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RAPID SAND FILTER USING COCONUT SHELL

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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. Capping of Crushed Coconut shell is used as a Dual Media. Designing Dual Media Filter Capped with Crushed Coconut Shell proves to be more efficient, economical and durable. The sample was collected from nearby lake which was highly turbid and having high amount of total solids. A Fabricated model was prepared having dimension 0.5x0.5x0.9m. Gravel, Sand, Coconut shell was filled in the model in the layer of size 20cm, 15cm, 20cm respectively. The tests which are conducted on sample are pH, Turbidity, BOD, Total solids. 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. This filter media reduces about 90% of turbidity. The total solid was decreased by about 89%.*

***Key Words*: Rapid sand filter, Coconut shell, Filtration, Turbidity, pH, BOD, Total solids.**

1. 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. Dual media and multimedia filters can overcome these limitation 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 the process of covering the filtration media by appropriate caps such anthracite coal, bituminous coal, crushed coconut shell. Capping 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.

1.1. LITERATURE REVIEW:

MOTA MANOJ H et al.(2012) 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 raid 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%.

RANJEET SABALE et al.(2017) studied two pilot filter columns. One is conventional RSF and other is capped RSF. Conventional filter has sand as filter media; capped RSF has PVC granules as filter media. Conventional rapid sand filter and capped rapid sand filter are compared. Sand media having characteristics as effective size (E.S.-0.35 to 0.60mm),uniformity co-efficient (U.C.-1.30 to 1.70),specific gravity -2.67, 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. Sand grains having small size come at top layer which reduces the porosity. 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 centimetres 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%.

ANSARI MUBESHSHERA 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 10mm. Intermediate layer 10cm 10mm to 20mm. 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%.

1.2. OBJECTIVES OF THE PROJECT:

1. To Design and construct pilot scale model of rapid sand filter.

2. To study the performance of coconut shell as filter media.

3. To study the performance of rapid sand filter based on the quality of effluent produced.

2. 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.

2.1 Materials:

2.1.1 Gravel:

Gravel which retained on 4.75mm has been used as supporting media for sand layer. The depth of gravel layer in the filtration units is 20cm. Gravel was washed and oven dried thoroughly before using as the supporting filter media layer.

2.1.2 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 15cm.

2.1.3 Crushed coconut shell:

Crushed coconut shells having an effective size of 1.91 mm were 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 20 cm. Coconut shells were crushed into pieces manually using a rammer then thoroughly cleaned before using it as capping. Crushed coconut shells were washed and oven dried for 24 hrs.

2.2 Fabrication of model:

Project work was carried out in Environmental Engineering lab, STJIT College of engineering. Glass fiber sheet of Thickness 3mm was cut as per the design .A pilot scale of size 0.5mx0.5mx0.9m 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 water tight.

2.3 Study Area:

The Sample was collected from the Gangajala Lake, Ranebennur-581115.The sample collected was turbid. The sample was collected in cans. The water was transported from the lake to the environmental engineering laboratory and necessary tests were conducted. Water sample was bought to laboratory and it was kept in large containers for sedimentation process with detention period for 3-4 hrs. The supernatant water was collected and then passed through Rapid Sand Filter.

Table-1: Initial Tests on Sample

Physical Characteristics	Unit	Values Obtained
pH	-	7.83
Turbidity	NTU	22
Total solids	mg/l	1800

Fig 2.1: Index Map.

2.3 Methodology:

The following procedure was adopted for conducting the test.

1. Filter layer consisting of gravel bed of 20 cm thickness, sand layer of 15 cm thickness and crushed coconut shell layer of 20 cm thick ness was spread in the filter unit.

2. The water obtained from the lake stored in a large container for a detention period of about 3-4 hours .The supernatant water after sedimentation process was passed through rapid sand filter.

3. Influent water is fed into the filter with the help of a dispenser of 20liters capacity has been placed well above the filter unit.

4. 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.

5. Effluent sample were taken at a frequency of every 1 hours. These sample are tested for turbidity, pH, total solids, BOD.

6. The experimental has been carried out up to 8 hours.

7. The following procedures were adopted to test the water sample in the laboratory.

Fig 2.2: Experimental setup in the laboratory.

3. Results and Discussion:

The result obtained during the sampling was as follows:

During the Filtration process Influent and Effluent water sample was tested for various Parameters like Tubidity,pH,Total Solid and BOD.Every 1 hour during the filtration process the Effluent samples were collected and tested.

Table-1: Turbidity values from hour to hour

Sl.No	Time in hr	Turbidity Values
1	1	08 NTU
2	2	08 NTU
3	3	08 NTU
4	4	07 NTU
5	5	06 NTU
6	6	04 NTU
7	7	04 NTU
8	8	02 NTU

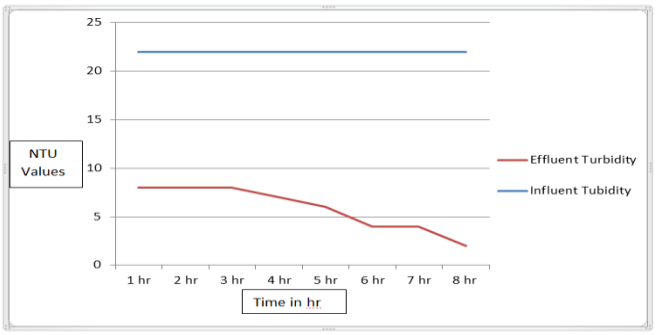

Chart-1 : Typical Graph differentiating the Influent and Effluent turbidity.

Table-2: Total solids values from hour to hour.

Sl.No	Time in hr	Total Solids Values
1	1	400 mg/l
2	2	320 mg/l
3	3	320 mg/l
4	4	280 mg/l
5	5	260 mg/l
6	6	240 mg/l
7	7	200 mg/l
8	8	190 mg/l

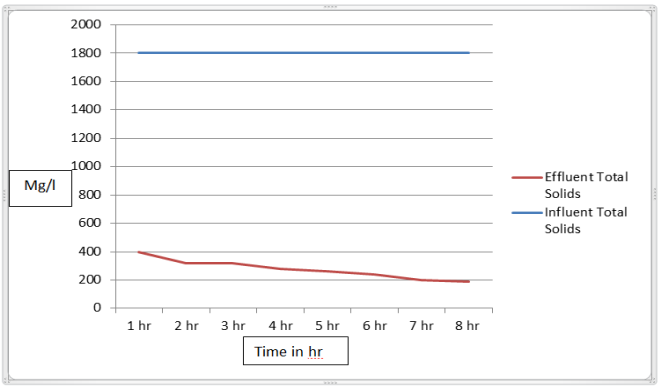

Chart-2: Typical Graph differentiating the Influent and Effluent Total solids.

Table-3: pH values from hour to hour.

Sl.No	Time in hr	pH Values
1	1	7.67
2	2	7.54
3	3	7.53
4	4	7.42
5	5	7.40
6	6	7.39
7	7	7.34
8	8	7.31

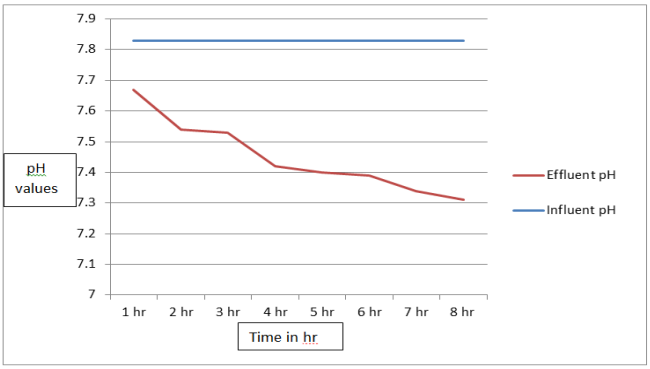

Chart-3: Typical Graph differentiating the Influent and Effluent pH.

Table-4: Influent and Effluent BOD

Sl.No	Characteristics	BOD Values
1	Influent BOD	7.6mg/l
2	Effluent BOD	1.5mg/l

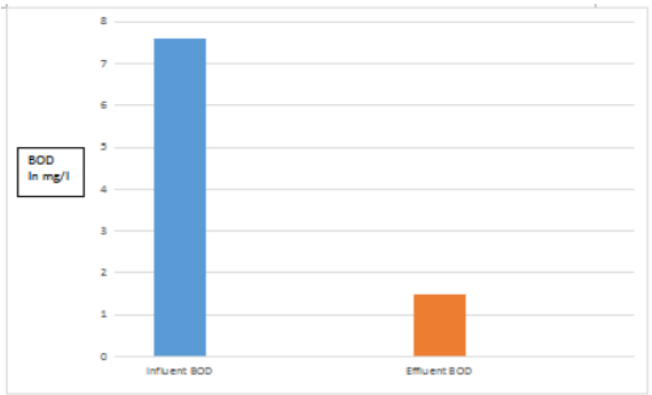

Chart-4: Typical Graph differntiating the Influent and Effluent BOD.

4. CONCLUSION:

1. Coconut shell when used as a filter media in the filtration process gives good efficiency.

2. There was considerable reduction in turbidity, total solid, pH and BOD.

3. There was considerable reduction in the color intensity.

4. The reduction in turbidity is up to 90%.

5. The Decrease in the total solids was upto 89%.

6. Reduction of BOD proves that organic compound can be efficiently removed by Coconut shell.

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