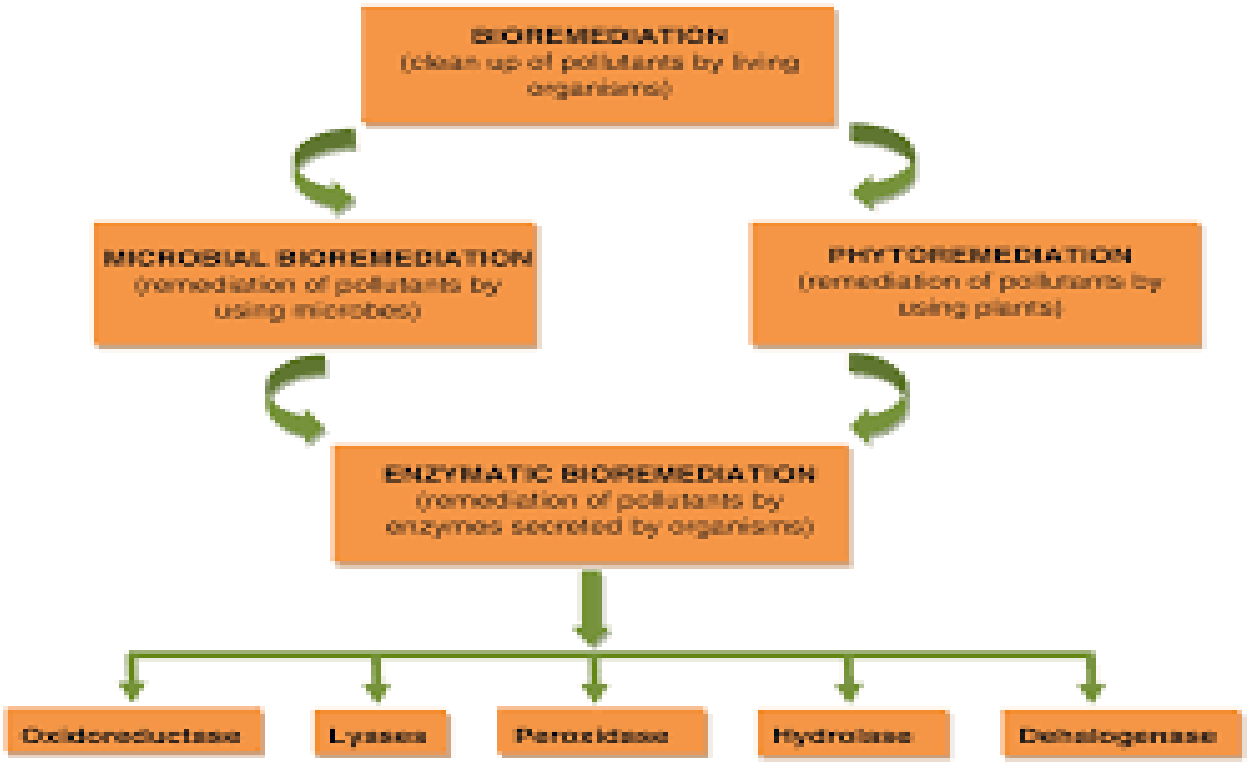


Fig: Environmental cleaning by fungal enzymes

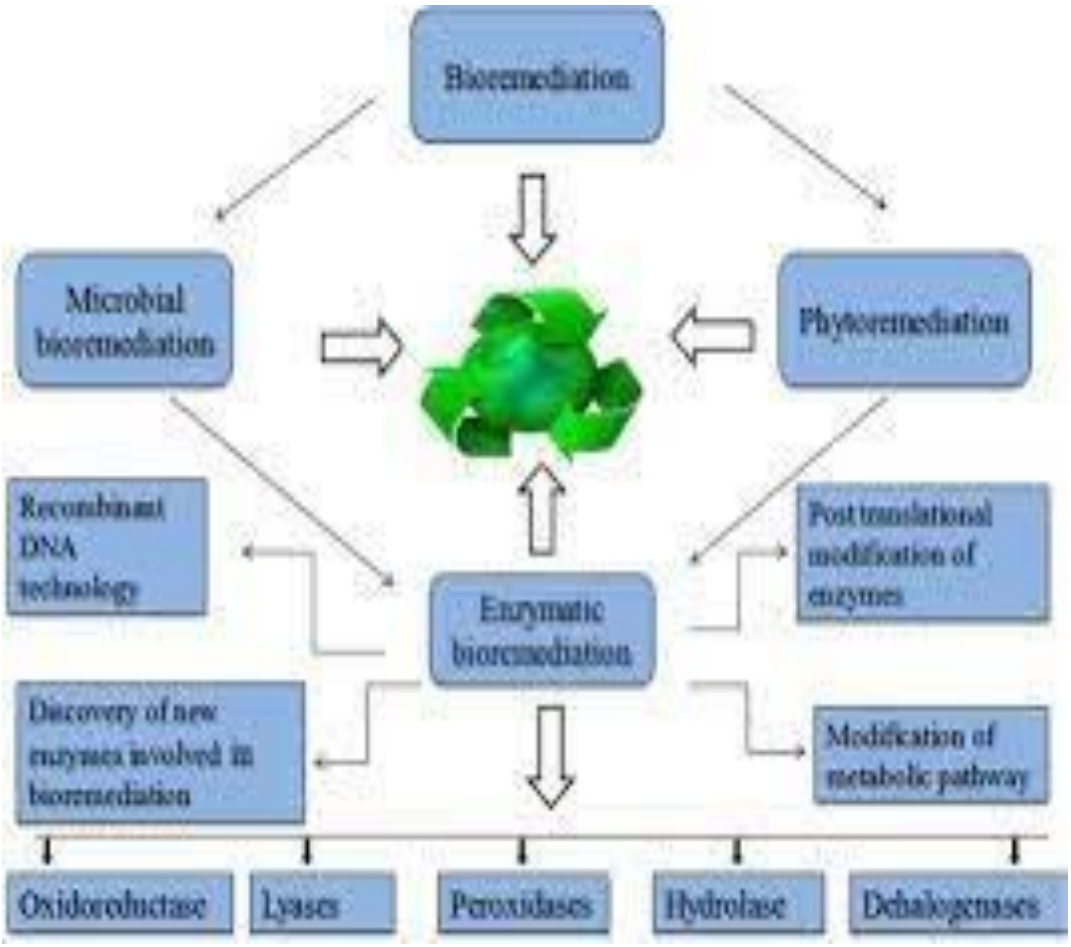


Fig: Contemporary enzyme based technologies for bio remediation

References-

1 Singh D., Sharma V., Singh J., Sharma S. Environmental Science, Paper 2.NTA UGC. Arihant publications(India) Limited.ISBN:978-93-13199-76-2

2.https://www.google.com/imgres?imgurl=https%3A%2F%2Fimg.jagranjosh.com%2Fimported%2Fimages%2FE%2FArticles%2FBioremediation-img.jpg&imgrefurl=https%3A%2F%2Fwww.jagranjosh.com%2Fgeneral-knowledge%2Fwhat-is-bioremediation-1554810577-1&tbnid=jdx3HpmVO29ZOM&vet=12ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygCegUIARDUAQ..i&docid=--xPDNbigoXhhM&w=640&h=480&q=bioremediation&ved=2ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygCegUIARDUAQ

3.https://www.google.com/imgres?imgurl=https%3A%2F%2Fars.els-cdn.com%2Fcontent%2Fimage%2F1-s2.0-S030147971731263X-

gr1.jpg&imgrefurl=https%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FS0301479717312 63X&tbnid=QonwinGOUceTSM&vet=12ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygGegUIARDcAQ..i&docid=p4OIy-vamrFfIM&w=535&h=379&q=bioremediation&ved=2ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygGegUIARDcAQ

4.https://www.google.com/imgres?imgurl=https%3A%2F%2Fwww.intechopen.com%2Fmedia%2Fchapter%2F70661%2Fmedia%2FF1.png&imgrefurl=https%3A%2F%2Fwww.intechopen.com%2Fbooks%2Ftrace-metals-in-the-environment-new-approaches-and-recent-advances%2Fbioremediation-techniques-for-polluted-environment-concept-advantages-limitations-and-prospects&tbnid=qCYMJbss61z1cM&vet=12ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygNegUIARDrAQ..i&docid=xFNOboqvOx46jM&w=650&h=381&q=bioremediation&ved=2ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygNegUIARDrAQ

5.https://www.google.com/imgres?imgurl=https%3A%2F%2Fmedia.springernature.com%2Foriginal%2Fspringer-static%2Fimage%2Fchp%253A10.1007%252F978-3-030-25506-0_2%2FMediaObjects%2F473155_1_En_2_Fig1_HTML.png&imgrefurl=https%3A%2F%2Flink.springer.com%2Fchapter%2F10.1007%2F978-3-030-25506-0_2&tbnid=iMyx6Iq4HXOv7M&vet=12ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygMegUIARDpAQ..i&docid=99lczJ5IvjCKbM&w=1200&h=992&q=bioremediation&ved=2ahUKEwjOsv7Y0OLwAhXnOLcAHcDWAnIQMygMegUIARDpAQ

(The above mentioned description including images are taken from above mentioned references and are used only for teaching and learning purposes.)