Domestic Wastewater Treatment using Multimedia Filter Technology

Mangesh L. Gulhane[1] Anuja U. Charpe[2]
[1]Associate Professor [2]P.G. Student
[1,2]Department of Civil Engineering
[1,2]Government College of Engineering, Amravati, Maharashtra

Abstract— Due to increasingly urbanized and industrialized society with a rapidly expanding population, the need for cost effective and environmentally sound technologies for wastewater treatment is required. Filtration technology is the simplest and low cost treatment technology based on the principle of attached growth process. Multimedia Filters represent a significant improvement over single media filters. A laboratory scale multimedia filter model was developed for treatment of domestic wastewater. Different packing media such as cellulose pads, brick bats and aerocon stones of varying sizes were used. The model was operated for varying detention time. The results obtained from this experimental study showed removal efficiency for BOD as 67%, COD as 69% and TS as 86% for 24 hours of detention time.

Key words: Aerocon stones, Brick bats, Cellulose pads, Domestic wastewater, Filtration, Multimedia Filter

I. INTRODUCTION

Domestic wastewater is the water that has been used by a community and contains all the materials added to the water during its use. It is thus composed of human body wastes together with the water used for flushing toilets and sullage, which is the wastewater resulting from personal washing, laundry, food preparation and the cleaning of kitchen utensils.Fresh wastewater is a grey turbid liquid that has an earthy but inoffensive odour. It contains large floating and suspended solids, smaller suspended solids (such as partially disintegrated faeces, paper, vegetable peel) and very small solids in colloidal (i.e. non-settleable) suspension, as well as pollutants in true solution. It is objectionable in appearance and hazardous in content as it contains number of disease-causing ('pathogenic') organisms [1].If this wastewater discharged directly into a watercourse, serious damage might result to the many form of life and would contribute potential risks transmission of the disease. So there is need to provide cost-effective and environmentally sound technologies for wastewater treatment. Wastewater treatment systems are considered to provide effluents which fulfill the required standards related to total solids (TS), biochemical oxygen demand (BOD) and chemical oxygen demand (COD) [2].

Filtration is a process for removing pollutants from wastewater by passing through the porous medium. It is the simplest and low cost treatment technology based on the principle of attached growth process to treat wastewater by removing contaminants like COD, BOD and total solids for a wide range of applications in domestic as well as industrial applications. Multimedia filters are those ones which utilize three or more than three different types of packing media. Multimedia filters are composed of different types of packing media of varying sizes to a total depth of 0.75 m to 1 m. Filtration process works on the principle of attached growth process. In attached growth processes the microorganisms responsible for the conversion of organic material or nutrients are attached to an inner packing material. The wastewater flowing past the attached growth are also known as biofilm packing material used in attached growth processes which include rock, gravel, slag, sand, redwood and a wide range of plastic and other synthetic materials [3].

In present research efforts were made to develop the promising and cost effective technique for domestic wastewater treatment. A laboratory scale multimedia filter model was developed and performance of attached growth system using different types of filter media of varying sizes was observed.

II. AIMS AND OBJECTIVES

The aim of the study was to upgrade the conventional treatment processes by developing the multimedia filter for domestic wastewater treatment. To study the performance of multimedia filter with different packing media such as brick bats, aerocon stones and cellulose pads was the objective of the experimental study. The removal efficiency of parameters like BOD, COD and TS were studied.

III. MATERIALS AND METHODS

A. Filter Media:

The selection of a suitable filter media is an important part in the design of operation and multimedia filter process in order to meet the required effluent quality. Removal efficiency increases with decreasing filter media size and increasing filter bed depth. Filter media provides large surface area to enhance the microbial growth. Therefore it plays a key role in maintaining a high amount of active biomass and a variety of microbial populations. In multimedia filter three different types of media were used such as brick bats, aerocon stones and cellulose pads.

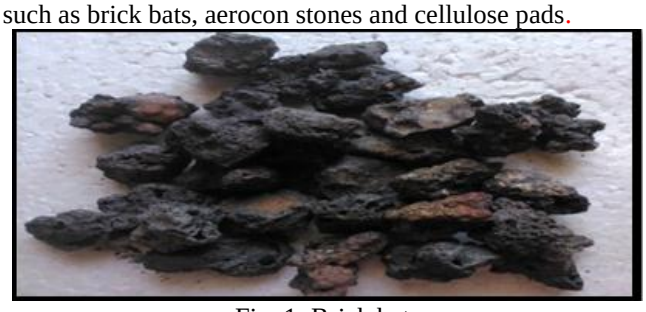

Fig. 1: Brick bats

Fig. 2: Aerocon stones

Fig. 3: Cellulose Pads

IV. EXPERIMENTAL SETUP

The lab scale model of multimedia filter of GI sheet was developed. The model consists of three compartments placed in series with upflow and downflow regime. The total reactor volume was of 60 litres capacity. All three compartments were packed with different packing media. The depth of the media was kept accordingly. The inlet and outlet arrangement were provided at appropriate locations for feeding and withdrawal of influent and effluent.

Compartment	Flow regime
1st	Down flow
2nd	Up flow
3rd	Down flow

Table 1: Flow Regime of the Three Compartments of the Model

The domestic wastewater was collected from local nallah in Amravati city and fed into inlet tank cum pre-sedimentation tank. The wastewater from inlet tank enters the inlet chamber and flows in sequence i.e. from the first compartment to the last compartment and then enters the collecting chamber and was collected from the outlet. The wastewater from the inlet chamber enters the first compartment through the perforated PVC pipes. The first compartment was packed with brick bats of size 25 – 16 mm. The second compartment was packed with aerocon size of 25 – 16 mm and the third compartment was packed with cellulose pads. The wastewater was allowed to flow from the first compartment to the third compartment in the downflow–upflow–downflow regime. The wastewater was collected in the collecting chamber and after reaching the outlet level the treated effluent was collected in the outlet tank. The model was operated for varying detention time.

V. RESULTS AND DISCUSSION

Throughout the study the multimedia filter was operated for varying detention time of 12 hours, 15 hours, 18 hours, 21 hours, 24 hours and 27 hours. During the study, influent and effluent samples were taken regularly and the concentrations of BOD, COD and TS were tested according to the standard methods. The multimedia filter gave the good results for 24 hours of detention time and removal efficiency for BOD was 67%, COD was 69% and TS was 86% was obtained. (As shown in Table 1)

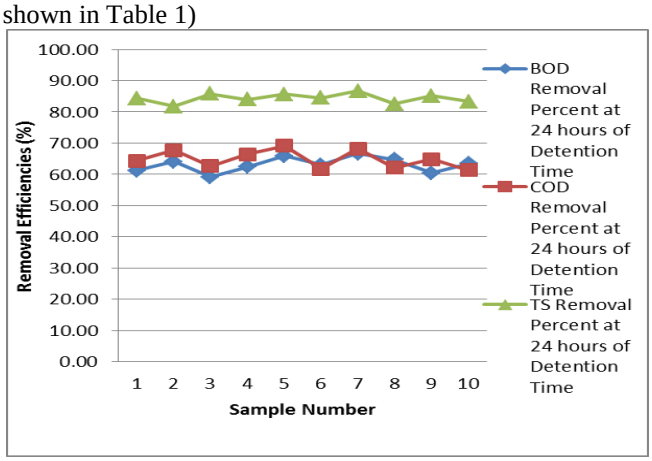

Fig. 4: Graphical Representation of Removal Efficiencies for BOD, COD and TS at 24 hours of Detention Time

VI. CONCLUSIONS

From this experimental study it is concluded that the Multimedia Filter process had givenan excellent results for total solids removal. Multimedia filter technology has a potential to provide an efficient treatment for domestic wastewater and can be used in small communities. Recent developments in the media types such as porous aerocon stones and synthetic materials have expanded new areas for study. Also, the above media may enhance the performance of the treatment system. Hence, this technology is environment friendly and cost effective.

Sample No.	Raw Sewage (mg/l)			Treated Sewage (mg/l)			Percent Removal (%)		
	BOD	COD	TS	BOD	COD	TS	BOD	COD	TS
1	214	356	255	83	127	40	61.21	64.32	84.31
2	178	254	236	64	82	43	64.04	67.71	81.77
3	208	260	274	85	97	39	59.13	62.69	85.76
4	234	396	313	88	133	50	62.39	66.41	84.02
5	188	470	217	64	145	31	65.95	69.14	85.71
6	241	395	361	89	151	56	63.07	61.77	84.48
7	219	353	347	73	112	47	66.66	68.27	86.45
8	238	396	281	84	150	49	64.70	62.12	82.56
9	215	364	276	85	128	41	60.46	64.83	85.14
10	227	391	323	83	151	54	63.43	61.38	83.28

Table 2: Performance of the Model at 24 Hours Detention Time

VII. ACKNOWLEDGEMENT

The authors like to acknowledge Dr. S. P. Tatewar, H. O. D., Department of Civil Engineering, GCOE, Amravati, Maharashtra for their valuable guidance, encouragement and tremendous support.

REFERENCES

[1] Ahmed M., Al Sidari, S., Prathapar, A. and Al Adwai, S., Evaluation of custom – made and commercial greywater treatment system: a case study

From Oman, Bio-resource technology, 65, 33-40, (2008)

[2] Affam A. and Adlan, M., Operational Performance of Vertical Upflow Roughing Filter For Pre Treatment of Leachate Using Limestone Filter Media, Journal of Urban and Environmental Engineering, 7, 117-125, (2013)

[3] Xing Liu Y., Ou Yang X., Xing Yuan D. and Yun Wu X., Study of municipal wastewater treatment with oyster shell as biological aerated filter medium, Desalination, 254, 149-153, (2010)

[4] Parjane S., and Sane M., Performance of grey water treatment plant by economical way for Indian rural Development, International Journal of ChemTech Research, 3, 1808-1815, (2011)

[5] Patil V., B., Kulkarni G., S. and Kore V., S., Performance of Horizontal Roughing Filters for Wastewater: A review, International Research Journal of Environment Sciences,1 (2), 53-55, (2012)

[6] [6]Havard P., Jamieson R., Cudmore D., Boutilier, L. and Gordon R., Performance and Hydraulics of Lateral Flow Sand Filters for On-Site Wastewater Treatment,720-728, (2008)

[7] Ahmedi F. and Pelivanoski P., Bottom Ash Behaviour as a Filter Material of Bed Filters on Small Scale On-Site Wastewater Treatment Systems, International Journal of the Physical Sciences, 81, 231- 238, (2012)

