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PHYTOREMEDIATION OF TEXTILE PROCESS EFFLUENT BY USING WATER HYACINTH - A POLISHING TREATMENT

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ABSTRACT

In a present investigation phytoremediation of textile process effluent by using water hyacinth has been carried out in the KIT's College of Engineering Campus, for studying reduction of COD and metals from textile process effluent. It has been observed that there is a reduction of 80% in COD and about 25 to 45% reduction in metals after 18 days period.

INTRODUCTION

Phytoremediation is the use of plants to remediate contamination by the uptake of contaminated water by plants. Plants can be used to contain, remove, or degrade contaminants. It is a name for the expansion of an old process that occurs naturally in ecosystems as both inorganic and organic constituents cycle through plants. Plant physiology, agronomy, microbiology, hydrogeology, and engineering are combined to select the proper plant and conditions for a specific site. Phytoremediation is an aesthetically pleasing mechanism that can reduce remedial costs, restore habitat and clean up contamination in place rather than entombing it in place or transporting the problem to another site. Phytoremediation can be used to clean up contamination in several ways:

Phytodegradation by plants

Organic contaminants are absorbed inside the plant and metabolized (broken

down) to non-toxic molecules by natural chemical processes within the plant.

A Phytoremediation system capitalizes on the synergistic relationships among plants, microoganisms, water, and soil that have evolved naturally in wetlands and upland sites over millions of years. In the biological sequences that transform contaminants to neutral compounds, plants contribute inherent enzymatic and uptake processes that can recyle or sequester the organic molecules they encounter.

Plants act as hosts to aerobic and anaerobic microorganisms, supplying them with physical habitat and chemical building blocks. Plants roots and shoots increase microbial activity in their direct environment by providing additional colonizable surface area, increasing readily-degradable carbon substrates by organic exudates and leachate and by decomposition of part of their mass and creating temporally and spatially varying oxygen regimes.

Physically, plants slow the movement of contaminants in soil, by reducing run-off and increasing evapotranspiration and by adsorbing compounds to their roots. Once a wetland or upland Phytoremediation system in place, its biological components are naturally self-sustaining, powered by plant photosynthesis.

Phytoremediation can be applied in terrestrial and aquatic environments. It can be used as a preparative or finishing step for other clean-up technologies. Plants are aesthetically pleasing, and theses are relatively self-sustaining and cost-effective.

Water hyacinth is just beginning to be used for Phytoremediation. This use came about for a few reasons, the first being that water hyacinth is so plentiful. People have been trying to remove the plant from many waterways, spending billions of dollars in doing so. In many cases removal is high up to impossible. It has been discovered that water hyacinth's quest for nutrients can be turned in a more useful direction.

The results of several studies show plants such as the water hyacinth use appreciable amounts of the inorganic forms of nitrogen and phosphorus found in domestic sewage. Because inorganic nitrogen and phosphorus are accumulated to a large extent in the roots (roots represent 20 per cent of the wet weight of the plants), this quality signifies a second possible use for the water hyachinth as 'compost', or organic fertilizer. Water hyacinth compost (total plant), however, presents a problem because the fiber is not degraded. Water hyacinth root compost has nevertheless been used with good results as a propagation medium for house plants (Trivedy and Gudekar, 1987; Trivedy and Thomas, 2005).

Water hyacinth is already being used to clean up waste water in small scale sewage treatment plants. This plant utilises vast amount of many nutrients, which are poisonous to humans in these amounts. The water hyacinth has been shown to remove nitrogen and phosphates, organic matter and heavy metals.

Water hyacinth thrive on sewage; they absorb and digest waste water pollutants, converting sewage effluents to relatively clean water. Thus, the plants have exciting promise as a natural water purification system, which can be established at a fraction of the cost of a conventional sewage treatment

facility. Water hyacinths are serving that purpose in several locales and a number of other communities are considering adoption of the technique. For maximum effectiveness, Pollution gorged water hyacinths must be harvested at intervals, but this apparent drawback offers potential for additional benefit. Harvested plants can be and are being used as fertilizer. And if an economical way of drying the plants can be developed, they may find further utility as high protein animal feed.

MATERIALS AND METHODS

Construction of trench for the study

The underground trench open to the sky, for storage of textile process effluent was constructed using one brick thick (0.09 m) thickness and lining was provided. Trench dimensions are

= 0.6 m x 0.6 m x 0.5 m

Volume = 0.180 m^3

Surface area = 0.36 sq.m.

2. To avoid seepage plastic cover was provided.
3. Treated textile process effluent is poured into the trench.
4. Release of water hyacinth in the tank.
5. Grab samples were collected from the tank and were analysed for COD and heavy metals as per standard methods of APHA (1998).

RESULTS AND DISCUSSION

Table 1

Reduction in COD of treated Textile process effluent in 18 days

Day	Date	COD mg/L
1	02.04.2006	415
2	03.04.2006	410
3	04.04.2006	400
4	05.04.2006	380
5	06.04.2006	366
6	07.04.2006	348
7	08.04.2006	344
8	09.04.2006	333
9	10.04.2006	320
10	11.04.2006	310
11	12.04.2006	280
12	13.04.2006	172
13	14.04.2006	140
14	15.04.2006	100
15	16.04.2006	92
16	17.04.2006	80
17	18.04.2006	78
18	19.04.2006	71

Table 2
Analysis of heavy metals on 02.04.2006 and 19.04.2006

Sr. No.	Metal	Concentration in mg/L 02.04.2006	Concentration in mg/L. 19.04.2006
1.	Cd	0.1	0.06
2.	Cr	0.41	0.3
3.	Cu	0.48	0.25
4.	Fe	1.62	0.9
5.	Ni	0.42	0.32
6.	Pb	0.32	0.16
7.	Zn	0.31	0.136

It can be seen from the results that there is a reduction of 80% COD and 25 to 45% of metals after 18 days period.

CONCLUSION

1. Phytoremediation of Textile process effluent by the use of water hyacinth is effective and efficient for the reduction of COD and metals present in the effluent.
2. Although the process is efficient, it consumes more time and requires higher land area . It also produces nuisance of odor and flies. Hence phytoremediation by the use of water hyacinth is recommended as polishing treatment for the textile process effluent.

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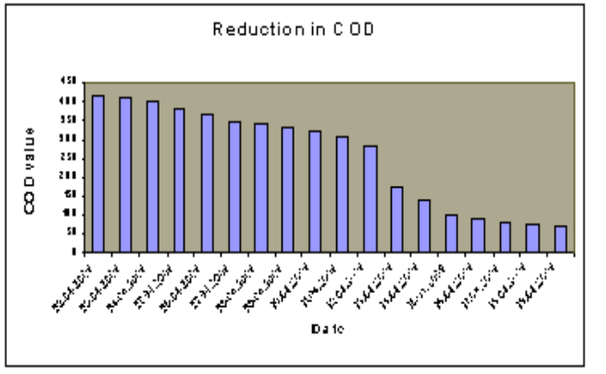

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