Performance Evaluation of Biofilter To Treat Domestic Waste Water

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Abstract- *Wastewater treatment is of major concern as the increasing population substantially increases the wastewater generation. There is a need of efficient alternatives in designing environmentally sustainable systems. This study involves filtration performance evaluation of 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. Three filter media arrangements were considered and four trials were conducted in each filter column arrangement. Filter media used in this study include Sand and Activated Carbon. The parameters analyzed in this study were TDS, BOD, COD, Nitrate nitrogen and Total phosphorus. From all of the trials conducted with the filter column arrangement, maximum removal efficiency was found in third trial, which is raw sewage filtered with the constant head of 1 litre. Maximum removal efficiencies of TDS, BOD, COD, Nitrate Nitrogen, and Total Phosphorus were 60%, 56.05%, 59.28%, 64.67% and 68.51% respectively. Removal efficiencies of all the parameters analyzed were higher for the raw sewage compared to diluted sewage.*

Keywords- Waste Water, Sand, Activated Carbon, Physico-Chemical Parameters.

I. 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. Anthropogenic activities lead to contamination of natural resources which may create problems to aquatic flora and fauna. Although waste is generated from various sources, most of it is domestic wastewater. Present scenario of waste water management is not that effective and it should be efficient and environmentally sustainable. Use of untreated domestic wastewater for irrigation or disposal on land may cause clogging of soil pores and obstruct movement of air and essential nutrients to root zone which are essential for growth of crops. 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 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.

Study Area: 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. Sampling location is shown in figure 1

Fig.1 Map Showing Sampling location

II. METHODOLOGY

A. Materials used

Sand: Sand is the most common filter media that is being extensively used. As the wastewater flows through the filter sand, it forms a gelatinous layer on the surface which helps in straining impurities. The sand was collected from Tungabhadra River and sieved. Sand passing through 1mm sieve and retained on 600 micron sieve is taken for experimentation. It was then washed with distilled water and allowed to dry completely. This sand was then filled in column as per the procedure.

Granular activated carbon: Granular activated carbon is made from high carbon content materials such as wood, lignite and coal. It has excellent adsorbing capabilities and resistant to most of the chemicals. Micro pores on the activated carbon act as tiny sedimentation tanks. GAC used has a diameter 1.2 to 1.6mm and density 520 kg/m^3. This granular activated carbon is placed in combination with the sand in the filter column.

B. Experimental Procedure

- 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 mentioned below
  - 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.

Table 1: Methods and Apparatus Used for Analysis of Wastewater characteristics

Parameters	Methods	Instruments Used
pH	Electrometric	pH meter
TDS	Gravimetric	Digital TDS meter
BOD_5 at 20^0 C	Winkler's Iodometric method	Titration apparatus
COD	Open reflux method	Titration apparatus
Nitrate Nitrogen	Kjeldhal method	Kjeldahl digestion apparatus
Total Phosphorus	Spectrophotome-try	Atomic absorption spectrophotomet-er

III. RESULTS & 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 2.

Table 2: 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

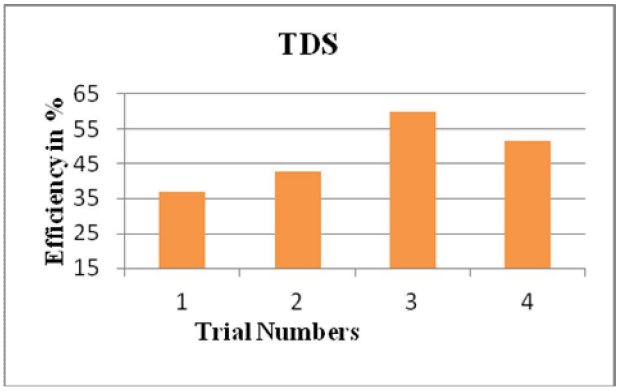

Fig 1: Removal Efficiency of TDS (Filter Column Arrangement 1)

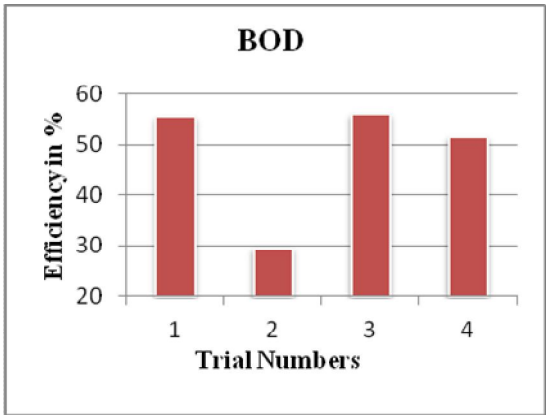

Fig.2: Removal Efficiency of BOD (Filter Column Arrangement 1)

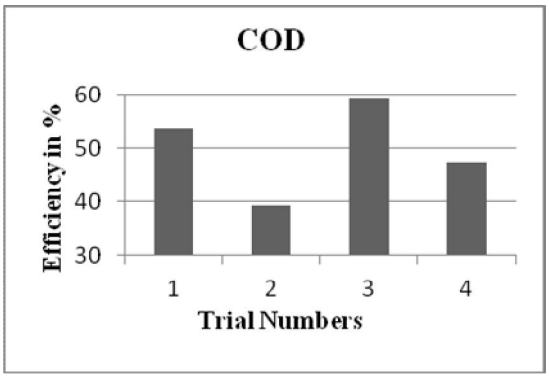

Fig.3: Removal Efficiency of COD (Filter Column Arrangement 1)

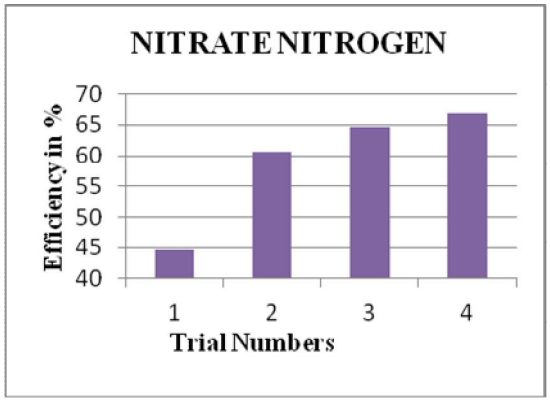

Fig.4: Removal Efficiency of Nitrate Nitrogen (Filter Column Arrangement 1)

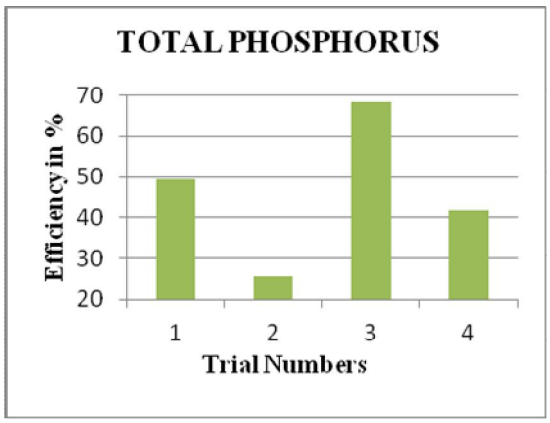

Fig.5: Removal Efficiency of Total Phosphorus (Filter Column Arrangement 1)

From all of the trials conducted with filter column arrangement, maximum removal efficiency was found in third trial, which is raw sewage filtered with the constant head of 1 litre.

IV. CONCLUSIONS

Filter arrangement performed well for the raw sewage than the diluted sewage. Pretreatment may improve the efficiency of the filter. Maximum removal efficiencies of TDS, BOD, COD, Nitrate Nitrogen, and Total Phosphorus were 60%, 56.05%, 59.28%, 64.67% and 68.51% respectively. Removal efficiencies of all the parameters analysed were higher for the raw sewage compared to diluted sewage.

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