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Sewage Treatment Potential of Coir Geotextiles in Conjunction with Activated Carbon and Sand

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Abstract - *An Wastewater treatment is of major concern as the increasing population substantially increase the wastewater generation. There is a need of efficient alternatives in designing environmentally sustainable systems. Geotextiles in wastewater treatment may prove to be effective alternative as filter media. This study involves filtration performance evaluation of coconut coir geotextile in conjunction with conventional filter media such as sand and activated carbon in removal of nutrients. The wastewater samples for this study are collected from a sewage treatment plant.*

The experimental setup consists of an acrylic column of 10cm diameter with a base plate attached to it with an opening at the bottom end to collect the treated wastewater samples. Porous plate is provided at 5cm from the bottom end to support the filter media and to facilitate the movement of treated water to the filtered water collection chamber. Two filter media arrangements were considered and four trials were conducted in each filter column arrangement. Filter media used in this study include Sand, Activated Carbon, and Coconut Coir Geotextiles. First and second arrangement consists of coconut coir geotextile in addition to sand and activated carbon. The parameters analysed in this study were TDS, BOD, COD, Nitrate nitrogen and Total phosphorus. Second filter column arrangement with filter media layers of sand, activated carbon and 600GSM coconut coir geotextile was found to be best arrangement with maximum pollutant removal efficiency. Maximum removal efficiencies of TDS, BOD, COD, Nitrate nitrogen, Total phosphorus were 68.91%, 73.03%, 75.46%, 74.89%, 78.93% respectively and were found in third filter column arrangement, where coconut coir geotextile was placed in intermediate and bottom layer.

Key Words: Waste Water, Sand, Activated Carbon, Physico-Chemical Parameters, Acrylic column.

1. INTRODUCTION

Water is the basic requirement for every living being on the earth. Resources of water are finite. Increasing population leads to increased consumption of natural water resources. Both industrial and domestic activities generate wastewater. There is a desperate need of remedies for increasing demand of fresh water. Reuse and recycling are to be seriously considered. Waste water can be reused for irrigation and industrial cooling which does not require drinking water standards. Wastewater from each industry will be unique but domestic wastewater is consistent in nature.

Management, treatment and reuse of wastewater have been one of the major issues as it demands sophisticated infrastructure and finance. Many of the cities in India still lack proper wastewater collection systems. Underground drainage systems are yet to be laid in most of the areas of the country where sewage treatment has become essential. Discharge of untreated wastewater in to natural water bodies leads to reduction in quality of water and further resulting in depletion of aquatic flora and fauna. Discharge of nutrients such as nitrogen, phosphorus, organic matter and waste water containing pathogenic microorganisms cause eutrophication and outbreak of epidemics.

The technologies to treat contaminants are of great importance in primary treatment systems of wastewater treatment.

It is essential to consider for improvement of present treatment techniques to be cost effective and environmentally sustainable. An effort has been made to evaluate the filtration efficiency of the coconut coir in conjunction with sand activated carbon in removing nutrients from domestic wastewater. Sewage samples from the sewage treatment plant at Shivanagar, Davanagere is collected and analysed for various characteristics for raw sewage as well as the effluent collected after the filtration process.

2. MATERIAL AND METHODOLOGY

The experimental setup consists of acrylic pipe of diameter 10cm with base plate and a porous circular plate of 10cm diameter to facilitate the movement of filtered water to bottom compartment.

There is an outlet attached to bottom compartment to collect filtered water for analysis. Sand, Granular Activated Carbon, Geo Textiles of different surface densities was used. The experimental setup is shown in figure 1.

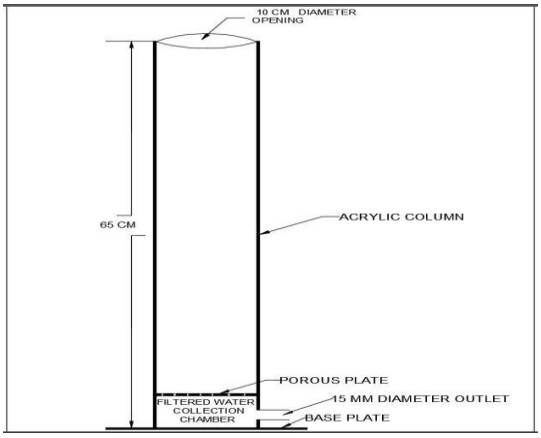


Fig.1: Experimental Setup

Source of Wastewater Samples:

Samples were collected from shivanagar sewage treatment plant Davanagere. Influent raw sewage which has passed through screens is collected for analysis. Type of sampling used was grab sampling and the samples were stored in refrigerator.

Geotextile:

Coconut coir geotextile of two surface densities are used for the study, namely 300 GSM, 600GSM. Coconut coir has lignin content higher than other natural geotextiles or filter media and it is durable than most of the natural geotextiles. Organic matter gets stacked on the surface of the coir fibre and further it it is oxidised by the micro-organisms.

Methodology

Collection of sample from the sewage treatment plant. Collected samples are analysed for mentioned characteristics. Samples are then allowed to pass through the filter columns under gravity in four trials that are,
Trial 1: Raw sewage is fed and 2 litre head is maintained in the filter column, Trial 2: sewage to be fed is diluted with tap water (2:1) dilution and 2 litre head is maintained in the filter column, Trial 3: Raw sewage is fed and 1 litre head is maintained in the filter column, Trial 4: Sewage to be fed is diluted (2:1) with tap water and 1 litre head is maintained in the filter column. Treated samples are then collected from the outlet provided and analysed for required parameters.

Filter Column Arrangement 1:

This filter column arrangement consists of four layers, which are sand, coconut coir geotextile, activated carbon and another layer of coconut coir geotextile successively. All four layers are of depth 10cm. coconut coir geotextile used in this arrangement is of surface density 300GSM. The bottom layer of filter media is supported on the porous plate. Wastewater to be filtered is allowed to pass through the filter media with the constant head. Treated effluent is then collected from the outlet and analyzed for the parameters mentioned in the objectives. The schematic diagram is shown in figure 2.

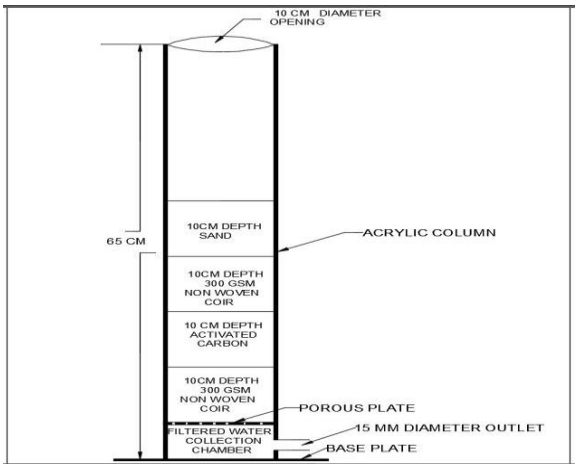


Fig. 2: Filter Column Arrangement 1

Filter Column Arrangement 2

The second filter column arrangement is similar to the second filter arrangement, except the surface density of the coconut coir. Surface Density of coconut coir used in this arrangement is 600GSM. All the four layers in the filter column are of same depth. The schematic diagram and image of the filter column arrangement 2 are shown in figure 3

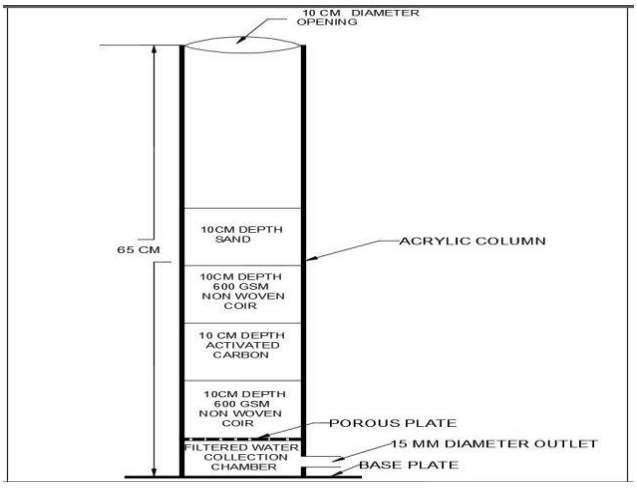


Fig. 3: Filter Column Arrangement 2

3. RESULTS AND DISCUSSIONS

This chapter discusses results obtained from the present study on the performance of geotextile, sand, and activated carbon for the treatment of Domestic Wastewater. Physico-chemical characterization of raw Domestic Wastewater has been analysed. The results of the tests conducted on the removal of the various pollutant parameters such as pH,

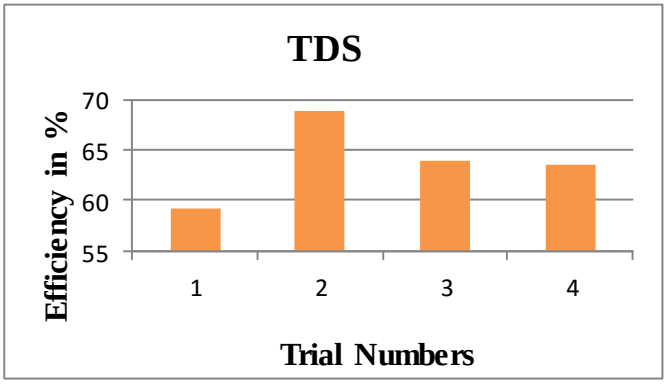
COD, BOD, TDS, Nitrate Nitrogen and Total Phosphorus have been discussed in this chapter. Initial characteristics of the wastewater samples analysed are shown in table 1.

Table 1: Characteristics of Domestic Wastewater Samples Collected

Parameters	Range
pH	6.8-7.5
Total Dissolved Solids	750-800 mg/litre
Biochemical Oxygen Demand (BOD_5)	300-370 mg/litre
Chemical Oxygen Demand	400-440 mg/litre
Nitrate Nitrogen	18-25 mg/litre
Total phosphorus	2.0-3.6 mg/litre

Performance of Non-Woven Coir Geotextile in Filtering Domestic Waste Water

Filter column arrangement 1 consists of one layer sand, one layer of activated carbon and two layers of coconut coir geotextile of surface density 300GSM. This arrangement showed increasing trend in removal efficiency of TDS, BOD, and COD. Maximum removal efficiencies of TDS, BOD and COD were 63.52%, 62.21%, and 61.89% respectively, but removal efficiency of Nitrate nitrogen was found to be maximum in trial 2, that is 70%, and total Phosphorus removal efficiency was found maximum in trial 3, that is 68.96%. filter column arrangement 2 performed efficiently than the filter column arrangement 1 where the coir geotextile of 600 GSM surface density was used. The graphical representation of pollutant removal efficiency of filter column arrangement 2 is shown in figures 4 to 8.



.Fig.4: Removal Efficiency of TDS (Filter Column Arrangement 2)

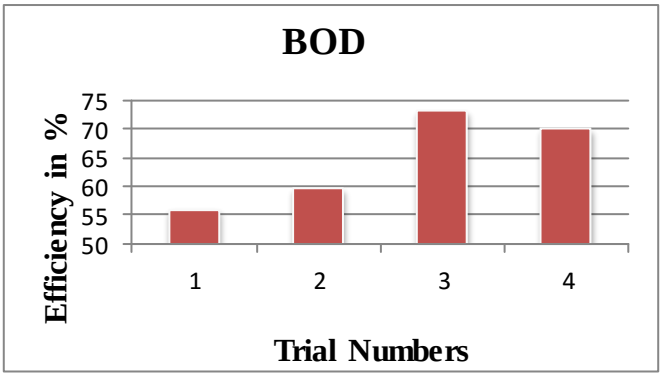


Fig.5: Removal Efficiency of BOD (Filter Column Arrangement 2)

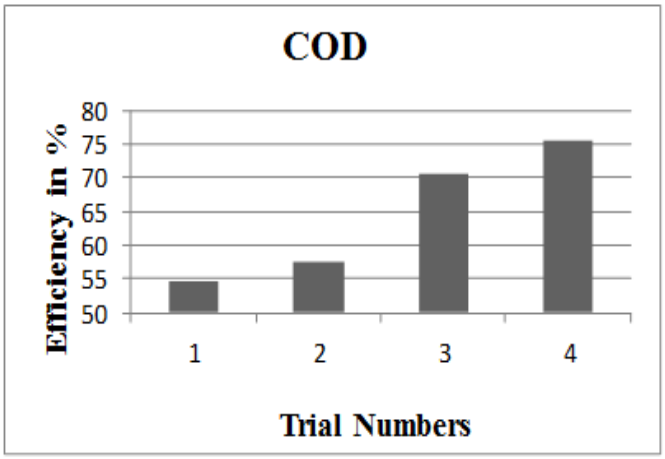


Fig.6: Removal Efficiency of COD (Filter Column Arrangement 2)

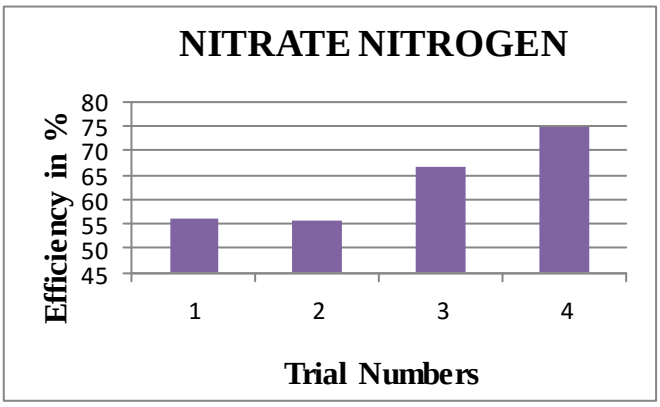


Fig.7: Removal Efficiency of Nitrate Nitrogen (Filter Column Arrangement 3)

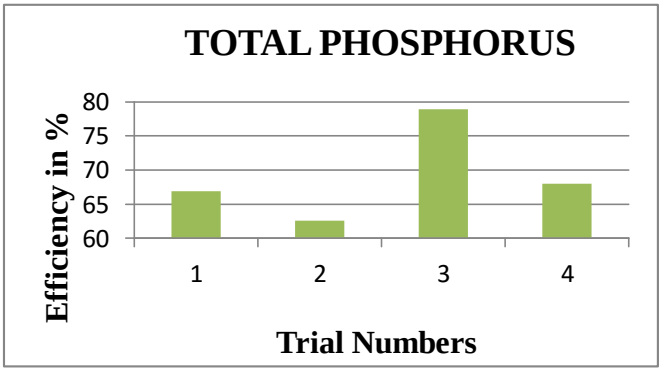


Fig.8: Removal Efficiency of Total Phosphorus (Filter Column Arrangement 2)

The second filter column arrangement performed better than the first filter arrangement. Maximum removal efficiencies of TDS, BOD, COD, Nitrate nitrogen and Total phosphorus were 68.91%, 73.03%, 75.46%, 74.89% and 78.93% respectively. BOD and Total phosphorus removal was found maximum in third trial. COD and Nitrate nitrogen removal efficiency was found maximum in fourth trial, as they have shown increasing trend of removal efficiencies in consecutive trials. TDS removal was found maximum in second trial.

4. CONCLUSION

Filtration performance two different arrangements of filter columns were evaluated in the laboratory using non-woven coconut coir geotextile and the following conclusions were made. Obtained results showed that removal efficiencies of TDS, BOD, COD, Nitrate nitrogen, Total phosphorus were maximum when coconut coir geotextiles are used in conjunction with sand and activated carbon in a filter column. Maximum removal efficiencies of TDS, BOD, COD, Nitrate nitrogen, Total phosphorus were 68.91%, 73.03%, 75.46%, 74.89%, 78.93% respectively and were found in second filter column arrangement, where coconut coir geotextile was placed in intermediate and bottom layer. Coconut coir geotextile with surface density 600GSM performed effectively than coir with surface density 300GSM. Second filter column arrangement with filter media layers of sand, activated carbon and 600GSM coconut coir geotextile was found to be best arrangement with maximum pollutant removal efficiency. Geotextiles when used with conventional filter media, they can improve durability and provide strength to the filters. Coir geotextiles due to its ease of installation compared to thick gravel and sand layer and durability higher than other natural geotextiles, it can be an efficient alternative filter media.

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