Reduction of Contamination from Water Using Slow Sand Filter

Pramod.B.N[1], Mahesh R[2], Pooja.S[3], Sangamesh.S[4], Umadevi.S.Rachotimath[5]

[1, 2, 3, 4] UG Students, Dept. Of Civil Engineering, S.T.J.I.T, Ranebennur, Karnataka, India.
[5]Professor, Dept. Of Civil Engineering, S.T.J.I.T, Ranebennur, Karnataka, India.

Abstract – *Today the water treatment is one of the most important and complicated world issues. This study aimed to investigate the comparison of the efficiency of slow sand filter and charcoal filter in purifying the given sample of Gangajala lake water[located at Ranebennur, Karnataka, India] at two different points. The tests were conducted on the different parameters such as pH, turbidity, total solids, dissolved oxygen and BOD. The results shows that efficiency of charcoal filter is higher than the slow sand filter in purification of given samples. The highest efficiency shows in the reduction of turbidity, total solids and color of the samples.*

Key Words: Slow sand filter, Charcoal filter, Turbidity, Total solids…etc.

1. INTRODUCTION

Slow sand filters are used in water purification for treating raw water to produce a potable product. They are typically 1 to 2 meters deep, can be rectangular or cylindrical in cross section and are used primarily to treat surface water [1,2]. The length and breadth of tanks are determined by the flow rate desired by the filters, which typically have a loading rate of 0.2 to 0.4 liters per hour.

Slow sand filters differ from all other filters used to treat drinking water in that they work by using a complex biological film that grows naturally on the surface of the sand [1]. The sand itself does not perform any filtration function but simply act as a substrate, unlike its counter parts for UV and pressurized treatments. Slow sand filters now are also being tested for pathogen control of nutrient solution in hydroponic system.

Slow sand filtration is a type of centralized or semi centralized water purification system [2, 3]. A well designed and properly maintained slow sand filters effectively removes turbidity and pathogenic organisms through various biological, physical and chemical processes in a single treatment step. Slow sand filters are characterized by a high reliability and rather low life cycle cost. Hence, slow sand filter is a promising filtration method. As stated by the WHO, slow sand filtration provides a simple but highly effective and considerably cheap tool that can contribute to a sustainable water management system[4].

1.1 Objectives

- Remove non settled floc from water by collecting it in porous media
- Removes pathogens and bacteria, flocs from coagulations, and some particulates [clay, silt]

1.2 Literature Review

- **Timoteo B. Bangundol, Anthony L. Awa,[2013].** College of engineering and technology, Misamis University, Philippines.

"Efficiency of Slow Sand Filter in Purifying Well Water".
In this paper entitled that, the efficiency increases at the increasing filter depth and flow through rate. This study aimed to investigate the efficiency of slow sand filter at 3 different depths and flow rates. And concluded that higher filter depth and flow through rates gives highest efficiency.

- **Abdolmajid Fadaei [2015].** Dept. of Environmental Health Engineering, School of Health, Shahrekord University of Medical Science, Iran.

"Comparison Of Efficiency Of Physical And Biological Treatment Of Slow Sand Filter In Kahkash Treatment Plant".
In this paper entitled that, the efficiency of removal of turbidity in spring is higher than summer. The highest efficiency belongs to suspended solids.

- **Ephrem Gulch [2015].** Dept. of applied biology, School of Natural and Computational Sciences, Samara University, Ethiopia.

"Review On Slow Sand Filter In Removing Microbial Contamination And Particles From Drinking Water".
In this paper entitled that, the removal efficiency is highly dependent on physical and operational characteristics of the filter. The formation of biological layer on the filter bed helps to remove the microbial contamination in water.

2. MATERIALS AND METHODOLOGY

2.1 Materials Used

- **Sand:** River sand of uniformity co efficient varying from 3 to 5 and effective size of IS sieve 2.36mm passing is used as a filter material. Sand is washed with clean water before grading to remove some clay and dirt content. The sand was sundried and graded according to required specification.

Fig-1: sand

- **Gravel:** it should be hard durable and free from impurities, properly rounded and have a density of about 1600kg/m^3 [5]. It supports the sand and allow the filtered water to move freely towards the under drains.

Fig-2:gravel

- **Charcoal:** charcoal works efficiently in purification of water. A single layer of charcoal is laid as filter media.

2.2 Construction and Operation

The construction of slow sand filter is divided into following steps

- Enclosure Tank: It consists of an open water tight rectangular tank, made of fiber glass sheet of thickness 6mm. The depth of tank is kepted as 1m, 0.5m length and 0.3m width. The size of tank is designed for capacity of 20 liter water purification.

- Filter media. In the filter media we are using sand and charcoal in different tanks comparing each other. The river sand of size 2.36mm is used in SSF at depth of 0.3m and charcoal of size 20 mm is placed in between the sand and gravel layer at depth of 0.1m.

- Base material: Gravel is the base material for both filters. It supports the filter media. The gravel layer is divided into three different layers with different size

Table -1: Specification of gravel layer in filter

Gravel layer in filter			
Sl.No	**Layers**	**Depth in cm**	**Size in mm**
1	Top layer	10	<10
2	Intermediate layer	10	10
3	Bottom layer	10	20

Slow sand filter works through the formation of a gelatinous layer called biological layer or Schmutzdecke in the top few millimeters of the fine sand layer [1]. The Schmutzdecke is formed in first week of operation and consists of bacteria, fungi, rotifer and a range of aquatic insect larvae [3]. The surface biofilm is the layer that provides the effective purification in potable water treatment, the under lying sand provides a support medium for this biological treatment layer. As water passes through biofilm, particles of foreign matter are trapped in mucilaginous matrix and soluble organic material is absorbed [5].

Slow sand filters slowly lose their performance as the biofilm thickens and thereby reduces the rate of flow through the filter. Eventually it is necessary to refurbish the filter. Two methods are commonly used to do this. In the first, the top few millimeters of fine sand is scraped off to expose a new layer of clean sand. Water is then decanted back into the filter and re-circulated for few hours to allow a new biofilm to develop [1, 2]. The second method, sometimes called wet harrowing, involves lowering the water level to just above the hypogeal layer, stirring the sand, thus precipitating any solids held in that layer and allowing the remaining water to wash through the sand [1].

2.3 Methods Used

Comparison of filter methods is done by adopting different filter media. The first filter media is of slow sand filter with sand and gravel layer. The second filter media is of charcoal, sand and gravel. The experiment is done for the different samples

- Sample.1-water sample of Gangajala Lake, Ranebennur

- Sample.2- water sample of Gangajala Lake at city waste discharge point, Ranebennur.

The testes are conducted for comparison of desirable values of water sample before and after the filtration. Some of the major testes conducted are discussed in table.2

Table – 2: Testes to be conducted

Tests to be conducted		
Sl.No	**Name of the testes**	**Equipments**
1	pH	pH meter
2	Turbidity	Nephelometer
3	Total Solids	Gravimetric method
4	Dissolved Oxygen	BOD bottles
5	BOD	BOD bottles

3. RESULTS AND DISCUSSION

Results of sample 1 comparing with slow sand and charcoal filter

Table – 3: Test results of sample 1- Gangajala lake water.

Test results of sample 1					
Sl.No	Tests conducted	Slow sand filter		Charcoal filter	
		Before	After	Before	After
1	pH	7.56	7.22	7.56	7.09
2	Turbidity	10 NTU	2 NTU	10 NTU	0 NTU
3	Total solids	1800mg/l	200mg/l	1800mg/l	160mg/l
4	Dissolved oxygen	23.15mg/l	5.7mg/l	23.15mg/l	4.72mg/l
5	BOD	5.48mg/l	2.22mg/l	5.48mg/l	1.55mg/l

Results of sample 2 comparing with sow sand and charcoal filter

Table – 4: Test results of sample 2- Gangajala lake water at discharge point.

Test results of sample 2					
Sl.No	Tests conducted	Slow sand filter		Charcoal filter	
		Before	After	Before	After
1	pH	7.83	7.3	7.83	7.07
2	Turbidity	12 NTU	2 NTU	12 NTU	0 NTU
3	Total solids	2200 mg/l	280 mg/l	2200 mg/l	240 mg/l
4	Dissolved oxygen	24.9 mg/l	6.19 mg/l	24.9 mg/l	5.22 mg/l
5	BOD	7.16 mg/l	3.03 mg/l	7.16 mg/l	1.84 mg/l

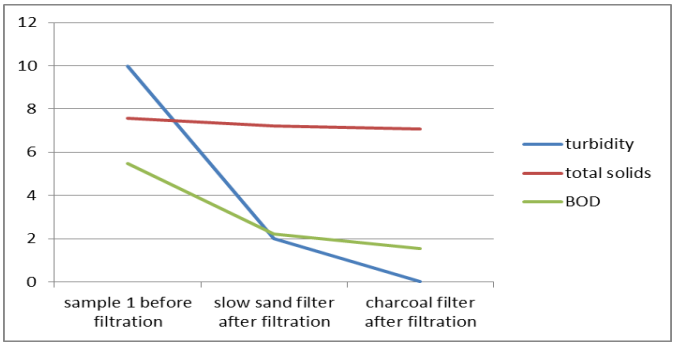

Chart -1: comparison of slow sand and charcoal filter for sample 1.

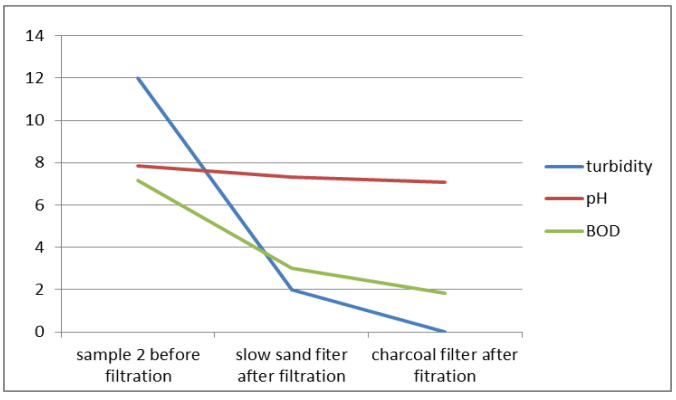

Chart-2 comparison of slow sand and charcoal filter for sample 2

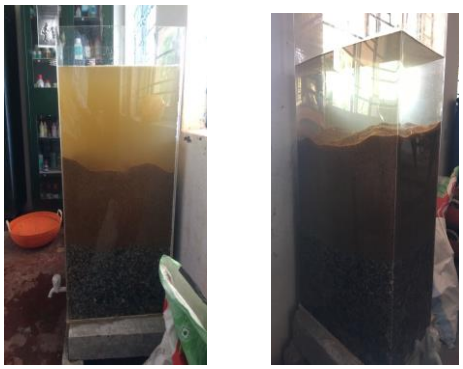

Fig -1: Before and after filtration of Gangajala lake

3. CONCLUSIONS

The design of slow sand filter and charcoal filter technology has a simple operation and has high filtration efficiency; however, the result obtained actually shows that the efficiency of charcoal filter in purifying the given samples is higher than the slow sand filter in all the parameters such as pH, turbidity, total solids, dissolved oxygen and BOD. The slow sand filter is also effective in purifying the given samples but little lesser efficient than the charcoal filter.

ACKNOWLEDGEMENT

Our great pleasure goes to Umadevi.S.Rachotimath and Vidyavathi.T for their guidelines in all the aspects of this study.

REFERENCES:

1) S.K.Garg water supply engineering Khanna publishers P, 406-471, 1977

2) Kardile J.N simple method in water purification INDIA, 1987

3) Punmia.B.C jain A.K and jainA.K water supply Engineering, dhanpat rai publishing co,New Delhi 1995.

4) Qasim,S.R.Motley E.M and zhu,water works Engineering .PHI Private lid,867-949,2002

5) Huisman L, GWH organization [1974] slow sand filtration, world health organization Geneva.