Designing and Working of Constructed Wetland for Red Industrial Effluent

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Abstract- *Constructed wetlands are man-made systems that can be designed for the treatment of polluted water. Due to their simplicity and low operation cost, constructed wetlands are becoming more prevalent in wastewater treatment all over the world. One of the main mechanisms of detoxification is considered to be the high microbial activity in the nutrient and oxygen rich environment surrounding wetland plant roots. Their range of applications is no longer limited to municipal wastewater, but has expanded to the treatment of heavily polluted wastewaters such as red category industrial effluents. A simple small-scale wetland model system was developed to evaluate the ability of a constructed wetland system to treat two types of wastewaters. A study is carried out to investigate feasibility and optimization in pollution concentration through Angular Horizontal Subsurface Flow Constructed Wetland in the Red category industry wastewater treatment using colocasia esculenta, canna indica, pampas grass(Cortaderia selloana), umbrella palm(Cyperus alternifoliu), typha augustifolia plant species. The sampling and analysis through physio-chemical and biological parameters viz. pH, TDS, BOD and COD were carried out at both inflow and outflow in the pilot plant. Results indicate that constructed wetlands can tolerate high pollutant loads and toxic substances without losing their removal ability, thus these systems are very effective bio-reactors even in hostile environments.*

Keywords- Industrial wastewater, constructed wetlands, colocasia esculenta, pampas grass (Cortaderia selloana), and typha augustifolia.

I. INTRODUCTION

Rapid industrialization has resulted in the generation of huge quantity of wastes, both solid and liquid, in industrial sectors such as sugar, pulp and paper, fruit and food processing, sago / starch, distilleries, dairies, tanneries, slaughterhouses, poultries, etc. Despite requirements for pollution control measures, these wastes are generally dumped on land or discharged into water bodies, without adequate treatment, and thus become a large source of environmental pollution and health hazard. Nature has evolved a number of systems to eradicate the pollutions generated due to natural events. The natural cycles in the environment offer a variety of ways in which pollutants can be altered and transported. These cycles are capable to tackle pollutions due to anthropogenic activity but to a certain extent. The best possible way is to remove Pollutants is by phytoremediation using aquatic plants. These natural processes of treatment include physical, chemical and biological mechanisms and require less energy, reduce the use of chemicals and have a small carbon footprint in comparison with conventional systems. The capacity of wetlands that are dominated by hydrophytes has ability to assimilate the nutrients and organic matter, thus treating waste water. In recent years effective treatment is achieved by the construction or management of wetland so that environmental conditions favor rapid degradation and cleaning of effluent. Among the different types of CWs, Horizontal Sub-surface Flow Constructed Wetlands (HSSFCWs) are most widely used and became low-impact alternatives to more conventional wastewater treatment processes.

II. RESEARCH ELABORATIONS

A. Experimental setup

Horizontal angular sub surface flow constructed wetland was constructed. The constructed wetland had colocasia esculenta, canna indica, pampas grass (Cortaderia selloana), umbrella palm (Cyperus alternifoliu), and typha augustifolia plant species. The constructed wetland lab model was made up of plastic and have dimension of 50cm x 25cm x 30cm and bed assembly is in rectangular shape. The volume of the bed is 37500cm3. The surface area of the bed was 1250 cm2. The inlet unit is provided with a PVC pipe. The water which will percolate through the bed assembly will come out from the PVC tap attached at the bottom and from there it will be collected in the beakers. Effluent was collected from dairy industry and sugar industry.

B. Preparation of Bed

The constructed wetland had a height of 30cm in which 3 cm were left on top for loading the wastewater hence only 27 cm was used to make the wetland bed out of which 15 cm was used to make the wetland (Soil & Plants) and the rest 12 cm was used for substrate. Top layer consisted of the local soil. Before placing the soil in the bed, it was cleaned properly and was ensured, free from impurities. The soil media had a

depth of 15cm, below the soil layer very fine sand (0.25mm) of 2cm depth were placed, below this layer there was layer of fine sand (passed through 4.75mm sieve and retained on 2.36mm sieve) of depth 1 cm. The Middle layer was made of again two layers of small pebbles (passed through 6mm sieve and retained on 4.75mm sieve) of depth 1 cm and second layer of pebbles (passed through 12.5mm sieve and retained on 6mm sieve) of depth 1.5 cm. The bottom of wetland unit was formed by two layers of aggregate of size 12.5 mm and 20 mm. different types of plant species as mentioned above were placed in the soil. The system was operated and maintained on volume based method. The wastewater was given appropriate inlet and HRT.

Fig.1. Bottom layer of wetland model

Fig.2. Middle layer of wetland model

Fig.3. Top layer of soil and plant species of wetland model

III. FINDINGS

During the experiment, it was noted that there was a marked correction in the pH of the effluent. pH was nearly neutralized. The color of the effluent was changed from dark to very faint. Also odour was negligible. Also both the study plants gave a good increase in height and number. The below table shows percentage reduction in various parameters of wastewater after treatment with sufficient retention time. Table 1 reveals that the combinations of different plant species are able improve the quality of red category effluents (Dairy industry and sugar industry). The test revealed that this combination of plant species have more potential to treat dairy effluent than sugar effluent.

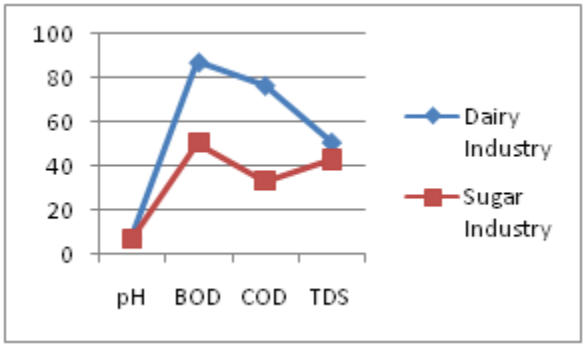

Fig.4. % Reduction in various parameters

It is also observed that increase in the retention time increases the % removal of pollutants due to good water holding capacity of local soil. Maximum effluent loss was found during as setup was operated in the summer season, due to which a daily loss of effluent was recorded.

IV. CONCLUSION

In the Constructed Wetland treatment process of dairy waste and sugar waste various quality characteristics were studied and it was found that the subsurface flow constructed wetland concept can offer high performance levels for almost all parameters at relatively low costs for construction and operation and maintenance. % reduction in parameters like pH, BOD, COD and TDS were 7.31%, 87.35%, 76.84% and 51% respectively for dairy industry and 6.87%, 50.66%, 33.25% and 43% for sugar industry. From the above study it can be concluded that combination of various plant species show better performance with respect to pollutants uptake. So the treated waste can be effectively used for irrigation and local purpose. Hence, the constructed wetland treatment process may prove to be a handy solution for the organic effluents from food based industries.

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