International Journal of Interdisciplinary Innovative Research &Development (IJIIRD)
ISSN: 2456-236X
Vol. **05** Special Issue **01** | **2020**

Treatment of sewage and greywater using Aerobic Brickbat Gravel Sand (ABGS) Filtration method.

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ABSTRACT

Wastewater treatment is a fundamental process to protect the health of our ecosystem, with rapidly growing population there is an increase in generation of domestic wastewater production and often some of its quantity especially in rural areas is left untreated and directly discharged into water bodies leading to pollution and disturbed ecosystem and the main barrier for addressing to this problem is cost of the treatment, land requirements and improper maintenance,therefore in present scenario, there is a need to find low-cost and nature friendly treatment option in which locally available materials can be used. In this research, lab scale model was prepared with length 0.6m, breadth 0.45m and height as 0.35m, such three units are prepared with taking the retention time as four hours in design.Filtering media used were brickbatscobbles and pebbles in first unit,coarse gravels and medium gravels in the second unit and river sand and hardcoke in the third unit of laboratory model. This experimental model was initially saturated with clean water for 24 hrs. The experiments were carried out with raw sewage and grey water. Initially raw sewage was flowed in a horizontal manner under gravity into three units and tested for wastewater parameters, after the trial runs, subsequently the treatment system was cleaned and again saturated with clean water and same process was followed for grey water.The performance of the experimental model showed removal efficiency of BOD3 as (81-87%); TSS as (83-85%); TOC as (72-89%) and increase in pH value of treated wastewater.

Keyword:-— sewagetreatment, grey water treatment, hardcoke, BOD3, TSS, TOC.

1. INTRODUCTION

As per 2011 census report in India, it was observed that millions of rural area household were not having proper drainage facility. With rapidly increasing human population and development with urbanization, the quantity of wastewater generation has become huge which is now a challenging situation in today's world especially in the developing nations like India and due to which discharge of untreated sewage has been increased and scarcity of water has reached an alarming rate. Centralized conventional treatment system of wastewater requires large capital, land, electricity and which becomes an expensive task.Therefore simplified treatment technology with low cost decentralized approach is clearly a present need for both rural and urban areas. Today, majority of our fresh water bodies nearly more than 70% are polluted, which puts pressure on groundwater table which ultimately results in ground water depletion and its contamination [1]. In wastewater treatment system, the wastewater characteristics and objective of treatment process collectively decides the suitable treatment process [2]. Out of the various treatment systems, filtration process has high micro-bacterial concentration which becomes suitable for reduction in wastewater contaminants like odor,color, BOD, and suspended solids[3].In filtration, the purification of wastewater significantly takes place due to settling of the suspended matter through the filter media and microbial action and attached growth process[4][5].In consideration with the pollution of aquatic bodies and water scarcity, biofilters and roughing filters are one of the emerging technologies whose application can be considered as good and reliable option for checking the pollution level in aquatic bodies and also for the reuse of the treated wastewater [6].

1.1 Roughing filtration

Roughing filter are majorly used for pre- treatment of wastewater because it efficiently removes fine suspended solids particles[7]without undergoing any hazardous chemical reaction and thus do not form harmful by-product.The present research work is based on the concept of roughing filtration system in which various filter medias are used such as brickbats, hardcoke, sand and variety of gravel and these are all locally available materials. In this filtration system the large filter area is available due to which sedimentation, absorption and biological process takes placewhich leads to the purification of wastewater with improvement in its quality.[8]

1.2 Experimental work

The sewage sample was collected from sewage treatment plant. Nearly about 20 Litres of wastewater was being sampled from the treatment plant. The grey water was collected from H block in hostel campus of College of Engineering, Pune.

Experimental design

The laboratory scale model of Aerobic Brickbat Gravel Sand (ABGS) filtration with length as 0.65m, breadth as 0.45m and height as 0.35m was fabricated with consideration of detention time 4 hour. Three units of given dimensions were fabricated [Figure 1] with adequate level of inlet and outlet. The dimensions of the model were designed for flow 25 to 30 litres per hour. The treatment unit was sectioned into various compartments due to which contact surface increases which increases oxygen absorption from atmosphere and hence leads to increase in treatment efficiency.

2. MATERIALS AND METHODOLOGY

The filter materials were washed and soaked in clean water for 24 hour, and then they were placed in their respective compartments with coarser particles in the beginning followed by finer particles at the end.

Fig -1: Experimental model

2.1 Materials

The present study has three treatment unit with first unit consisting of brickbats (50-90mm size), cobbles and pebbles (50-65mm size) with brickbats in first two compartments, and cobbles on last two compartments. The second unit consist of coarse gravels (25-40mm) placed first followed by medium gravel (5-10mm size). The third unit consist of hardcoke and sand in which sand was placed at the bottom and hardcokewas placed at top. Wastewaterflow was gravity flow.

2.2 Methodology

The sewage and greywater was collected from its respective sources. Then sample was fed into the experimental setup wherein it was passed through all the three units of the treatment system under the gravity flow. Subsequently the treated wastewater samples were collected from an outlet level from first and second unit, wastewater was allowed to stand for three to four hours in third unit. Overall the wastewater flowed from coarser to finer materials.[9] All the treated wastewater samples collected from each unit was analysed for parameters i.e BOD, TSS, TOC and pH.

3. RESULTS

All the testing results for influent and effluent from theTreatment units are formulated in Table (1).

Table -1: Table containing influent and effluent values

	BOD(mg/L)				TSS(mg/L)				pH				TOC(mg/L)			
	Influent	Unit 1	Unit 2	Unit 3	Influent	Unit 1	Unit 2	Unit 3	Influent	Unit 1	Unit 2	Unit 3	Influent	Unit 1	Unit 2	Unit 3
Sewage	125	60	57	24	300	140	85	50	6.8	7.5	7.5	7.89	110	75	69	30
Grey Water	65	34	28	8	170	78	52	26	7.5	7.7	7.7	8	72	46	38	8

3.1 Analysis

The results show that BOD_3, TSS, and TOC value goes on decreasing whereas pH value increases from unit 1 to unit 3 as seen in (Figure2-5), with treatment efficiency for BOD as 81 % for sewage and 87 % for grey water; for TSS as 83% for sewage and 85% for grey water and TOC as 72% for sewage and 89% for grey water.Figure 6 shows the influent and effluentfrom three units in series.

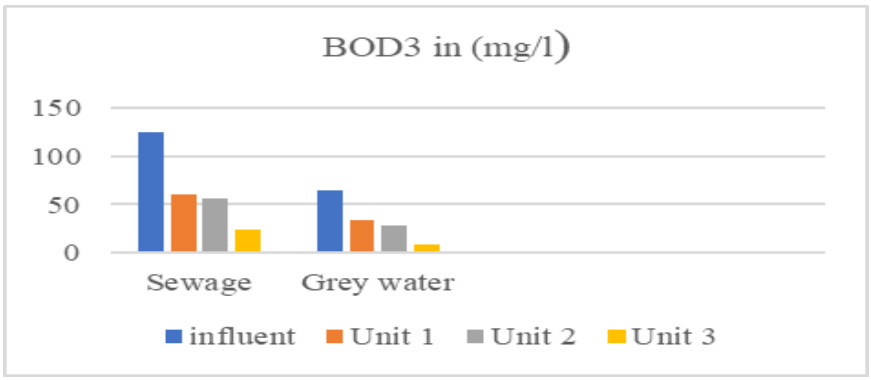

Figure-2: Analysis of BOD3

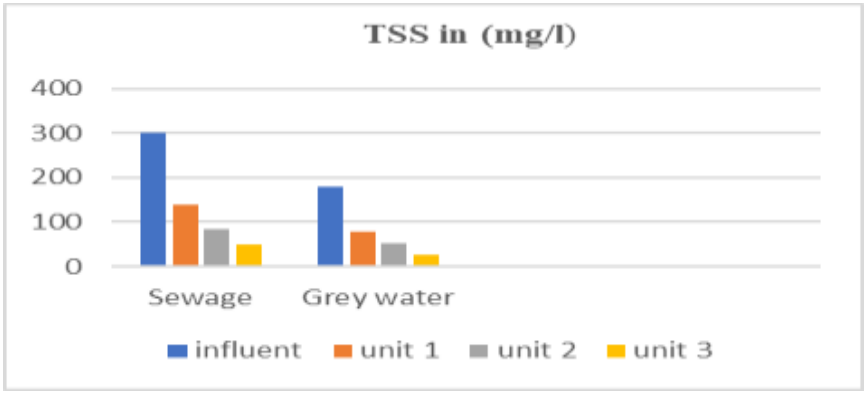

Figure-3: Analysis of Total suspended solids

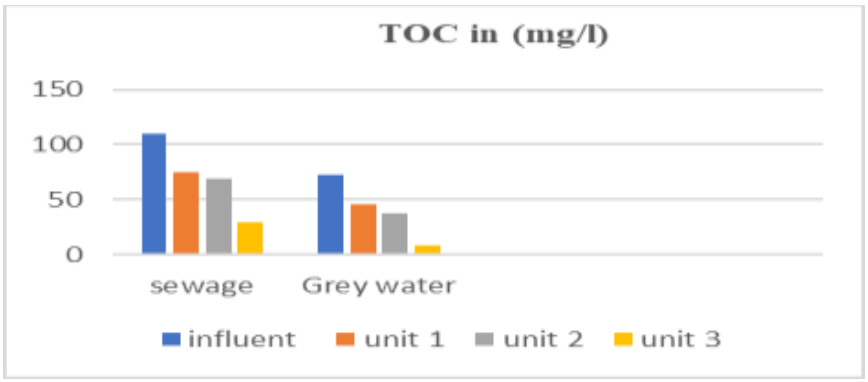

Figure-4: Analysis of Total Organic Carbon

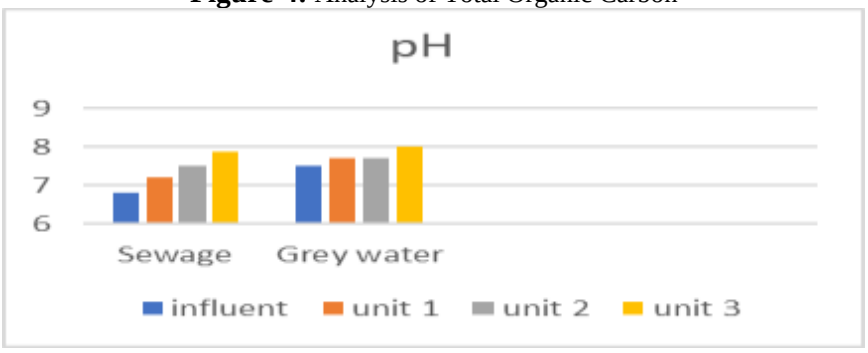

Figure-5: Analysis of pH

Figure 6 :influent (left) and outlet fromthree units.

4. CONCLUSIONS

The present study reveals that the sewage and grey water can be efficiently treated by adopting a simplified technique of horizontal gravity roughing filtration system using low cost and locally available materials. The removal of BOD, TSS and TOC was fair enough with both sewage and grey water, however the grey water treatment performance was better than sewage. It was also seen that the treatment unit 3 was more effective as compared to the two units. The percentage contamination removal efficiency for sewage was BOD (81%), TSS (83%), TOC (72%) and for grey water was BOD (87%), TSS (85%), TOC (89%). The treated values were well within the standards for discharging treated wastewater.

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