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FEASIBILITY STUDY OF WATER HYACINTH FOR WASTEWATER TREATMENT

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Abstract - *Water Hyacinth (Eichhornia crassipes) is a free floating aquatic weed which is becoming a serious problem in many countries by reducing the oxygen level in water. When not controlled, it is considered as serious threat to bio diversity. WH can be cultivated for waste water treatment and can be used to aid the water purification process due to its amazing ability to absorb and concentrate many compounds from aquatic environments. The rich fiber content in the roots of the plant makes water absorbency which is equal to the cotton fiber. This study attempts to evaluate the effect of WH in two different mechanisms, one through phytoremediation and other through biosorption. In phytoremediation living plant is used and in biosorption dried roots of WH is used as filtering material. Further, the reading for various parameters like Potential of hydrogen(pH), Turbidity, TSS, TDS, Phosphate, Nitrate, Chemical oxygen demand (COD) and Biological Oxygen Demand (BOD) for domestic wastewater has been periodically taken for every 5,10 and 15 days of treatment. The removal efficiency of these two mechanisms has been studied. The effect of dried roots of WH has resulted in significant decrease in turbidity, BOD and COD comparing to live plant. The primary purpose of this study is to make use of the WH plant for the purification of the domestic waste water and its treatment.*

Key Words: **Water Hyacinth, Aquatic Weed, Domestic Wastewater, Phytoremediatio, Biosorption, Dried Roots.**

1. INTRODUCTION

Water, land and air are the fundamental media in which life exists. Apart from food and shelter clean water is an inevitable necessity in human life**.** Surface and underground water are the major sources of clean water. However, with the rapid growth in population and increasing industrial development many water sources have become polluted. Hence, wastewater must be adequately treated prior to discharge into the environment.

In most cases the domestic sewage is discharged as such in the form of untreated, treated or partially treated into the nearby water bodies, where it can cause severe sanitary and other water pollution problems. Considering the pollution caused by domestic wastewater, these are treated before their disposal. Non-conventional sources are now necessary over conventional sources for the mode of energy, eco-friendlier and energy saving ways to treat water and should be put to use. Recent researches have reported the potentials of aquatic plants for inorganic and organic pollutant removal.

Water hyacinth is a free-floating perennial aquatic plant native to tropical and sub-tropical South America. With broad, thick, glossy, ovate leaves, water hyacinth may rise above the surface of the water as much as 1 meter in height. The leaves are 10–20 cm across, and float above the water surface. They have long, spongy and bulbous stalks. Phytoremediation technique is a branch of bioremediation which employs the application of plants for the remediation of wastewater. In this mechanism plant roots absorb nutrients from wastewater. Biosorption capacity of water hyacinth roots increases when it becomes dried. This paper evaluates the efficiency and comparison of mechanism involved in wastewater remediation using water hyacinth.

1.1 Objective of the study

- To make use what is so called “natural waste” to a “useful product”.
- To identify the efficiency of wastewater treatment using dried water hyacinth roots.
- To compare the efficiency of water treatment using phytoremediation and bio sorption.

2. METHODOLOGY

2.1 Collection of Water Hyacinth

Water hyacinth was collected from Kottooli wetlands near Calicut. Washed thoroughly with demineralised water to remove the earthy particles in the roots and leaves. Large quantity of plants were collected and cleaned.

Fig -1: Water Hyacinth

2.2 Collection of Sample

The domestic wastewater sample is collected from Aster Mims collection tank. The physio-chemical parameters of waste water such as pH, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Turbidity, Biological Oxygen Demand (BOD)5, Chemical Oxygen Demand (COD), Nitrate and Phosphate present in the samples were studied following the Standard methods outlined by APHA (1995) before and after introduction of the water hyacinth plants in the samples.

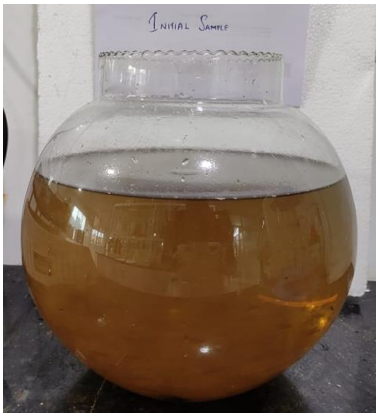

Fig -2: Initial sample

2.3 Preparation of the biosorbent

Collected water hyacinth roots are separated and oven dried in hot air oven at 105ºC for 24 hours. Dry biomass was crushed and wrapped in an un-whitened cotton cloth.

Fig -3: Dried Roots

2.4 Experimental Procedure

The treatment is conducted in two batches. The detention time of 15 days was applied to both the batches. In the first batch 10 liter capacity glass bowl is filled with wastewater of 7 liter. To this water hyacinth plant is allowed to grow. In the second batch same capacity bowl with 7 liter of wastewater is taken. To this, dried roots of water hyacinth is immersed by wrapping it in an un-whitened cotton cloth. On every interval of 5th, 10th and 15th day the physio-chemical parameters such as pH, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Turbidity, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Nitrate and Phosphate of sample is tested. A bar graph representing the removal efficiency and table representing the comparison on variation in concentration of parameters were plotted.

Fig -4: Experimental set up for live plant and dried roots

3. RESULTS AND DISCUSSION

The overall treatment efficiency was high and stable during the period of study. The followings are the observation on the chemical characteristics of domestic wastewater during the experiment. Table 1 shows the Characteristics of wastewater before treatment.

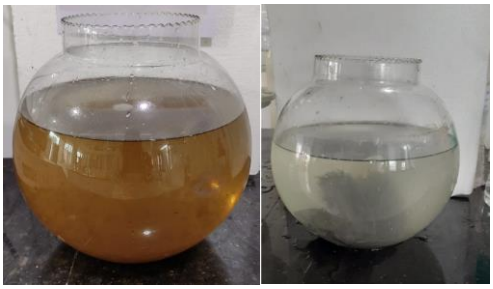

Fig -5: Live plant and dried roots treatment after 5 days

Fig -6: Live plant and dried roots treatment after 10 days

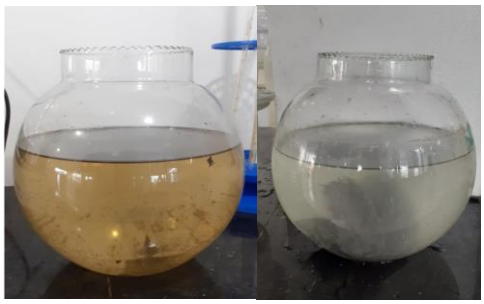

Fig -7: Live plant and dried roots treatment after 15 days

Table -1: Characteristics of water sample before treatment.

Parameters	Initial Value
pH	7.39
Total Suspended Solids (TSS) (mg/l)	116
Total Dissolved Solids (TDS) (mg/l)	631
Turbidity(NTU)	23
Biological Oxygen Demand (BOD) (mg/l)	332
Chemical Oxygen Demand (COD) (mg/l)	556
Nitrate(mg/l)	28
Phosphate(mg/l)	33

Table 2 shows the results of comparison on values of treatment with live plant and dried roots after 15 days of treatment.

Table -2: Comparison on values of parameters after treatment.

Parameters	Initial Value	Live Plant	Dried Roots
pH	7.39	7.45	7.48
Total Suspended Solids (TSS) (mg/l)	116	72	23
Total Dissolved Solids (TDS)(mg/l)	631	460	394
Turbidity(NTU)	23	13	4.3
Biological Oxygen Demand (BOD)(mg/l)	332	61	27
Chemical Oxygen Demand (COD)(mg/l)	556	244	122
Nitrate(mg/l)	28	7.4	4.8
Phosphate(mg/l)	33	5.9	7.3

Water Hyacinth has adequate capacity in removing pollutants from domestic wastewater as the treatment with water hyacinth is most common. In this study, the removal efficiency of live plant of Water Hyacinth is compared with dried roots of Water Hyacinth. It is observed that removal efficiency of dried roots is more in comparison. Table 3 shows the removal efficiency of treated effluent after 15 days.

Table -3: Removal efficiency of treated influent

Parameters	Removal efficiency for live plant	Removal efficiency for dried roots
Total Suspended Solids (TSS)	37.93%	80.17%
Total Dissolved Solids (TDS)	27.09%	37.55%
Turbidity	43.47%	81.30%
Biological Oxygen Demand (BOD)	81.62%	91.86%
Chemical Oxygen Demand (COD)	56.11%	78.05%
Nitrate	73.57%	82.85%
Phosphate	82.12%	77.87%

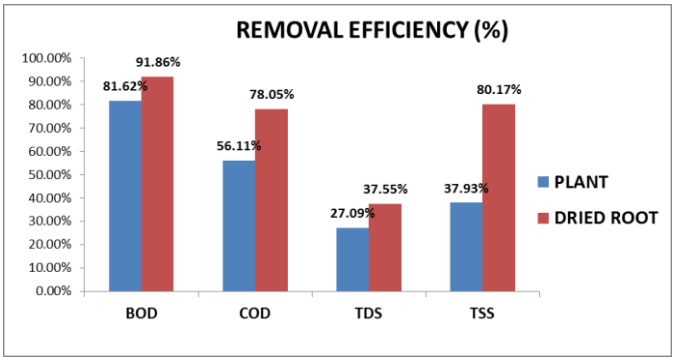

Chart -1: Removal efficiency of BOD, COD, TDS and TSS

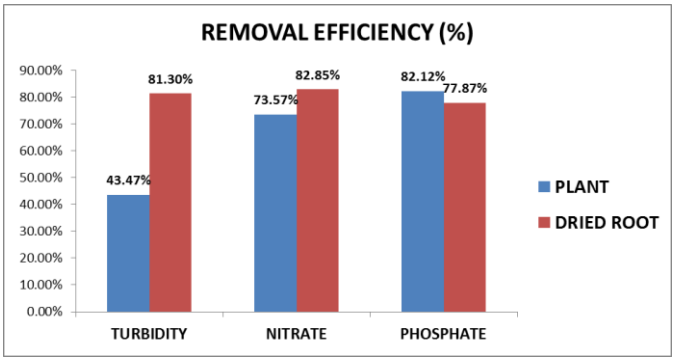

Chart -2: Removal efficiency of TURBIDITY, Nitrate and Phosphate

Water Hyacinth effectively removes all the parameters within the treatment period. 15 days of treatment gives 91.86% of removal efficiency of BOD from domestic wastewater in the case of dried roots filtration whereas only 81.62% removal in the case of live plant. Similarly, removal efficiency of COD changes from 56.11% to 78.05% in the case of live plant to dried roots treatment. It was observed that there is a tremendous change in the removal efficiency of turbidity. From 43.47% removal efficiency in the case of live plant to 81.30% removal efficiency adopted in the case of dried roots of water hyacinth. Bio absorption ability of Water Hyacinth roots also removes colour from the wastewater after treatment.

4. CONCLUSIONS

From the experimental analysis, the effective treatment of wastewater can be achieved by biosorption rather than phytoremediation. It is observed that aquatic plants having suitable characteristics reduce the pollutants from wastewater. The water hyacinth has an ability to absorb nutrients from wastewater. This study confirmed that the bio sorbent prepared from Water hyacinth roots, a low cost, easily available and environmentally problematic plant, could effectively remove Turbidity, BOD & COD than the live plant. The effect of WH has resulted in significant decrease in turbidity and due to which the removal of flocs and reduction in organic matters in water have been observed. Also the residue after treatment can be again dried in oven and converted into ash. This ash content can be used as manure. More studies have been done on water hyacinth by many researchers.

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