Research article Available online www.ijsrr.org ISSN: 2279–0543

International Journal of Scientific Research and Reviews

Study of Phytoremediation Techniques and Its Application

Wanganekar Omkar[1*] and Thakare Sunil[2]

[1]Research Scholar, Civil Environmental Engineering, ABMSP's APCOER Parvati, Pune, India
[2] Guide , Civil Environmental Engineering Department, ABMSP's APCOER Parvati, Pune, India

ABSTRACT

Phytoremediation is biotechnological application of plants for waste utilization and conversion to reduce, assimilate, degrade and metabolize environmental pollutants such as heavy metal, hydrocarbons, fertilizers, pesticide, organic and inorganic loads in soil and water. Phytoremediation includes different plant technologies as Phytoextraction, Phytodegradation, Phytovolatization, Rhizofilteration, Phytostabilization. This paper addresses definition and brief description of phytoremediation techniques and its practical application in wastewater treatment and restoring soil.

KEYWORDS: Phytoextraction, Biotechnological, Phytodegradation, Phytovolatization, Rhizofilteration, Restoration, Phytostabilization.

***Corresponding author:**

Omkar R Wanganekar

Civil Environmental Engineering,

ABMSP'S AnantraoPawar College Of Engineering And Research,

Pune 411009,MH,INDIA

Email: omkarwan@gmail.com, Mob No-8605952240

INTRODUCTION

Phytoremediation is a technology that uses plants to degrade and extract contaminants from soil and wastewater. This technology has received attention lately as innovative and good alternative to present treatment methods. Which cause secondary pollutants. It is efficient treatment method. It is a "Green Revolution" in the field of innovative cleanup technologies. Phytoremediation gained attention over the last several years. The process is going on naturally for centuries. Numbers of plants have been tested to find appropriate plant for phytoremediation so as to treat soils containing heavy metals and contaminants in wetlands. To treat wastewater. As water flows through various layers of phyto bed containing plants. Not every plant is suitable for phytoremediation. The godfather of phytoremediation and study of hyper accumulator plants may is Robert Richard Brooks[14]. Hyper accumulator plants are those that can uptake heavy metals more than one present of their dry weight. Now soils have become increasingly polluted by heavy metals and other chemical pollutants due to human activities. This threatens everything ecosystems, water resources. This all have bad effect on food cycle. As contaminants enters the food chain. And has a bad effect on human health. The use of plants for remediation of soils and water wastewater has gained acceptance in the past two decades. As a cost effective method. A variety of wastewater can be treated as municipal wastewater, industrial wastewater, coal pile runoff, landfill leachate, mine drainage, and groundwater.

PHYTOREMEDIATION TECHNIQUES

There are plant processes applicable in wastewater treatment and purification. In removing excessive organic matter from water reservoirs and in improving of soils polluted with heavy metals. Phytoremediation processes rely on the ability of plants to take up and metabolize, accumulate and degradation of contaminants. Plants are selected on basis of their growth rate, root depth it has, its ability to survive contaminants in root zone.

Phytoextraction

It is uptake of contaminant from soil, surface water, groundwater in to the root. It is planting a crop of known species that is known to accumulate a particular contaminant from soil or water. This is in return converted into plant biomass. This is useful in separating heavy metal from water. This is a concentration tech. The plants must be able to survive high concentration of heavy metals and produce large amount of biomass. Another approach is releasing degrading microorganism in the soil that help the uptake process of contaminant. It is generally limited to the root zone. Corn is hyper accumulator of heavy metals and also fast growth rate and absorb zinc, iron, lead.

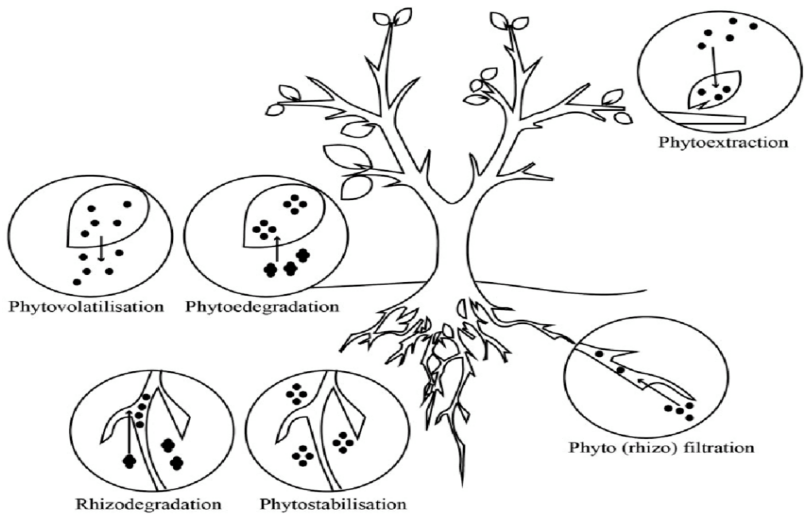

Figure 1. Phytoremediation Process[9]

Phytovolatization

Phytovolatiztion is the uptake and release of a contaminant by a plant to atmosphere through leaves. This is during photosynthesis. Plants release the contaminant in a less toxic form. This is mainly applied to groundwater, soil and sludge's. Water uptake is affected by climatic and seasonal condition and daily temperature variation. Root of plant which may be deep shallow root or small but large numbers of root. Young roots grow faster and absorb the nutrients at higher rate than older ones. Extensive Mercury from soils has been shown to move from a plant into air in a less toxic form during transpiration. Mercury in soil is more dangerous than in air as it may enter food chain and even contaminate groundwater as water flows through the soils it may get carry with it. Reduce danger to environment.

Phytodegradation

It is microbial degradation of the contaminant in the root zone of plant the rhizosphere. The main mechanism is the plants absorb the organic compounds from the soil and convert them into less toxic form or helps in increasing plant biomass. This may occur within or outside of the plant in the root zone. The contaminant degrading microorganisms are secreted in the soil by the plant roots. Uptake is dependent on contaminants solubility. This process is affected by microbial population. Physicochemical characteristic of soil and mainly depends on plant type. Indian mustard might be able to reduce chromium.

Rhizofilteration

Rhizofilteration is absorption onto roots of the plant organic matter that is in solution. This method is used in treatment of wastewater from industries or water containing heavy metals. The plants used in this method must be able to survive inorganic compounds such as lead, mercury and organic matter which results in low oxygen concentration in water. Extensive root system that grows rapidly so as to produce large amount of surface area for microorganisms to act. This tech does not work with sludge's and sediments. Water hyacinth is used for removal of heavy metals from wastewater.

Phytostabilization

This is stabilization of contaminants by binding. This method is used in soil remediation. It prevents groundwater contamination. Plants must have deep root zone that provides adsorption and accumulation of contaminants in the tissue. Mine waste containing copper was stabilized by grasses.

ADVANTAGES AND DISADVANTAGES OF PHYTOREMEDIATION

It can even be applied for industrial wastewater that contains heavy metals. Reclamation of the polluted soil in situ. Make sites aesthetic. And even attract birds towards it. Helps in making natural habitat for birds. It does not require huge equipment. Greatly cost effective. As there is no mechanical equipment and requires only planting of new younger plants when old ones die. Thus it is Solar powered. Produce biomass for renewable energy. It can be operated in almost all media aquatic, soil, sediment, sludge. It can also be built in existing sewage treatment plant as a tertiary treatment. We can also use plants for phytoremediation that will provide some income to owners.However phytoremediation also has limitations. Pollutants are treated only near the root zone not enough deep in the soil. It is applicable only to the upper layer of the soils and not deep enough. And the harvested biomass contains hazardous pollutants which may enter human food chain and animal. Long time needed for effective treatment. Age of the plants also affects treatment. Transpiration rates due to sun/ shade exposure can affect plant uptake. Phytoremediation site must be large enough to grow plants. We have to select most appropriate plant to phytoremediation new plants have been studied for their suitability for phytoremediation of wastewater and soils.

APPLICATIONS

Phytoremediation are more suitable for schools, hotels, hospitals and smaller communities. It will be more successful on small scale as it will be more easy to operate. The application can be classified based on mechanism involved extraction of contaminant from soil, sediment, sludge or

groundwater, transpiration of contaminant from plant to air, immobilization of contaminants in root zone, degradation of contaminant or a combination of these. The problem is that roots don't reach far enough into ground not more than five to six meters. And disposal of plant biomass after hyperaccumulation has taken place. As the biomass will decompose and finally end in soil but in less harmful form. Extensive root system of the plants used can prevent soil erosion. This increases soil productivity as well as soil aeration. It can be applied at diversity of pollutants such as pesticides, crude oil, explosives, chlorinated solvents and heavy metals in soil. Trees having deep root system and high transpiration rates are also being analyzed in phytoremediation of landfill leachates and pesticides contaminants.

CONCLUSION

Phytoremediation is an environmental friendly and economical approach to treat the wastewater naturally. That supports the goal of sustainable development. Reduce water and air pollution. And soil is restored. So far the phytoremediation processes are poorly understood further studies are needed to finding more efficient remediating plants and microbes.

REFERENCES

1. Lakade S,Gawande S, "Review and Study of Water Hyacinth and Their Application on Environment"; International Journal of Advance Research, Ideas and Innovations in Technology 2017; 3, ISSN: 2454-132X
2. HosseinFarraji, "Wastewater Treatment by Phytoremediation Methods," International Journal Of Scientific Research In Agricultural Sciences(IJSRPUB), 2014; 206-218.
3. Kokyo Oh, Tiehua Cao "Study on Application of Phytoremediation Technology in Management and Remediation of Contaminated Soils Journal of Clean Energy Technologies, 2014; 2(3): 216-220.
4. Materac M, Wyrwicka A, "Phytoremediation techniques in wastewater treatment," Environmental Biotechnology, 2015; 10-13.
5. Mankoskar A, "An Energetic And Low Cost System Red Bed Technolgy Used For Wastewater Treatment" July 2015; 2(2) | Issn: 2349-6002
6. Chopra A, Shah U and Sudarsan J, "Waste Water Treatment by Phyto-Remediation Technique," International Journal of Earth And Science, 2016; 393-399.
7. Masgar R, Khan A, "Waste Water Treatment Using Water Hyacinth," 32ND Indian Engineering Congress, 2017.

8. Sarode D, Reuse of Wastewater to Conserve the Natural Water Resources International Conference on Sustainable Waste Management through Design ICSWMD 2018, Springer Nature Switzerland AG 2019.
9. https://www.researchgate.net/profile/Tatiana_Armijos_Moya2/publication/325901220/figure/fig1/AS:662134899884032@1534876670098/Phytoremediation-techniques.png
10. Kore P,Mugale V,Kulal N, Mane K, "Textile Waste Water Treatment by using Phytoremediation" International Journal of Engineering Trends and Technology (IJETT) March 2017; 45(8) ISSN: 2231-5381
11. BolajiZ, Castor Oil Plant (RicinuscommunisL.): Botany, Ecology and Uses,International Journal of Science and Research (IJSR), 2014; 1333-1341.
12. T. Bindu, V.P. Sylas, M. Mahesh, P.S. Rakesh, E.V. Ramasamy, "Pollutant removal from domestic wastewater with Taro (Colocasiaesculenta) planted in a subsurface flow system" Ecological Engineering 2008; 33: 68-82.
13. Raman V,Ghole V,Valipour A, "Phytoremediation Of Domestic Wastewater Using Eichhornia Crasspies", J. Environ. Science & Engg. 53(2): 183-190.
14. Trueman S. "Phytoremediation: Cleaning the Soil with Flowers". 2019,Available Fromhttps://www.thoughtco.com/phytoremediation-cleaning-the-soil-with-flowers-419222