An Experimental Analysis on Sewage Water Treatment Using Step down Sand Filters (SDSF)

M.Shanmugaraj
Lecturer, Department of Civil Engineering, VSVN Polytechnic College, Virudhunagar- 626001

***Abstract*- The main objective of this experiment is the sewage water treatment by using the step down sand filters, the municipal sewage water treatment is needed for this world, everyday water crises is increase, in present scenario, the availability of water is a major challenge. Alternative water sources available include rainwater, sea and brackish water, grey water and domestic or municipal sewage waste water. Among these, grey water represents the most profitable sources in terms of its reliability, availability and raw water quality. In this research a cost effective system to meet the water requirements is established. From the experimental results we found that grey water can be treated by using drawer sand filter and the treated grey water can be reused for domestic purposes. The paper concludes that Step down Compacted Sand Filters would be appropriate for use in dense urban areas as its footprint is small and appropriate for a sewage water treatment.**

Index Terms- Sewage water, Rain water, Brackish water, step down sand filters.

I. INTRODUCTION

Water covers 70% of the globe's surface, but most is saltwater. Fresh water that is available for human consumption comes from rivers, lakes, underground sources and aquifers. These sources together account for only 1% of all water on the Earth. Water scarcity currently affects many regions in the world, As human population increase, the need for water also increases in domestic, agricultural, industrial and urban sectors, Consequently, water or blue gold is widely predicted to be a critical resource. In water scarce environment, wastewater reuse and reclamation are often considered as a viable option for increase water resources availability, grey water and domestic or municipal waste water. Among these, grey water represents the most profitable source in terms of its reliability, availability and raw water quality. Grey water reuse has played a major role in meeting domestic and irrigation demands Proper design of wastewater treatment plant and its further exploitation requires the knowledge of characteristic changes of quantitative sewage inflow. The inequality of sewage outflow from sewage systems appears both in daily, weekly and yearly cycle. The most important factors, which determine the quantitative characteristics of sewage produced in settlements are dependent primarily on the quantity of households equipment with sanitary facilities and its condition, the method of water supply, the method of sewage disposal, the price of water and the cost of sewage drainage, people's lifestyle, the number of people living in the area, different types of manufacturing present, service and administration facilities which are not equipped with their own sewage disposal systems, and the degree of influence the infiltration and accidental water has on sewage systems.

Objects which are affected by improper dimensioning, by incorrectly defining the reliable flow can have problems with hydraulic under load. In this case, the challenge is to maintain the activated sludge in good condition with very low, or even evanescent, sewage inflow. Small amounts of sewage inflows to wastewater treatment plant cause the increase of the time of their retention in different technological objects of a wastewater treatment plant. Apart from the objects which have problems with hydraulic under load, one can also meet objects which even several times exceed the designed capacity. On such state, the uncontrolled inflows of foreign water – accidental and infiltration water – has influence. These waters cause dilution of pollutants contained in the sewage and cause reduced sedimentation ability of sludge as a result of too high sewage flow speed and the reduction of organic substance content susceptible to biodegradation in raw sewage. Increasing sewage inflows to wastewater

treatment plant contributes to the reduction in the efficiency of the equipment such as sand traps, and initial and secondary clarifiers. They can also cause flushing of the activated sludge from the biological reactor and can increase the financial expenses of transportation and sewage aeration.

II. METHODOLOGY

The project on sewage water treatment by step down sand filters is done by collecting sewage water from homes, industries, office buildings, etc., and treating it economically. The step down sand filters is a modified design for a sand filter in which the sand layer is broken down into several layers, each of which is 10 cm high and placed in a movable drawer separated by a 8 cm space. It involves the following steps, Collection of Sewage water, Laboratory investigation of sewage water before treatment, Treatment of sewage water using drawer sand filters, Laboratory investigation of treated water, Reuse of treated water

III. LABORATORY INVESTIGATION OF GREY WATER BEFORE TREATMENT

Sewage water or sullage is the waste water generated in household, offices and other buildings. Sources of sewage water include sink, shower, water from washing machine and dish washers. To check the characteristics of grey water tests were conducted on alkalinity, hardness, temperature, pH, TDS, COD and BOD and the test result are as given in Table 1.

IV. DESIGN OF STEP DOWN SAND FILTERS

A step down sand filters unit for testing and optimizing the design under laboratory condition was constructed. A metal framework of 70 cm × 32 cm × 70 cm was designed and fabricated. Five plastic drawers with dimensions of 35 cm × 28 cm × 6 cm were obtained and placed on the frame as shown in (Figure. 1). Each draws of step down sand filters was filled with different grades of sand (Lukas, 2015; Nimala, et al., 2016; Rodgers, et al., 2004; Winward, et al., 2008). The purity of water increases with fineness of sand. Each drawer except the lowest drawer (number 5) – was perforated with holes. Pump was used to pump synthetic grey water from a small storage tank placed next to the drawer sand filter. the below details shows all design details of the laboratory sand filter.

Drawer 1 Gravels retained in the sieve 5.75 mm
Drawer 2 Sand retained in the sieve 1.36 mm
Drawer 3 Sand retained in the sieve 0.98 mm
Drawer 4 Sand retained in the sieve 500 micron
Drawer 5 Sand retained in the sieve 100 micron
Depth of media 60 mm (for each drawer)

Design parameters of the laboratory step down sand filters dimension of each filter is 40 × 30× 8mm. Small gravels and silica sand, of two different sizes, were used as treatment materials.

V. TREATMENT SYSTEM

Sewage water systems that involve storing grey water must treat the grey water to reduce the other micro-organism that can multiply in stagnant water. Physical and chemical sewage water treatment system primarily utilizes disinfection and filtration to remove while biological treatment uses aeration and membrane bio reactors. In step down sand filters unit sand is placed in movable filter and is exposed to air from above and below; this facilitated oxygen movement within and between the sand layers, thus oxidation occurs in all layers with no chance of oxygen depletion.

The sewage water was pumped using a submersible pump and transferred via well-designed manifold lines placed over the upper surface of the sand layer of drawer number 1. The water then percolates through the filtering media placed in drawer number 1 to drawer 2 and passively passes through the filtering media in all drawers. The step down sand filters was operated under varying hydraulic loading rate of 70,100,130 l/m2/day. The water, which comes out from the last drawer, is accumulated to be sampled and tested.

VI. LABORATORY INVESTIGATION OF TREATED WATER

The performance of the filter compacted step down sand filters in the sewage water treatment was studied and the results of the study are reported are given in Table 1.

Parameters	Hydraulic loading rate (l/m2/day)	Effluent concentration	% Removal
COD	100	58	51
BOD5	100	32	83.95
pH	100	6.92	20.73
Hardness	100	285	26.6
TDS	70	355	32.3
Alkalinity	100	290	31.8
Temperature	100	33	4.22

Table 1. Performance of DCSF

From the above analysis it was found that slight difference was noticed in terms of overall filter efficiency between different loads for all parameters. The highest percentage removal of maximum number of parameters was at the hydraulic loading rate of 70.

VII. CONCLUSION

The step down sand filters unit designed in this project was found able to overcome the problems associated with conventional sand filter design adopted, such as clogging and also which requires a large land area to house the filter. From the experiments carried out, it was found that slight difference was noticed in terms of overall filter efficiency between different loads for all parameters. The analysis result showed that most of the parameters of grey water are above permissible limits for reuse. This new compact design would allow sand filters to be used in locations where space is at a premium, such as dense urban areas, and the low maintenance requirements mean that a wide range of users could easily operate a step down sand filters.

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