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Treatment of Effluents by Plants, Animals and Microorganisms

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ABSTRACT
This review article provides useful information for understanding the role of plants, animals and microorganism in the pollutants removal. The current literature is collected and organize to provide and insight into the specific roles of microorganisms toward plants and pollutants. Water hyacinth removes arsenic from arsenic contaminated drinking water, Peace Lily remove dangerous effects of toluene, xylene and benzene. The algae adsorbing heavy toxic metals. Microorganisms used for converting alkene into alkene oxide by the process known as bioaugmentation.

Keywords : Effluents, Phytoremediation, Bioaugmentation, Bioremediation.

I. INTRODUCTION

The abiotic environment includes water, air and soil while the biotic environment consists of all living organisms - plants, animals and microorganisms. It is the biotic community that are affected by environmental pollution in its abiotic environment to a great extent. For example water pollution makes the aquatic life tough and unhealthy. Similarly the growth of certain microorganisms indicates the presence of pollution (algal bloom).

The cost of cleaning up tens of thousands of toxic sites on factory grounds, farms, and military installations is staggering. However, recent research, found that hundreds of species of plants, along with the fungi and bacteria that inhabit the ecosystem around their roots, seek out and often break down chemical molecules that can harm most other life. For example, there are sunflowers that capture uranium, ferns that thrive on arsenic, clovers that eat oil, and poplar trees that destroy dry-cleaning solvents. Research into using plants as pollution sponges must continue, but early reports of their helping to clean up pollution were promising.

II. TREATMENT OF EFFLUENTS BY PLANTS (PHYTOREMEDIATION)

It is the process where plants are introduced into an environment to remove contaminants from it and clean the environment. There have even been studies where these plants have turned the contaminant into a harmless substance and then once harvested can be used for mulch (decaying plant material used for improving the soil), animal feed, paper, etc. In some instances (especially if trees are being used) the plants are left in the environment and allowed to grow and mature as normal.

Phytoremediation has been used to clean up *metals, pesticides, solvents, explosives, crude oil, polyaromatic hydrocarbons, land fill leachates, agricultural runoff. acid mine drainage, and*

radioactive contamination. Phytoremediaton has been used in many different locations. It is being used in *Chernobyl with sunflowers to remove cesium- l37 and strontium-90. Hybrid poplars have been used in Whitewood Creek in South Dakota to absorb arsenic from mine wastes* and in Aberdeen, Maryland to remove trichloroethylene and polycyclic aromatic compounds from groundwater.

Water hyacinth removes arsenic from arsenic contaminated drinking water. The plant is extremely tolerant of, and has a high capacity for, the uptake of heavy metals, including Cd, Cr, Co, Ni. Pb and Hg, which could make it suitable for the bio cleaning of industrial wastewater. In addition to heavy metals, it can also remove other toxins, such as cyanide, which is environmentally beneficial in areas that have endured gold mining operations.

Some natural plants which can fight pollution inside the house are *Devil's ivy* (Golden Pathos - scientific name is Epipiremnum Aureum) that controls common air pollutants like the benzene, carbon monoxide and formaldehyde; another plant *Peace Lily* (Spathiphyllum) removes the dangerous effects of toluene. xylene and benzene. These are easily found in the nail polish removers, paints used at home, solvent solutions and adhesives which we frequently used harmful things. Many indoor plants play an essential role in indoor air pollution control sy stem by removing high concentrations of pollutants such as cigarette smoke and organic solvents.

Even before awareness of indoor air pollution increased in the early 1980s, NASA had funded research on using plants to biologically treat waste water. Biological waste water treatment technology proved effective and is used at small- to medium-scale municipal sewage treatment plants and to reclaim water for irrigation.

It is well known fact that the oxygen is restored by plants and trees and they absorb CO_2 during photosynthesis. Thus the quality of the air can be greatly influenced by plants. They stop the movement of dust and pollutants. Through the intake of carbon dioxide, plants can also lessen the greenhouse effect caused from the burning of fossil fuels like coal.

A diverse cover of plants aids in 'maintaining healthy watersheds, streams, and lakes by holding soil in place, controlling stream flows, and filtering sediments from water. Regional climates are impacted by the amount and type of plant cover. Forest and marshes, for example, can cool local climates. Natural disasters, such as drought, have been blamed on the destruction of forests and other critically important plant communities.

The pollution is mostly resulting from human activity. But the smaller entities in the animal kingdom play their own role in cleaning pollutants. Many aquatic animals including muscles, oysters, and shell fishes absorb heavy metals like Cd, Cr, Ni. Cu, Zn and Hg. These are used as indicators of heavy metal pollution in a water body, and researches are going on using them to clean the heavy metal protection by growing them.

Household waste and municipal waste can be processed by using worms in *vermiculture* and covert the organic waste into useful vermicompost that can be used as a fertilizer. Many birds act as natural scavengers of organic waste by eating it.

The use of dangerous pesticides in agriculture can be avoided if friendly pets and bugs are used to drive away the pests that attack the farm.

Microorganisms are known natural scavengers; so the microbial preparations (both natural as well as genetically engineered) can be used to clean up the environmental hazards. Many of the effluent treatment systems like activated sludge treatment, lagooning, trickling filtration etc uses microorganisms.

III. TREATMENT OF EFFLUENTS BY MICRO ORGANISMS (BIOREMEDIATION)

Bioremediation is the process of using microorganisms to remove the environmental pollutants where microbes serve as scavengers. The other names/terms used for bioremediation are *biotreatment. bioreclamation, and biorestoration*.

Unnatural and synthetic chemicals such as pesticides, herbicides, refrigerants, solvents and other organic compounds undergo microbial degradation, reducing the environmental pollution.

Sewage that mainly contains organic and inorganic compounds, toxic substances, heavy metals and pathogenic organisms are treated to biodegradation by microorganisms. The biodegradation involves the degradation of organic matter to smaller molecules (CO_2, NH_3, PO_4 etc.) and requires constant supply of oxygen. The process of supplying oxygen is expensive, tedious, and requires a lot of expertise and manpower. These problems are overcome by growing microalgae in the ponds and tanks where sewage treatment is carried out. The algae release the O_2 while carrying out the photosynthesis which ensures a continuous only of oxygen for biodegradation. The algae are also capable of adsorbing certain heavy toxic metals due to the negative charges on the algal cell surface which can take up the positively charged metals. The algal treatment of sewage also supports fish growth as algae are a good source of food for ashes. The algae used for sewage treatment are *Chlorella, Euglene, Chlamydomonas, Scenedesmus, Ulothrix, Thribonima* etc.

Another purpose of biological treatment is for nitrification/denitrification. Nitrification is an aerobic process in which bacteria oxidize reduced forms of nitrogen (Ammonium to oxides of Nitrogen). Denitrification is an anaerobic process by which oxidized forms of nitrogen are reduced to gaseous forms (N_2), which can then escape into the atmosphere. This helps to minimise eutrophication.

Some microalgae like *Chlorella pyrenodiosa*, are known to be more efficient than higher plants in utilizing atmospheric CO_2 for photosynthesis and generate more O_2.The growing of these microalgae near the industries and power plants (where the CO_2 emission in to atmosphere is very high) will help in the reduction of polluting effects of CO_2.

IV. TREATMENT OF EFFLUENTS BY ANIMALS (BIOLOGICAL CALCIFICATION)

Certain deep sea organisms like corals, green and red algae store CO_2 through a process of biological calcification. As the $CaCO_3$ gets precipitated, more and more atmospheric CO_2 can be utilized for its formation.

Biotechnology is used to create new microorganisms that are more efficient towards specific effluent treatment. The problem of pollution can also be minimized by controlling pollution occurring at different stages of the manufacture (like secondary treatment of effluent). Biotechnology plays an important role in this in paper, leather and tannery industries.

In Plastic industry, the conventional technologies use oil based raw materials to extract ethylene and propylene which are converted to alkene oxides and then polymerized to form plastics such as polypropylene and polyethylene. There is always the risk of these raw materials escaping into the atmosphere thereby causing pollution. Using biotechnology, safer raw materials like sugars (glucose) are being used, which through the direct of microbes are converted into alkene oxides; e.g., *Metlylococcus capsulatus* has been used for converting alkene into alkene oxides.

It is possible to increase biodegradation through manipulation of genes i.e., using genetically engineered microorganisms and by using a range of microorganisms in biodegradation reaction. (This is known as bioaugmentation).Use of genetic engineering and genetic manipulations is nowadays developed for more efficient bioremediation.

Example of Biotechnological method is to reduce atmospheric carbon dioxide (CO_2). Biotechnological methods have been used to reduce the atmospheric CO_2 content at two levels-

(1) The fast growing plants utilize the CO_2 more efficiently for photosynthesis. The techniques of micro-propagation and synthetic seeds should be used

to increase the propagation of such fast growing plants.

(2) Further, the CO_2 utilization can be increased by enhancing the rate of photosynthesis. The enzyme ribulose biphosphate carboxylase (RUBP-case) is closely linked with CO_2 fixation. The attempts are being made to genetically manipulate this enzyme so that the photosynthetic efficiency is increased.

V. CONCLUSION

The advancement of wastewater treatment technology not with standing, treated sewage may still contain some harmful substances. There is a wide range of microbial pathogen types which occur in wastewater with the type and number present being highly dependent on the socioeconomic conditions. In order to purpose an efficient way to treating waste water, there is need to under stand the negative environmental impacts posed by the untreated or inadequately treated wastewater entering the nearby ecosystems, especially on the lives that depend on the ecosystem for substances. To safeguards ecosystems and public health, there is the need to treat waste water effluents before discharge. The remediation of waste water can be achieved by various treatment processes such as pytoremediation, microbial remediation process. Although there treatment process play vital role in wastewater remediation.

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