International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 12 (2018) pp. 10243-10245

Modified Drawer Compacted Sand filter using Mineral sand

[1]Subair.V, [2]Ihzana.N, [2]Anjali.M, [2]Ihsan Saleem K.K, [2]Risiyas E.K, [2]Vyshak. P

[1]*Assistant Professor, Civil Department*

[2]*Civil Department, Eranad Knowledge City Technical Campus, Kerala, India.*

Abstract

In our world, the populations require both more clean water and better ways to dispose of wastewater, the demand for water reclamation will increase. Treating water for reuse is an important part of water conservation efforts and in some regions of the world makes great economic sense. The efficiency of drawer compacted sand filters and modified drawer compacted sand filter in terms of COD, BOD, Hardness, turbidity and TDS reductions were evaluated in this project. Drawer compacted sand filter (DCSF) is an established setup due to the economic criteria. The study concluded that the grey water after the treatment by using Modified DCSF with mineral sand met the irrigation standards and can be used for non-potable purposes.

Keywords: Drawer compacted sand filter, mineral sand, BOD, COD, Hardness, turbidity and TDS.

INTRODUCTION

Water scarcity currently affects many regions in the world. The world's fresh water sources are threatened by climate change. Scientists around the world agree that recent climate changes occurring globally are the result of human activities. In water rich countries, urbanization and industrialization have frequently led to contaminated and deteriorated surface water and ground water such that these countries are unable to meet the ever increase water demand.

Grey water is all the wastewater produced in a household excluding toilet waste water. Sullage, grey wastewater and light wastewater are terms also used. Grey water is wastewater from baths, showers, hand basins, washing machines and dishwashers, laundries and kitchen sinks. Typically, 50 – 70% of household waste water is grey water. The composition of grey water mainly depends on quality and type of available water supply and household activities. Grey water may contain soaps, food particles, grease, oil, lint, hair, pathogens, and traces of other chemicals. Grey water also contains high levels of detergents. By reusing treated grey water the pollution of fresh water resources can be reduced since the contaminants are removed before discharge to water resources. This leads to the fact that also the quality of water will be improved. There are different methods for treating grey water. A treatment system is considered efficient if it produces the required effluent quality, is simple in operation with minimum maintenance and affordable due to its low energy consumption and low operational and maintenance cost. One of the effective and economical methods of grey water treatment is filtration. Sand filtration is a simple and reliable process. They are relatively inexpensive to build, but do require highly skilled operators. Intermittent Sand Filters have been used successfully in water and wastewater treatment for more than a century. They consist of a multilayer series of beds filled with a particular medium, such as washed graded sands, gravel etc.

Drawer Compacted Sand Filter (DCSF) is a modified design for sand filter, which comprises with the movable drawers with filled sand particles separated by a 5cm spaces. Placing treatment media in a separated movable drawer is a significant to facilitate the oxygen movement between layers, to avoid the occurrence of saturation condition, and to easing the maintenance requirements.

EXPERIMENTAL MATERIAL

A. Materials

(a) ***Mineral sand***

Mineral sand are a class of ore deposit which is an important sources of various minerals like titanium, zirconium, thorium, industrial minerals like diamond sapphire etc. These sands are commonly found in beach environment by concentration due to specific gravity of the mineral grain.

In DCSF sand used as the major filtering medium .Sand could remove large extend of impurities from water. Each draws of DCSF filled with different grades of sand. The purity of water increases with fineness of sand.

(b) Charcoal

Charcoal is a porous material which can purify water. It is obtained by burning of wood. It is available in different grades in the market.

(c) ***Gravel***

It filters the bigger chunks in the water, so they don't interfere with the sand and are easily removed. If, for instance, a branch falls into sand, due to water movement it can start to dig in, and start to decompose at a depth sand cannot filtrate. If gravel sits on top of sand, the branch cannot go down and further and is easily spotted and removed.

(d)***Cotton Cloth***

The cloth filter is a simple and cost-effective appropriate technology method for reducing the contamination of drinking water. Water collected in this way has a greatly reduced pathogen count - though it will not necessarily be perfectly safe, it is an improvement for poor people with limited options.

(e)*Synthetic waste water preparation*

Synthetic grey water has to be prepared so that the DCSF could be tested and optimized using grey water of consistent quality. The synthetic grey water can be prepared by mixing 0.18g of dish washing solution, 0.18g hair shampoo, 0.18g washing powder, 0.11g of coconut oil, and 1 L of tap water. The synthetic grey water was prepared on daily basis and stored at room temperature.

(f) *Drawer compacted sand filter (DCSF) fabrication*

A DCSF unit under laboratory conditions will be constructed. A fabricated steel framework and six plastic drawers with dimensions of 50cm x 30cm x 10cm are to be obtained and placed on the frame. Each drawer except the lowest drawer (number 6) has to be perforated with holes. A distribution manifold will be placed over the top drawer and it is connected to the storage tankwhichcontains synthetic grey water, placed next to DCSF.

EXPERIMENTAL SETUP

Table 1: Design Parameters

Filter medium	**Materials**
Drawer 1	Gravels ;effective size 4.75mm
Drawer 2	sand; effective size 1.18 mm
Drawer 3	sand; effective size 600micron
Drawer 4	Mineral sand; effective size 75micron
Drawer 5	Charcoal
Drawer 6	Cotton cloth
Depth of media	10cm (for each drawer)
Perforation for each drawer	Orifice size=4mm Orifice spacing=10cm Number of orifices =15

ANALYTICAL METHODS

Physiochemical characteristics like pH, COD, BOD, Hardness, turbidity and TDS have to be tested as per procedures in standard methods. The instruments and the methods employed for the analysis are listed below in the table 2.

Table 3: Analysis Method

PARAMETER	**METHOD**	**INSTRUMENT**
BOD	Dissolved oxygen determination by Winkler method	BOD incubator
COD	Potassiumdichromate Reflux method	Reflux apparatus
Turbidity	Nephelometric method	Nephelo-meter
pH	Electrometric method	pH meter
Hardness	EDTA Method	Pipette, burette
Total dissolved solids	Evaporation method	Drying oven

RESULTS

The performance of Drawer Compacted Sand Filter (DCSF) in the grey water treatment was studied and comparing with modified DCSF with mineral sand. MDCSF has 6 layers in which the 4th layer was of mineral sand .The 5th layer was of coconut shell activated charcoal. The rest of all the trays was with the same materials that of DCSF. There was a gap of 10cm between the layers which was given for aeration. Further result will obtain, corresponding to the sample collecting from the experimental setup from upcoming 5th day.

Table 4: Characteristics of synthetic grey water

Parameter	Unit	Concentration
COD	mg/l	212
BOD	mg/l	18.2
pH	-	6.19
Turbidity	NTU	5
Hardness	mg/l	274
TDS	mg/l	536.12

Performance of DCSF

DCSF has 6 layers in which first 5 layers are of sand with different grades and the sixth layer was of granular activated charcoal. There was a gap of 10cm between the layers which was given for aeration.

Table 5: Experimental data of the DCSF

Parameter	Influent concentration	Effluent concentration	% Removal
COD (mg/l)	212	14.140	93.33
		13.91	93.37
		13.42	93.61
BOD5 (mg/l)	18.2	1.12	93.77
		1.092	93.93
		1.08	94
Turbidity (NTU)	5	0.469	93.76
		0.431	91.38
		0.79	84.20
Hardness (mg/l)	274	160	41.60
		162	40.87
		167	39.05
TDS (mg/l)	536.12	436.21	18.635
		445.12	16.97
		438.25	18.25
pH	6.19	6.62	NA
		6.61	NA
		6.72	NA

Performance of MDCSF

MDCSF has 6 layers in which the 1st layer of gravel and 4th layer was of mineral sand. The 5th layer was of granular activated charcoal .The 6th layer comprises with the cotton fabric. The rest of all the trays was with the same materials that of DCSF having a gap of 10cm between the layers which was given for aeration and light.

Table 6: Experimental data of the MDCSF

Parameter	Influent concentration	Effluent concentration	% Removal
COD (mg/l)	210	9.1	95.6
		9.2	95.61
		9.0	95.71
BOD5 (mg/l)	18.2	0	100
		0	100
		0	100
Turbidity (NTU)	5	0.401	91.98
		0.312	93.76
		0.308	93.76
Hardness (mg/l)	270	150	42.59
		142	47.40
		138	48.88
TDS (mg/l)	535.73	280.53	47.30
		275.32	48.38
		270.32	49.54
pH	6.18	6.62	NA
		6.70	NA
		6.79	NA

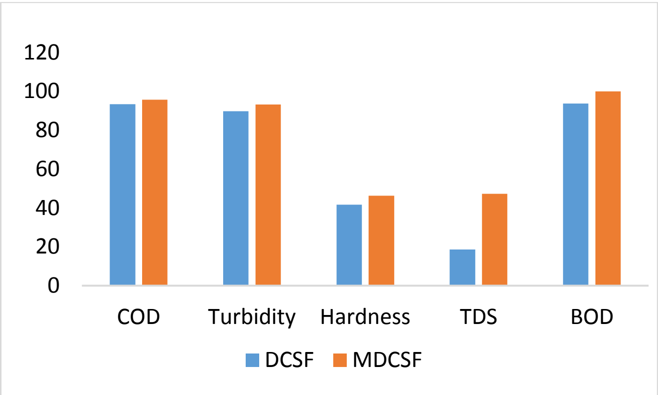

Fig 1: Percentage removal of various parameters in DCSF and MDCSF

The results concluded that Modified DCSF has achieved high performance in the removal of BOD5, COD. The efficiency of BOD5 removal ranged 100% and for COD 95-96%. The efficiency of TDS removal ranged 47-50% and for total hardness 46-48%. Finally we have concluded that, Modified drawer compacted sand filter using mineral sand is more efficient in removal of BOD by 7%. In the case of hardness there is an improvement of 14% and an increase of 24.42% removal for total dissolved solids.

CONCLUSION

The percentage removal of COD, BOD, turbidity, hardness and TDS were 93.51%, 94.10%, 92.4%, 40.1% and 18.7% respectively in the case of DCSF. It was found that MDCSF has high removal efficiency than that of DCSF. The percentage removal of COD, BOD, turbidity, hardness and TDS at optimum conditions were 95.64%, 100%, 93.76%, 46.29% and 48.70% respectively. The overall result indicated that the grey water after the treatment using MDCSF with mineral sand met the irrigation standards and attains a range for portable conditions.

REFERENCES

[1] AbeerAlbalawneh et al., Tsun-Kuo Chang. (2015). 'Review of the grey water and proposed grey water recycling scheme for agricultural irrigation reuses', *British journal of applied science and technology* 3(4)

[2] Almoayied Assayed, Steven Pedley. (2015).Assessing the efficiency of an innovative method for onsite grey water treatment: Drawer compacted sand filter –A case study in Jordan. pp.525-533

[3] Beenakumari K.S. (2009) Removal of iron from water using modified coconut shell charcoal as adsorbent, pp.321-326.

[4] Almoyied Assayed, Jonathan Chenoweth, Steven Pedley. (2014) Drawer compacted sand filter: a new and innovative method for on-site grey water treatment", pp.1-11.