

# Experimental Study and Performance of Rapid Sand Filter by Using Turmeric-Root, Coconut-Shell and Charcoal

Hemath Kumar.R<sup>1</sup> Sivasubramani.M<sup>2</sup> Surya.K<sup>3</sup> Arun.M<sup>4</sup> Ramya.M<sup>5</sup>

<sup>1,2,3,4</sup>UG Student <sup>5</sup>Assistant Professor

<sup>1,2,3,4,5</sup>Department of Civil Engineering

<sup>1,2,3,4,5</sup>Sree Sakthi Engineering College, Coimbatore, India

**Abstract**— A study was carried out to determine about Rapid Sand Filter, which are very commonly used in Conventional Water Treatment Plants. The Rapid Sand Filter beds are suffering by the problems like Mud ball formation, unsatisfactory effluent. Dual Media and multimedia filters can overcome the limitations of RSF. Turmeric root Capping of Crushed Coconut shell, charcoal. Designing Dual Media Filter Capped with Crushed Coconut Shell proves to be more efficient, economical and durable. The sample will be collected from nearby water source which was highly turbid and having high amount of total solids. The tests, which are conducted on sample, are pH, Total solids, Fluoride, Nitrate. It improves the performance of filter in terms of high filtration rate, high turbidity removal and high decrease in percentage of total solids and thus making it more applicable. **Key words:** Rapid Sand Filter, Coconut Shell, Charcoal and Turmeric Root, pH, Total Solids, Nitrate, Fluoride

## I. INTRODUCTION

Filtration is a process that is widely used for removing fine particles from water. Almost all conventional Surface water treatment facilities and some Ground water treatment facilities make use of Rapid Sand Filter. Rapid sand filter is commonly used in the treatment of surface water supplies. Some form of pretreatment of raw water, such as sedimentation, is usually needed. Most of the conventional water treatment plant are overloaded due to increase demand, which highlights the need of higher filtration rate. Multimedia filters can overcome these limitations of RSF alternatively; higher filtration rates even can be achieved. However, the use of such techniques is limited in India due to unavailability of filter materials apart from sand

Capping is involves the replacement of portion of sand with appropriate caps. The Proposed study was made to assess the use of Coconut shell as a capping media. Coconut shells are easily available and it helps to tackle some additional flock loads. It improves quality of filtration with respect to bacterial measure. Turmeric root is the improve immunity power of the human health. He process of covering the filtration media by appropriate caps such charcoal crushed coconut shell, turmeric root.

### A. Literature Review

1) S.STASINOS AND ZABETAKIS., *ECOTOXICOL ENVIRON SAF.*, [2013]

Studied the effect of capping of RSF by the use of coconut shell as a capping media by pilot scale study. This study has shown that rapid sand filter are very common in all conventional water treatment plants. Major problem associated with it is stratification; it restricts the complete use of sand bed. Almost all rapid sand filter beds are suffering by problems like high backwash water requirement, unsatisfactory Effluent and mud ball formation. A pilot scale

model of filter is constructed using glass columns with an inside area of 0.15m\*0.15m along with piping and valves. The co- efficient of uniformity of sand used was 1.7 and effective size was 0.6mm.the co-efficient of uniformity of co-efficient of uniformity of capping media used was about and effective size of 1.91mm. Capping is the process of covering the filter media by caps of crushed coconut shell, bituminous coal, anthrax filt, etc.

Higher rate of filtration is possible along with less backwash requirement and higher filter run .Backwash requirement for capped RSF caps is less as compared to conventional RSF by 33%. Crushed coconut shell as capping media can increase the filter run by 80%.

2) MOHAMMAD ABDOLLAHI.ET AL. (2014)

Studied two pilot filter columns. One is conventional RSF and other is capped RSF. Conventional rapid sand filter and capped rapid sand filter are compared. limiting head loss-1.80 to 3.0m,depth of sand - 60cm,depth of gravel support -40cm, etc. A rapid sand has many advantages like easy operation, more filtration rate, easy backwashing, and output. Due to improper backwashing, major problems shown in the filter media is mud-ball formation. Stratification of sand media takes place at the time of backwashing process. Filtration process is affected due to the increase in head loss in shorter run time. Capping of rapid sand filter is suggested by the researchers to overcome to these problems. Capping is the process in which upper sand bed layer is replaced with few centimeters of capping material. Capping proves efficient techniques for improving performance of RSF. Capping with PVC granules with 3cm depth gives turbidity removal up to 92%.

3) ANSARI MUBESHHERA AWAIS et al. (2017)

The attempt is made to study the effect of capping of the pilot SF by the use of coconut a capping media by pilot scale study. The pilot scale study has shown very encouraging results. Comparative study shown that higher rate of filtration is possible along with higher filter run and less backwash requirement. Top most layer 75cm 2mm to 6mm to 10-mm. Intermediate layer 10cm 10mm to 20-mm. Bottom layer 10cm 20mm to 50mm. capping with coconut shell proves to be very effective in improving performance of RSF in pilot scale. Use of filter with coconut shell as capping media for longer period will give better efficiency. Backwash requirement for capped RSF is less as compared to conventional RSF by 33%. Higher rate of filtration can be obtained after capping without much effect on the filtrate quality. Capping of RSF using the crushed coconut shell as capping media can increase the filter run by about 80%.

### B. Fabrication of model:

Project work was carried out in Environmental Engineering lab, SSEC College of engineering. Glass sheet

Of Thickness 6mm was cut as per the design .A pilot scale of size, 0.6m x 0.4m x 0.9m is fabricated using fiber sheet. An outlet is provided at the bottom for collection of filtered water. A tap is attached to the outlet opening for controlling the filtration rate. Necessary care has been taken to make the model watertight.

### C. Objectives of the Project:

- 1) To Design and construct pilot scale model of rapid sand filter.
- 2) To study the performance of coconut shell, charcoal and turmeric root as filter media.
- 3) To study the performance of rapid sand filter based on the quality of effluent produced.

## II. MATERIALS AND METHODOLOGY

In this chapter, testing facility, experimental procedures and experimental programs are included. Design of experimental set up is done based on the basic design of rapid sand filtration. As per the literature review the design for set-up is done.

### A. Materials

#### 1) Sand stone:

Gravel, which retained on 10mm, has been used as supporting media for sand layer. The depth of gravel layer in the filtration units is 5cm. Gravel was washed and oven dried thoroughly before using as the supporting filter media layer.

#### 2) Sand:

River sand having uniformity co-efficient 1.7 and effective size 0.60mm is used as filter material. Sand was washed with clean, sun dried and oven dried before using as filter media. The depth of sand layer maintained in the filtration unit is 8cm.

#### 3) Charcoal:

Charcoal having an effective size is 40mm where used as capping media above the sand layer. A charcoal where placed in layers above the sand as capping. The depth of Charcoal layer in filtration unit was 10 cm. Charcoal where crushed into pieces manually using.

#### 4) Crushed coconut shell:

Crushed coconut shells having an effective size of 1.91 mm where used as capping media above the sand layer. crushed coconut shell were placed in layers above the sand as capping. The depth of coconut layer in filtration unit was 12 cm. Coconut shells where crushed into pieces manually using.

#### 5) Turmeric root:

Turmeric roots having an effective size of 5cm where used as surface media above the coconut shell layer. A dry turmeric roots are using this media.

### B. Study Area:

The Sample was collected from the pond near the SSEC campus. It was very Odour. The sample was collected in cans. The water was transported from the pond to the environmental engineering laboratory and necessary tests were conducted. The supernatant water was collected and then passed through Rapid Sand Filter.

### C. Methodology:

- 1) The following procedure was adopted for conducting the test.
- 2) Filter layer consisting of gravel bed of 5 cm thickness, sand layer of 8 cm thickness, and layer of 10 cm and crushed coconut shell layer of 12 cm thick ness was spread in the filter unit.
- 3) The water obtained from the pond stored in a large container for a detention period of about 1-2 hours .The supernatant water after sedimentation process was passed through rapid sand filter.
- 4) Influent water is fed into the filter with the help of a dispenser of 20liters capacity has been placed well above the filter unit.
- 5) A head of water above the filter media in the filtration unit of 10 cm was maintained throughout the test period .the raw water was fed to filtration unit continuously through dispenser placed above the filtration unit.
- 6) Effluent sample were taken at a frequency of 15 minutes. These samples are tested for pH, total solids, fluoride and nitrate.
- 7) The following procedures were adopted to test the water sample in the laboratory.

The result obtained during the sampling was as follows



Fig 2.3: Experimental setup in the laboratory

### III. RESULTS AND DISCUSSION

During the Filtration process, Influent and Effluent water sample was tested for various Parameters like pH, Total Solid, fluoride and nitrate. 15 minutes during the filtration process, the Effluent samples were collected and tested.

Sl.No	Characteristics	pH Values
1	Influent pH	6.8
2	Effluent pH	7.06

Table-1: pH value

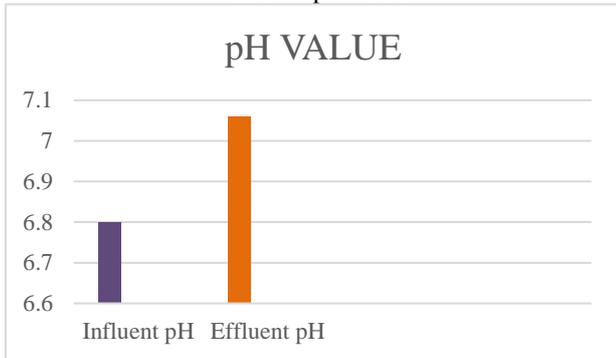


Chart-1: Typical Graph differentiating the Influent and Effluent pH.

Sl.No	Characteristics	Total solids Values
1	Influent Total solids	130.25 mg/l
2	Effluent Total solids	89.45 mg/l

Table-2: Total solids values.

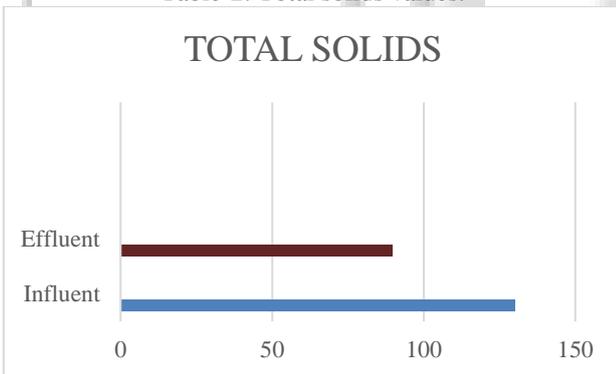


Chart-2: Typical Graph differentiating the Influent and Effluent Total solids.

Sl.No	Characteristics	Fluoride Values
1	Influent fluoride	0.006 mg/l
2	Effluent fluoride	0.001 mg/l

Table-3: Fluoride values.

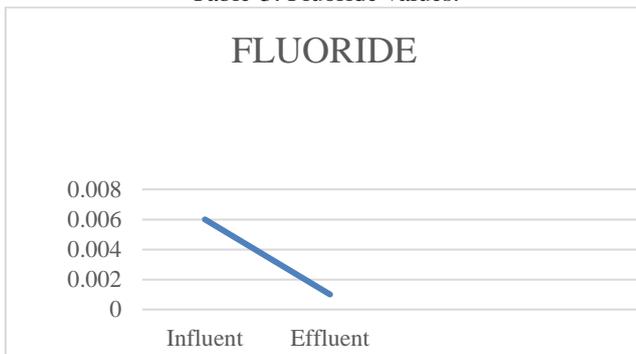


Chart-3: Typical Graph differentiating the Influent and Effluent fluoride.

Sl.No	Characteristics	Nitrate values
1	Influent nitrate	15.98 mg/l
2	Effluent nitrate	6.98 mg/l

Table-4: Nitrate values.

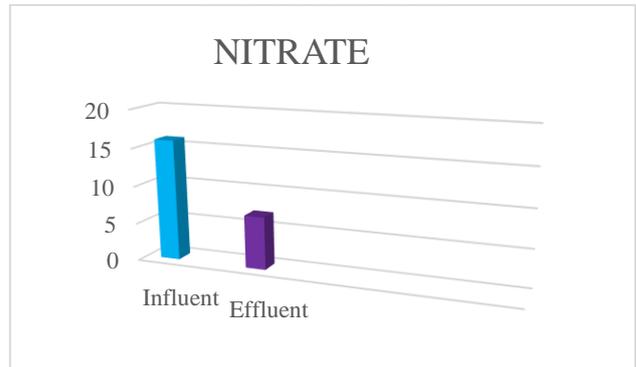


Chart-4: Typical Graph differentiating the Influent and Effluent Nitrate.

### IV. CONCLUSION:

- 1) Charcoal, Coconut shell and turmeric root when used as a filter media in the filtration process gives good efficiency.
- 2) There was considerable reduction in pH, total solid, fluoride and nitrate.
- 3) Using a turmeric root improving the immunity to human health.
- 4) The reduction in fluoride is up to 84%.
- 5) Using a coconut shell is giving a taste to water.

### REFERENCES

- [1] P.M.A Odira, "Performance of Crushed coconut shell Dual media filter".2007.
- [2] Mota Manoj H,"Improvement of Performance of Rapid Sand Filter using Coconut Shell as Capping Media". International Journal of Science and Research, 2012.
- [3] Rajesh R. wankhade "Role of some natural herbs in water purification" – 2016.
- [4] Machunda.L "Defluoridation of water supplies using coconut shells activated carbon" – 2016.
- [5] Umesh M,"Use of Coconut Shell as Capping for Sand in Rapid Sand Filter", 2017.