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Cost Effective Approach for Purification of Waste Water

Pranat Jain[1], Dr. Parag Sadgir[2]

1. *P.G. student, Department of Civil Engineering, College of Engineering Pune, India.*
2. *Professor, Department of Civil Engineering, College of Engineering Pune, India.*

ABSTRACT

Water, the need of life, is possibly to pose greatest challenge in the coming years, on account of its increased demand with population rise, economic development and shrinking supply due to over exploitation and pollution. Water is of vital importance and throughout history it has been considered as natural resource critical to human survival. Wastewater treatment is a fundamental process to protect the health of our ecosystem. Domestic wastewater discharge rate rapidly increases with rise in population. Various technologies have been used or being recently developed for grey water treatment and its reuse. So, reutilization of wastewater by appropriate technique is the only way to conserve freshwater from forthcoming concerns of water shortage. This study aims to present the importance of waste materials(bagasse, sawdust, activated charcoal) to purify and treat domestic waste water and reuse it. Column study is performed separately for each filter media. Various physicochemical properties like pH, BOD, COD and Turbidity of water sample was evaluated. The column was operated for varying detention time and flow rate. The results obtained from this experimental study showed BOD removal efficiency as 72-88% and COD removal efficiency as 80-90% for bagasse and activated charcoal both and turbidity removal is 85-95%.

Keyword: - Grey water, Media filters, Domestic wastewater, reutilization of wastewater.

1. INTRODUCTION

Water is one of the utmost necessary element that leads to development of heathy life. Water is essential for both plants and animal and it is the responsibility of human to take care of this resource, not only as a social, industrial and commercial good but also for a viable profit of all present and future living matter. The upcoming water demand could only be fulfilled by intensifying the water use efficiency and demand management. Segregation of domestic sewage into black water and grey water is considered as a symbolic outcome of new visionary development proposing waste as a resource. The purpose of wastewater treatment is to remove pollutants that can harm the aquatic environment if they are discharged into it.

Grey water is defined as urban wastewater without any input from toilets and so includes sources from baths, showers, hand basins, washing machines, dish washers and kitchen sinks. Purification using media filter of this waste water is one of the best ways to deal with the upcoming disposal of grey water. This paper presents a column study of dual media filters i.e., bagasse and activated charcoal. Research concludes that bagasse is extremely effective as a media filter as it is cost effective and easily available.

2. AIMS AND OBJECTIVES

The aim of the research is to treat and reuse grey water and upgrade conventional treatment processes by using combination of filter media for domestic waste water treatment. The main objective of this study is to endow in integrated water resource management to minimize the effect of water scarcity as water conservation in urban areas by treating domestic waste water through low cost, easily available waste material as filter media. The removal efficiency of parameters like BOD, COD and Turbidity were evaluated.

3. LITERATURE REVIEW

A short review of the work that is related to this research is presented Masi et al.[1] presented a case study carried out in Pune for greywater treatment by a pilot installation of green wall. They arranged the experimental analysis in two stages. In the 1st stage greywater is allowed to pass through green wall filled with LECA only. The COD and BOD removal efficiency was observed as 18.3% and 24.6%. They concluded that LECA layer does not allow for proper contact time between solution and active agents involved such as adsorption and biosorption. In 2nd stage LECA with sand and LECA with coco fiber were tested as filter porous media. The BOD and COD removal

efficiency for LECA with sand and LECA with coco fiber was observed as 44.3% , 53.7% and 42% and 53.3% respectively. The effluent quality obtained is suitable for reuse in irrigation, gardening purpose. The results obtained highlights that current setup of tested green wall could be ready to upscale and be adopted in real cases.

Martina et al.[2] has presented a study on bio-wall as approach to treat grey water. Appropriate treatment is necessary before utilization, as grey water adds wide range of pollution concentration. Bio-wall commonly known as green living wall are considered as self-sustaining vertical garden with significant potential to manage water. While designing a bio-wall there are certain critical factors which need to be analyzed such as plant selection, HRT of filter media, periodicity of greywater inflow(depends on habits of user) and influent pollutant concentration. It is being observed that vegetated bio-wall can undertake constructed wetland treatment ability and covert it to smaller area, treatment efficiency being comparatively same. About 90% removal efficiency of BOD5, COD, TSS is achieved. Total nitrogen and Phosphorous removal is as high as 98-99%. Bio-wall concept is based on "do it yourself" approach. Plants and filter media selection is very critical as plants which can tolerate for water logging conditions, high nutrient environment and elevated salinity are preferred. To improve the removal efficiency of parameters and water retention, lightweight substrate with granular material is used(gravel at bottom and coarse washed sand mix with sawdust). Greywater discharged from sinks, showers and washing machine is used.

Mahadeva et.al.[3] carried out a study on growing wall structures using waste water & biofilter .They suggested that waste water of the house which is leaved simple to sewage are prevented by growing green on the wall by this waste water. They observed that these green wall not only prevents water pollution but also prevents air pollution and even leads to reduction in global warming. The plants acts like integrated water filters in the whole process.

Gulhane M. L et.al.[4] studied the performance of modified multimedia filter for domestic waste water treatment. They suggested that multimedia filter model is based on concept of attached growth process as its advantage is that it maintain high micro-organism concentration which results in high removal efficiency at relatively low HRT. They conducted study by a model which consists of 3 reactors placed in series with total reactor volume of 90 lt. and waste water is allowed to flow in Downflow-Up flow-Downflow regime through all 3 reactors. Detention time is varied and various filter media like burnt bricks, Aerocon media, plastic media are used. They concluded that multimedia filter are one of the best alternative as efficient pre-treatment process for waste water treatment.

4. MATERIALS AND METHODOLOGY

4.1 Materials

4.1.1 Bagasse

Bagasse is the left-out material that remains after the squeezing of sugarcanes at the sugar production. Even though bagasse is a so-called by-product, many people see it as a waste product because in the past, bagasse was mainly used as a fuel for industries. It is very stable, sturdy, readily available and completely bio-degradable.

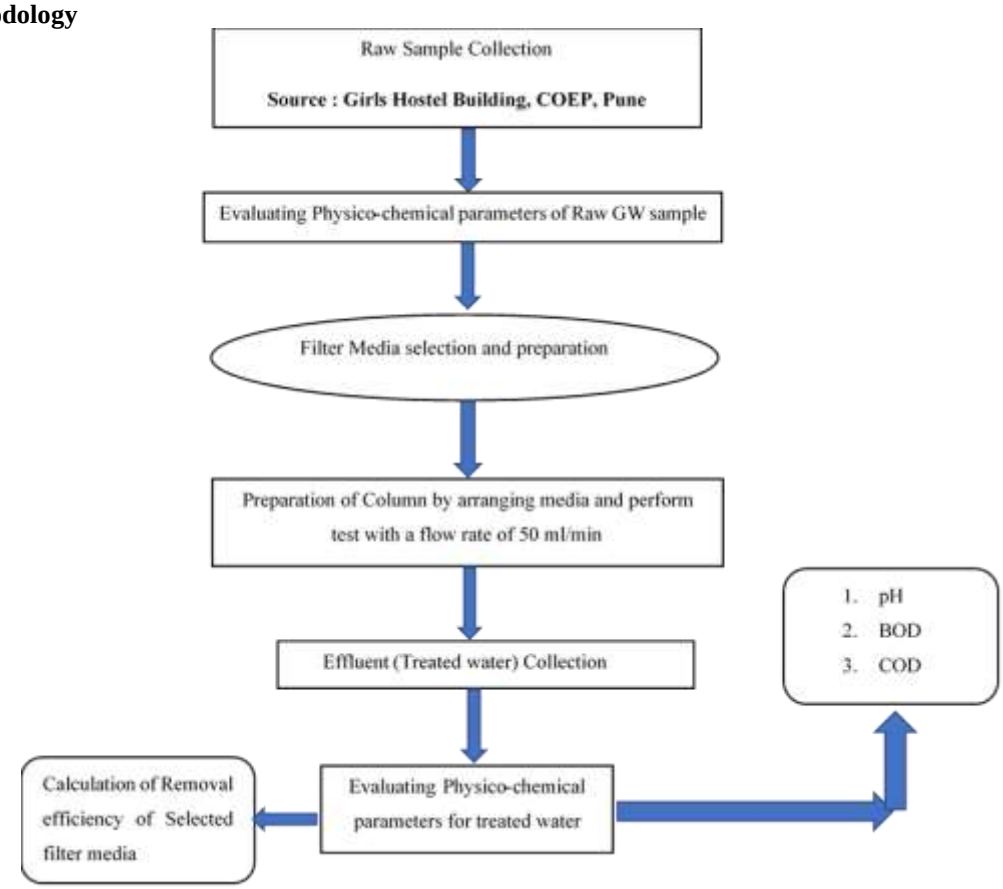
Fig-1: Bagasse

4.1.2 Activated Charcoal

Each particle of carbon in activated charcoal provides a large surface area allowing contaminants the maximum possible exposure to the active sites within the filter media. One gram of activated carbon has a surface area in excess of 2850 m^2. Activated carbon works via a process called adsorption, whereby pollutant molecules in the fluid to be treated are trapped inside the pore structure of the carbon substrate.

Fig -2 : Activated Charcoal

4.2 Methodology



5. EXPERIMENTAL SETUP

The setup consist of the use of waste material in treating grey water. A column 86.6 cm height, inner diameter 7 cm and thickness 0.5 cm of multimedia filter of acrylic material was made. Inlet water arrangement is made through a hole at 6 cm height from top and 2 cm diameter. A mesh is fitted at a height of 5.6 cm from bottom and is 0.5cm thick. Fig. 3 and fig.4 show full details of column with line diagram representation and column setup respectively.

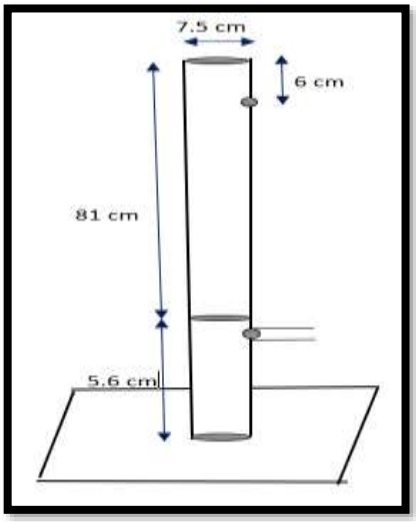


Fig- 3 : Column with full details

Fig -4 : Original Column

The waste water is collected from Girls Hostel Building at College of Engineering Pune. The physico-chemical parameters were evaluated. Water was fed to column with the help of peristaltic pump at a desired flow rate of 50 ml/min.

6. RESULTS AND DISCUSSION

Throughout the study the media filters i.e., Bagasse and activated charcoal were operated with a flow rate of 50ml/min. BOD, COD and turbidity removal efficiency of Bagasse is better than Activated charcoal.

Sr. No.	Raw Waste Water (mg/lt)				Treated Water with Bagasse (mg/lt)			
	pH	BOD	COD	Turbidity	pH	BOD	COD	Turbidity
1	5.4	88	300	39.3	7.4	22	40	3.86
2	5.9	87	310	36	7.0	20	44	3.54
3	5.6	88	280	29	6.8	20	40	2.86
4	5.54	80	260	32	7.7	18	36	2.62
5	5.8	82	300	31.8	7.2	15	35	2.48
6	5.4	86	280	27.8	6.9	12	32	2.18

Table 1: Evaluation of water quality parameters for raw waste water and treated water with bagasse.

Sr. No.	Raw Waste Water (mg/lt)				Treated Water with Activated charcoal (mg/lt)			
	pH	BOD	COD	Turbidity	pH	BOD	COD	Turbidity
1	5.4	88	300	39.3	7.80	24	50	5.2
2	5.9	87	310	36	6.85	24	48	4.58

3	5.6	88	280	29	6.96	22	44	5.17
4	5.54	80	260	32	7.4	20	40	4.24
5	5.8	82	300	31.8	7.6	19	36	3.82
6	5.4	86	280	27.8	7.66	17	38	3.13

Table 2: Evaluation of water quality parameters for raw waste water and treated water with activated charcoal.

Sr. No.	Removal Efficiency of Bagasse			Removal Efficiency of Activated charcoal		
	BOD	COD	Turbidity	BOD	COD	Turbidity
1	75	86.66	90.17	72.72	83.33	86.76
2	77.01	85.80	90.17	72.41	84.51	87.27
3	77.27	85.71	90.137	75	84.28	82.17
4	77.5	86.15	91.81	75	84.61	86.75
5	81.70	88.33	92.20	76.83	88.0	88.00
6	86.04	88.57	92.16	80.23	86.42	88.74

Table 3: Removal efficiency of Bagasse and activated charcoal.

7. CONCLUSIONS

Low cost filter media has potential for application to medium-scale systems. These media filters are new development in the filtration technology which involves the use of cost effective, easily available filter media other than the costly conventional media. The performance of column is enhanced by using these media filters. From the study performed it is concluded that both bagasse and activated charcoal are effective in treating domestic waste water.

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