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Treatment of Grey water Using Horizontal Flow Constructed Wetland - A Review

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Abstract: Constructed wetlands are increasingly being employed for wastewater treatment. Which is the last of defense against water pollution, and the need of quality the degree to which the pollution has actually impacted the environment has become paramount. Therefore, there is a need to develop tools for determining the environmental impact of pollutants and monitoring the ecological recovery of the site after remediation. To evaluate the constructed wetland technology, a project was implemented, using different types of constructed wetland system, for the wastewater treatment to evaluate relative advantages and disadvantages of water quality these types of systems, analyze their behaviour and efficiency in water environment renovation, develop, evaluate and improve basic design and operation criteria, and transfer technology. Constructed wetlands represent an alternative for sewage treatment plants based on various technologies because they are equally or more effective at removing pollutants than those used during the treatment of other types of wastewater, becoming important to manage or process wastewater where constructed wetlands provide predictable water quality benefits when properly designed and maintained. Constructed wetland carries filtration process to remove the contaminants from the wastewater. This report will summarize the state of technology, and profile a site where constructed wetlands have been implanted for treatment application other than municipal wastewater. In this project, we will treat the grey water i.e. from washbasin, washing machine, bathroom, etc except the water discharged from the water closet.

Keywords: Constructed Wetlands (CW), Total Suspended Solids (TSS), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand.

I. INTRODUCTION

A grey water bio-filtration system is a constructed wetland that removes a significant amount of pollutants from greywater before it flows into the water bodies. The certain amount of pathogens, bacteria, and non-biodegradable toxins entering to the surface water can be avoided with this type of treatment, to promote a better ecosystem and more sterile conditions. This treatment can be used for residential areas at low cost. Grey water is the wastewater produced from sinks, baths, or clothes-washing; it does not include toilet water, which contains bacteria and pathogens. Grey water may also contain some traces of toxic chemicals, soaps, salt, microorganisms, bleach, froth, and foodstuff. Additions of grey water to surface water bodies can cause the imbalance in pH levels, increase in oxygen demand and increase in turbidity.

A. Definition of Greywater

Greywater is defined as the wastewater generated from the kitchen, washbasins and baths, it can be recycled for uses such as toilet flushing, land irrigation and engineered wetlands. Greywater also includes wastewater from clothes washing machines and sometime include discharge from dish washers and kitchen sinks. It differs from the discharge of toilets, which is nominated as sewage or blackwater to indicate it contains night soil.

B. Constructed Wetlands

Constructed wetlands are the management systems, designed and constructed to exploit the natural functions of wetland vegetation. Microbes in soil treat contaminants in surface water, groundwater or waste streams.

C. Types of Constructed Wetlands

Constructed wetlands are classified according to the water flow regime into either free water surface flow or subsurface flow and according to the type of macrophyte plant as well as flow direction. Subsurface flow CWs are designed to keep the water level totally below the surface of the filter bed. They can even be walked on. This avoids the mosquito problem of FWS. The coarse sand used in subsurface flow CWs contribute to the treatment process by providing a surface for microbial growth and by supporting adsorption and filtration processes. This results in lower area demand and higher treatment performance per area for subsurface flow CWs, compared to free water surface flow CWs.

D. Selection of Plants

There are a few plants that are most frequently used for greywater bio-filtration wetlands, many of which can be found in natural wetlands. Wetland plants found close to the constructed wetland area are the most beneficial because they are

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already accustomed to the local climate. If these plants cannot be found locally, any wetland plants that grow well can be used.

• Canna lily (Canna indica) grow in the garden in temperate and subtropical regions. Cannas are used to extract many undesirable pollutants in wetland environment.
• Reed Plants (Colocasia esculenta) has the hole from the leaves throughout the stem to the root zone. It supplies oxygen to the root zone from atmosphere. Hence, the root zone is sufficient to grow the aerobic bacteria.
The plant which we will use is canna lily which was available in Bhuigaon region (Vasai).

II. LITERATURE REVIEW

S. Sinthana Gorky (2015) developed the model and in this study, the effectiveness of the wetland plant Colocasia esculenta in the treatment of greywater by vertical subsurface flow constructed wetland system is studied. A laboratory scale vertical flow reed bed of size 0.4 x 0.3 x 0.2m was constructed. Seven numbers of Colocasia esculenta species was grown. The system was fed at the flow rate of 3.0litres/day. The raw Greywater and treated Grey water were collected periodically and tested for quality. It is seen that reed bed unit is reducing the concentrations of TSS, TDS, BOD and COD by 66%, 89%, 85% and 82% respectively on an average.

BOYD C. HODDINOTT (2006) constructed a horizontal flow wetland which shows that good treatment efficiency for the five commonly measured parameters (TSS, BOD, nitrogen, phosphorous, and fecal coliforms) and efficient treatment of sewage is problematic for small systems and single-family dwellings. The release of large quantities of pollutants from inadequately treated wastewater contaminates the environment and can be particularly devastating to groundwater, which is the main source of drinking water for most of the world.

S. Sarafraz and his team (2009) studied four horizontal subsurface flow wetlands (HSSF) were constructed at the Research Station of Tehran University, located in Karaj, Iran. The study was carried out from April to September 2007. Gravel and zeolite were used in this study as substrate. Gravel-beds with and without plants (called GP and G) and gravel-beds mixed with (10%) zeolite, with and without plants (called ZP and Z) were examined to investigate the feasibility of treating synthetic wastewater which was specifically produced and modified to imitate agricultural wastewater.

Constructed Wetlands for Wastewater Treatment by Jan Vymazal (2010) gave the classification of constructed wetlands. It is based on: the vegetation type (emergent, submerged, floating-leaved, free-floating); hydrology (free water surface and subsurface flow); and subsurface flow wetlands can be further classified according to the flow direction (vertical or horizontal). In order to achieve better treatment performance, namely for nitrogen, various types of constructed wetlands could be combined into hybrid systems. All types of constructed wetlands are very effective in removing organics and suspended solids, whereas removal of nitrogen is lower but could be enhanced by using a combination of various types of CWs. Removal of phosphorus is usually low unless special media with high sorption capacity are used. Constructed wetlands require very low or zero energy input and, therefore, the operation and maintenance costs are much lower compared to conventional treatment systems.

III. DESIGN

The design is for 200 person having discharge 135lpd. By adopting a scale ratio of 1:10, we calculated the dimension as follows:

1. Secondary filtration tank
   Length = 40cm, Breadth = 25cm, depth = 10cm
2. Tertiary filtration tank
   Length = 40cm, breadth = 25cm, depth = 10cm
3. Collection tank
   Length = 50cm, breadth = 25cm, depth = 10cm
   The size of coarse aggregate is 20 to 25mm and size of fine aggregate is below 4.75mm. The thickness provided is 25cm.

IV. CONCLUSION

Based on above review shows that the grey water is treated by using horizontal, vertical and hybrid constructed flow wetlands. And in their model with sufficient slope grey water will flow through gravity. Subsurface vertical flow constructed wetland system could be used for the treatment of the grey water. A constructed wetland system can be an effective treatment facility for grey water. The treatment level was affected by not only by the change of seasons but also by the variations in influent quality and quantity.

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It is concluded from the review that the grey water contains contaminants such as chlorides, nitrites, carbonates sulphates, pathogens, etc which is discharged from the wash basins, sinks, washing machines, bathroom, etc except water closet.

Moreover, study shows that the different plants that can be used are as follows: Canna lily (Canna indica), Common reed (Phragmites Australis), Typha, Umbrella palm, Dwarf palm and they reduce chlorides, Nitrites, Phosphates, and BOD.

Constructed wetlands are very effective in removing organics and suspended solids, whereas removal of nitrogen is lower but could be enhanced by using a combination of various types of CWs. Removal of phosphorus is usually low unless special media with high sorption capacity are used.

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