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Study on Greywater Treatment Using Hybrid Constructed Wetlands

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Abstract - Nowadays, water scarcity becoming a bigger issue in global level that's why one easy solution we should create for reuse and recycling of wastewater generated in society i.e. Constructed wetlands (CWs). Constructed wetlands are engineered systems which are designed and constructed just like the natural process of wetlands. This system is basically fully man- made activity which applies various technical designs as well as wetland hydrology, soils/substrates, microbes and plants. Constructed wetlands are categorized according to various parameters based on hydrology, macrophytes growth and flow path for open water-surface flow and subsurface flow, emergent, submerged, free floating and horizontal-vertical respectively. This paper reports the contaminants removal by using performing two stages of treatment i.e. horizontal constructed wetland (HCW) and vertical flow constructed wetlands (VFCW). Plants and various substrates were used in this system. This system has advantages and disadvantages too mainly it depends on materials used, flow conditions and retention time, atmospheric (climatic) conditions etc. Initial cost of CWs is considerably lower than conventional treatments. The experimental results showed that the removal efficiencies of contaminants from wastewater is achieved i.e. 58%, 59%, 56% and 47% for BOD, COD, chlorides, hardness respectively.

Key Words: Hybrid constructed wetland, substrates, Canna Indica, greywater, parameters

1.INTRODUCTION

Water became a rare source in various locations of the world so that it is necessary to recycle as

well as treat wastewater in economical way. Nowadays there are number of technologies available for treatment of water and wastewater. Some of them are costly so that it is necessary to find out the economical and easy solution. Constructed wetland (CW) is best solution that will be designed and can be implemented easily. Constructed wetlands that can be utilize natural processes for treatment of wastewater that are using substrates, plants and microbial communities. Conducted wetland (CW) technology has grown in popularity for wastewater treatment since the early 1970s. The initial cost of CWs for primary and secondary treatment is preferably lower than conventional treatments. There are the different conventional methods for wastewaters treatment such as active sludge process (ASP), rotating biological contactor (RBC), stabilization ponds, oxidation ditch, trickling filter (TF), sequence batch reactors (SBR), lagoons and up flow anaerobic sludge blanket (UASB), Micro-algae techniques etc. These methods having the limitations like energy, economic, need for large land, complex construction and operation, sensitive to temperature and excessive sludge (Simi and Mitchell, 1999; Tanner and Sukias, 2003; Sayadi et al., 2011)

Classification of different types of CWs depending on macrophytes and wastewater level in relation to the surface and direction of flow is shown in Fig.1.

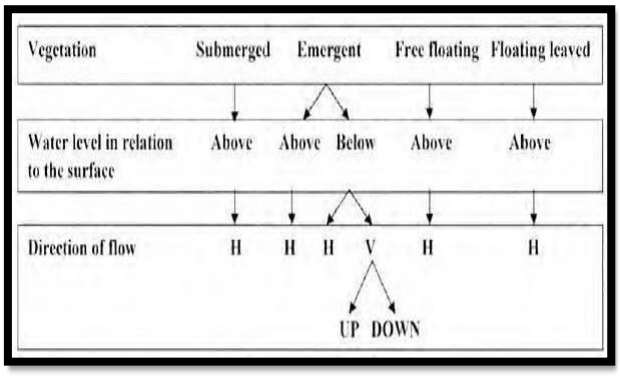

Fig.1- Various types of CWs depending on macrophytes, water level and direction of flow (Vymazal, 2010).

Constructed wetlands may be categorized according to the various design parameters, but the three most important criteria are hydrology (open water-surface flow and subsurface flow), type of macrophytic growth (emergent, submerged, free-floating) and flow path (horizontal and vertical). There are different types of constructed wetlands as follows-

Free water surface systems (FWS) (or **surface flow wetlands):-**

This type of system consists of a basin or channels with a barrier to prevent seepage, soil to support the roots of the vegetation, and water at a relatively shallow depth flowing through the system. The water surface is exposed to the atmosphere, and the flow path through the system is horizontal.FWS closely resemble natural wetland in

appearance and functions because they contain aquatic plant that are rooted in a soil layer on the bottom of the wetland and water flow through the leaves and steams of plants, with a combination of open-water areas, emergent vegetation, varying water depths, and other typical wetland features. Shape, size, and complexity of design often are functions of site characteristics rather than preconceived design criteria.

2. Materials & methods

Here in this report we are considering the greywater which is generated from hostel. Generally greywater is basically a wastewater which originated from kitchen, bathroom , laundry, wash basin, washing machines etc but as we have considered greywater from hostel the sources of greywater is bathroom and wash basin only.

Lab scale wetland system-

a) Inlet zone:

The primary criterion for design of inlet structure was discharge which was expected to be uniform along the entire width. A 25 liter container was used to provide a continuous flow of greywater through the inlet with natural aeration by allowing grey water to dripping on surface of beds.

b)Wetland cell:

The pilot wetland unit consisted of a PVC container of diameter and depth of 37 cm and 48 cm, respectively .The media consist of a bed underlain by a permeable layer of filters. Bed was filled to height of 40 cm with sand of size 4.75 mm, aggregates of size 10-20 mm and brickbats of size 30-45 mm and a layer of coal on bed of VSSFCW (vertical subsurface flow constructed wetlands).

c)Wetland media:

The media consist of a bed underlain by a permeable layer of filters. Bed was filled to height of 40 cm with sand of size 4.75 mm, aggregates of size 10-20 mm and brickbats of size 30-45 mm and a layer of charcoal on bed of VSSFCW. Table shows substrates used-

SR. NO.	TITLE	EFFECTIVE SIZE (MM)	DEPTH (MM)
1	SAND	4.75	50
2	AGGREGATE	10 -20	100
3	BRICKBATS	30-45	150

Table 1-: Substrates used in treatment system

d) Vegetation :

"Canna Indica a local wetland species, were used in the study. The plants were collected from a nearby lake and planted in the wetland unit. They were used to increase the residence time of water by reducing velocity so as to increase sedimentation of the suspended particles as well as to add oxygen and provide a physical site for microbial bioremediation. The plants had been used to remove suspended solids, nutrients, heavy metals, toxic organic compounds and bacteria from acid mine drainage, agricultural landfill and urban storm water runoff as well as grey water.

Here lab scale model is shown in the figure for hybrid constructed wetland.

Fig.2- Real view of laboratory scale setup of hybrid constructed wetland

1. Sample collection and quality testing

The sample was taken from Hostel Building by using jar on time of peak grey water generation nearly on morning time. It was necessary to carry the grey water immediately to the lab scale model to avoid the further process take place in grey water. The physical and chemical parameters were analyzed for the samples following conventional methods described in APHA 1992.

Range Of Parameters	pH= 7.0-8.5	BOD = 120-380	COD = 260-900	HARDNESS =200

Table 2:- Range of parameters for treatment system

Sr no.	Retention Time	pH	BOD	COD	Hardness	Alkalinity	Acidity	Chloride
1	4 Hrs.	8.02	261	350	92	70	120	145
2	8 Hrs.	8.12	257	341	124	76	136	200
3	12 Hrs.	8.12	252	342	43	72	112	170
4	16 Hrs.	8.18	248	331	90	68	112	145

Table 3- Results of Grey Water Treated By Pilot Model of Hybrid Constructed Wetland.

Results and discussion-

This section consists of the results of grey waste water characterize and performance of lab scale pilot model of SSFHCW The results obtained by analyzing the samples of

grey water and samples collected from outlet of laboratory scale model after treatment are presented below and subsequently discussed. The wastewater samples collected and tested are as follows-

The In the Constructed Wetland treatment process of wastewater, various quality characteristics were studied and it was found that initially the pH of restaurant waste sample was more acidic but due to the techniques implemented the pH was brought up near to the neutral axis also the removal efficiency of BOD is 58.40% and COD is 59.60% so the treated wastewater can be effectively used for external purpose.

3. CONCLUSIONS

1. The removal efficiency of contaminants removal is 58.40% and 59.60% for BOD and COD respectively.
2. It is very economical process as *Canna Indica* is naturally available in abundance in our area & Low cost material is used.
3. Cost Of Construction, Operation, maintenance is less & no skilled labor is required.
4. The treated water can be used gardening, washing, firefighting, Construction, toilet flushing etc.
5. Method is suitable for rural, undeveloped areas.
6. The cost of construction and maintenance is low as compare to other type of waste water treatment plant.
7. Constructed wetland can be effectively used for isolated households or apartments as it is compact in size.

Hence, the wetland treatment process is effectively worked.

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