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Domestic Waste Water Purification by Bio filter Combined Canna Indica Bed

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Abstract

In the current scenario, as fresh water is becoming scarce, it is the need of the hour to find out a replacement for the fresh water that is used for a various domestic purposes such as washing and bathing. The used domestic water consist of organic matters like, vegetable waste, oils, detergents, dirt from floors, soap and oil used in bathing and washing. This water is referred to as "greywater" or "sullage" and mainly contains dissolved and suspended solids, phosphates, proteins, carbohydrates, fats, and nitrates. These degradable contaminants use up oxygen in the degradation process. About 60 percent of used fresh water inside a house will be converted to greywater. In this work, the Sullage or greywater samples are to be collected from an apartment complex and are to be treated by passing it through a lab scale setup that consists of a sedimentation tank, a bio filter, an aeration tank and finally beds of Canna Indica which will reduce the phosphate level. The aim of this project is to reduce the BOD, COD, and turbidity, pH and phosphate levels and reuse the same for other household purposes. This treatment process is economical and simple when compared to the conventional setup. The untreated and treated water samples were tested for BOD, COD, and pH and turbidity levels and the results are represented graphically. The treatment efficiency for each parameter is also found out and tabulated. It is found that the BOD removal is enhanced by 19.3%. The amount of phosphate present in the treated samples is also determined and found to be satisfactory. Since domestic uses like flushing or cleaning of toilets, floors, yards and for gardening need not be of potable quality, the treated greywater can be replaced for such uses. This helps in saving the fresh water usage for the above domestic purposes and at the same time helps in alleviating water scarcity.

Keywords: *Biofilter, canna indica, greywater, sullage*

INTRODUCTION

We know that not only the lakes and aquifers are getting dried up due to global warming but at the same time are becoming too polluted to use due to increased human interventions. Almost half of the world's wet lands have been disappeared. Therefore, the need of an alternative for fresh water source has become a necessity today. Since, conventional waste water treatment system bears significant capital investments and energy inputs, this approach are inappropriate for small rural communities. This has led to the development of alternative wastewater treatment systems, which is efficient and less expensive to operate, than conventional domestic wastewater treatment systems. If treated grey water is reused for non-potable water needs, in urban areas, the fresh clean water demand can be reduced benefitting the urban water supply system. As the sources of sullage like Kitchen sinks, showers, clothes washing machines or dish washers are harmless with fewer pathogens, it is safer to handle. The treated sullage is very much suitable for flushing of toilets,

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household cleaning purpose, irrigation etc. In other words, Grey water is a freely available waste water resource which after suitable treatment, can be considered as an alternative water resource itself. The treatment to be adopted must be in an eco-friendly manner where special expensive equipment is not required. The recycle of grey water reduces overall burden on sewer and septic systems. Since, grey water consists of lower levels of contaminants, it is easier to treat and recycle. Such treated water can be used for various domestic purposes. The treatment processes that can be used are same as those used for sewage treatment, except that they are usually installed on a smaller scale, in a decentralized manner, at households.

In this work, the Sullage or greywater samples are collected from a six family apartment complex and are treated by passing it through a lab scale setup that consists of a sedimentation tank, a bio filter, an aeration tank and finally bed of Canna Indica. Keffala C and Ghrabi A [1] compared the treatment efficiencies of phragmites and typha in a pilot scale with horizontal and vertical flow. They have experimented with planted and unplanted system. Nitrogen removal in planted system was found to be better compared to that in unplanted system. Bacterial removal was found to be same in both cases. Jan Vymazal [2] has given an overview of constructed wetlands for wastewater treatment. Nazeemul Irfan and M V Molykutty [3] compared the waste water treatment efficiencies of canna and phragmites australis with reed-less filter bed efficiency. The sullage from the staff quarters, school hostels and college hostels of a University campus, in Chennai are treated in the campus sewage treatment plant (STP) and used for watering the garden. The testing is done with the primary treated water from the campus sewage treatment plant. From the experiment it was found that the reed bed system using cannas gave the best treatment efficiency compared to others. Sha et al., considered three different aquatic macrophytes viz. water hyacinth, duckweed and water lettuce for evaluating the treatment efficiency for municipal wastewater collected from Taxila (Pakistan) [4]. Removal efficiencies are concerned, water hyacinth was found to be most effective. Adedayo A Badejo et al., [5] used Vetiveria zizanioides plant to treat waste water utilizing vertical flow constructed wetland and found out treatment efficiency for chemical oxygen demand (COD), Total Kjeldahl Nitrogen (TKN), Total suspended solids (TSS) and free & saline ammonia. Sathyapriya K and C Chinnusamy [6] in their review paper elaborate on the benefits of reed bed system as a better alternative technology to conventional wastewater treatment method.

MATERIALS AND METHODS

In conventional sewage treatment plant, waste water from houses is taken to a common place and purification is done. The treated water can be utilized in the adjacent area for irrigation. But in the decentralized treatment every house hold can have the system and treated water can be used there itself for non-potable purposes.

In this work, the component of treatment system consists of a sedimentation tank, bio filter, aeration tank and reed bed filters. The reed can also be used in the conventional filter unit for enhancing the quality of water. A lab scale experimental set up is made and the water quality parameters are tested. If the system can be commercialized, it will be handy to reuse.
The experimental methodology adopted is shown in Fig. 1 and the set-up are shown in Fig. 2.

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Figure 1: *Methodology flow chart.*



Figure 2: *Experimental set up.*

In sedimentation tank, as waste water flows slowly, suspended particles are settled down by gravity purifying the waste water. The settled sludge at the bottom of the tank is to be periodically removed. In this project, the grey water or sullage of 30 liters from 6- house apartment is fed into the sedimentation tank with a detention period of 3 days. The lighter particles floating on the top can be skimmed off.

BIOFILTER

The second stage of enhancing the quality of sullage is by the process called as biofiltration in which natural filter media is used in layers. The water devoid of oil and grease from the sedimentation tank is fed into the bottom of the bio filter using T pipe and PVC connections. This bottom up flow approach through filter media makes the back washing efficient. The filter media of bio filter is made of the following layers:

- Coarse screen
- Fine screen
- Cellular sponges and scrubbers
- Bio balls
- Gravel

Coarse screen is provided at the bottom. Organic vegetable matter if present is detained in the first layer of coarse screening process.

Fine particles are removed by passing the sullage through fine screens. Minute organic matter present can be screened off with the help of fine mesh provided. Filtering media consists of cellular sponges and scrubbers.

Bio ball is one of the best filtering media in which bacteria is coated which consumes food waste. Ammonia supplied by food wastes is converted into nitrite and to less toxic nitrate by such bacteria. The water that forces through sponge layer brings

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nutrient and oxygen required by the bacteria, completing the nitrogen cycle. Thus the neutralization of ammonia and nitrate occurs in the bio filter setup. When the bio ball gets too clogged, it can be easily rinsed off by backwashing. The water coming out through the bio filtration process is collected for testing the turbidity level and then allowed to pass through aeration tank for further purification.
The microbial growth is promoted by aeration, by way of pumping air into the tank. By this process, the organic compound in the waste water gets converted into simple compounds. The aeration is done for a day in this test.

Canna indica is effective for the removal of high organic load, color and other waste particle and phosphates present due to the use of surfactants. Canna Indica bed consists of Gravel layer, Sand layer, Soil for plant and well grown plants. Each layer is made of 5cm height.

TESTING

The waste water samples were collected from the sedimentation tank that is untreated water sample and the water from the canna indica bed i.e. treated water sample are tested for various parameters. The following parameters were tested with standard procedure and tabulated in Table 1. Fig. 3 represent the graphical representation of BOD and COD values before and after treatment.

- Biological oxygen demand
- Chemical oxygen demand
- PH value
- Phosphate
- Turbidity

The turbidity reduction of the waste water after bio filter treatment has also been tested and is reduced from 11.5 BTU to 8.7 BTU. The maximum turbidity removal by canna indica is found to be 82.75%.

Table 1: *Waste water quality parameters before and after treatment.*

Sr. No.	Paramters	Units	Result		Reference Method
1	TURBIDITY	NTU	11.5	1.5	ALPHA 2130 B
2	COD	mg/l	734	287.5	IS: 302/P58/2016
3	BOD 3DAYS @ 27° C	mg/l as O2	465.5	35.8	IS: 3025/P44/2003
4	PHOSPHATES AS PO4	mg/l	3.4	0.54	IS: 3025/P31/2009
5	PH @ 25°C	-	6.92	4.44	ALPHA 4500H*B

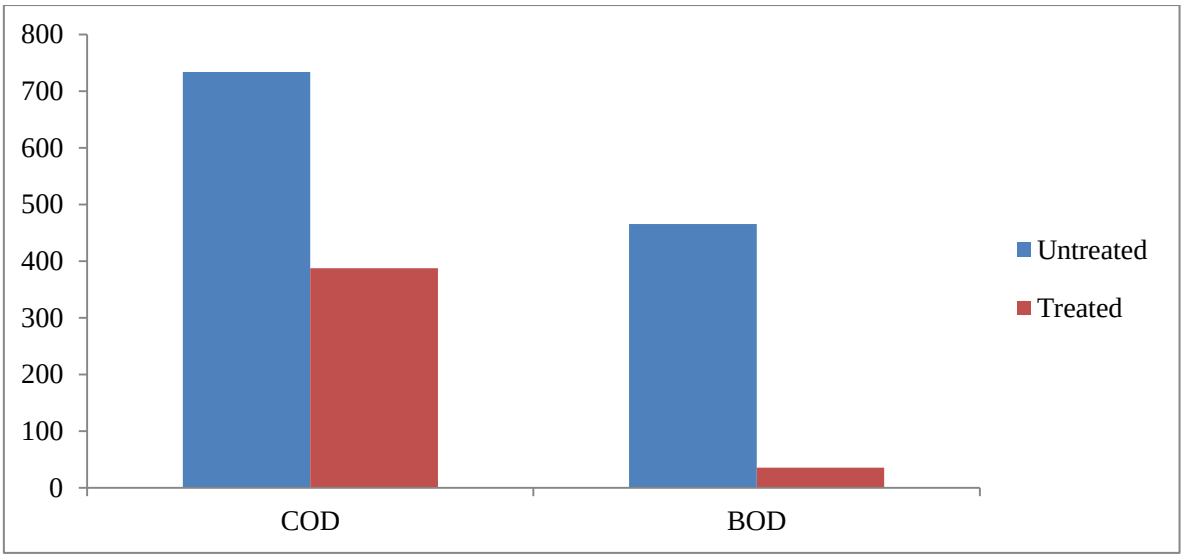


Figure 3: *Graphical representation of BOD and COD values before and after treatment.*

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RESULTS AND DISCUSSION

Comparison of quality parameters are given in Table 1 and shown graphically in Fig. 3. Compared to the previous studies by one of the authors, when bio filter is introduced the BOD removal is increased by 19.3% but there is not much change in the COD removal. The reduction in pH can be balanced by adding a little lime.

CONCLUSION

The sullage treatment using bio filter and canna indica meets the required standards and thus suitable for reusing it. The quality of treated sullage is enhanced by the introduction of biofilter. The usage of this treated water is recommended for various household purposes, where potable quality is not a must and thus leads to conservation of potable water as well. Hence the bio filter treated sullage using canna indica is one of the cost effective system which can be easily adopted in every household.

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