

Performance of Conventional Sand Filter using Coconut Husk and Broken Brick As Capping

Sanjeev Paudel ¹, Shabeena Shaji ², Jinu Jayaram ³, Swathi S Kumar ⁴, Vilbin Varghese ⁵

^{1,2,3,4} Undergraduate Students, ⁵Assistant Professor

Department of Civil Engineering,

Mangalam College of Engineering, Ettumanoor, 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. Capping of Coconut husk chip and broken brick is used as a Dual Media. Designing Dual Media Filter Capped with Coconut husk chip and broken brick proves to be more efficient, economical and durable. A Fabricated model was prepared. Gravel, Sand and capping material was filled in the model in the layer of size 10cm, 10cm, 5cm respectively. The tests which are conducted on sample are pH, Turbidity, Acidity and hardness. It improves the performance of filter in terms of high filtration rate, high turbidity removal. This filter media reduces about 93% of turbidity.

Keywords: *Rapid sand filtration, capping of filters, broken brick, coconut husk chip etc.*

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 pre-treatment 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 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 the process of covering the filtration media by appropriate caps such coconut husk chip, broken brick, 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 husk chip and broken brick as a capping media. Coconut husk chip and broken brick are easily available and it helps to tackle some additional flock loads. It improves quality of filtration with respect to bacterial measure.

II. LITERATURE SURVEY

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 is 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, anthracite, 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 coefficient (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)

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%.

III. OBJECTIVES OF THE PROJECT

- To Design and construct pilot scale model of sandfilter.
- To study the performance of coconut husk chip and broken brick as filter capping.
- To study the performance of sand filter based on the quality of effluent produced.
- To improve water quality and reduce the cost of providing the clean water and improve ecosystem by maintaining water quality to acceptable levels.

IV. MATERIALS

- **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 10cm. For maximum efficiency, filter gravel must possess the necessary attributes of hardness and be rounded rather than angular.
- **Sand**- 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 10cm.
- **Coconut husk chip**- Coconut husk chips are used as capping material at a depth of 5cm.
- **Broken brick** - Filtration work is carried out by using capping of broken brick granules. Capping is done with depth of 5cm.

V. STUDY AREA

The Sample was collected from the Moscow Junction. 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.

Table-1: Initial Tests on Sample

Physical Characteristics	Unit	Values Obtained
PH	-	7.9
Turbidity	NTU	30
Hardness	mg/l	164

VI. METHODOLOGY

The following procedure was adopted for conducting the experiment:

- Filter layer consisting of gravel bed of 10cm thickness and sand layer of 10cm thickness was spread in the filter unit.
- The influent water was collected from Moscow junction which was discharge waste water from MRF industry and it is stored in a large container.
- The influent water is fed in the filter.
- A head of water above the filter media in the filtration unit of 5cm was maintained throughout the test period.
- The filtered water is stored in a bottle and this sample is tested for PH, Turbidity, Hardness and Acidity.
- The filter unit is cleaned and coconut husk chip are kept above the sand layer as capping material at a depth of 5cm and same procedure is repeated.
- The same procedure is repeated for broken brick (for 5cm depth) as capping.
- The same procedure is repeated for both broken brick and coconut husk chip together (2.5cm depth each) as capping material.



Fig 1 Experimental setup

VII. RESULT AND OBSERVATION

The result obtained during the sampling was as follows: During the Filtration process Influent and Effluent water sample was tested for various Parameters like Turbidity, pH, Hardness.

Table-2 PH values

Sl no	Water	PH
1	Normal filter	7.3
2	Broken brick	6.3
3	Coconut husk chip	6.9
4	Broken brick+Coconut husk chip	6.7

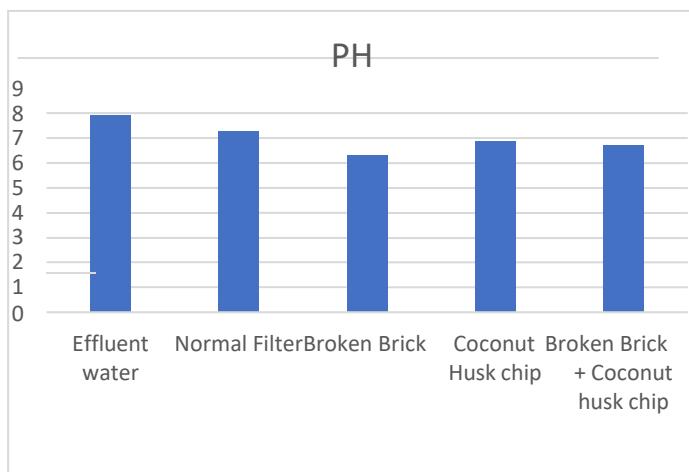


Table-3 Turbidity values

Sl no	Water	Turbidity
1	Normal filter	12
2	Broken brick	2
3	Coconut husk chip	6
4	Broken brick+Coconut husk chip	4

Turbidity

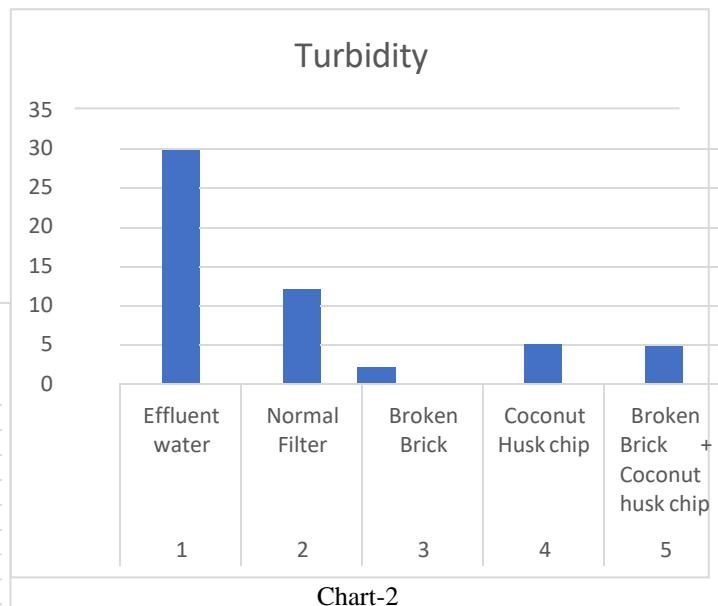


Table-3 Hardness values

Sl no	Water	Hardness
1	Normal filter	98
2	Broken brick	54
3	Coconut husk chip	34
4	Broken brick+Coconut husk chip	36

Hardness

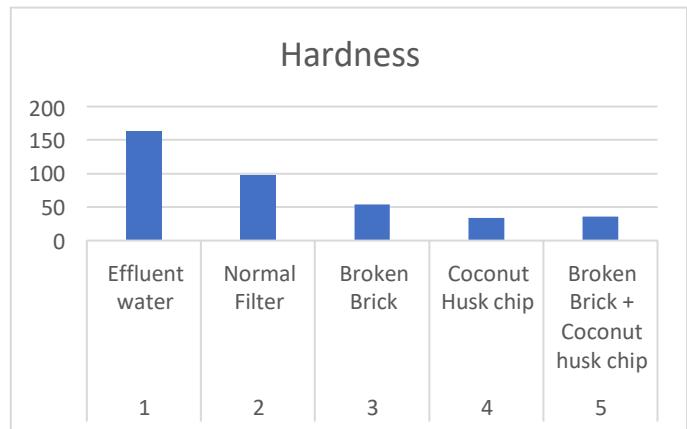


Chart-3

VIII. CONCLUSION

- There is a considerable reduction in the hardness of water.
- The turbidity amount is also reduced in the sample nearly up to 93%.
- By using the coconut husk chip and broken brick as a capping material for filter media, it had given very good efficiency during the filtration process.
- Even, there was a considerable reduction in the color intensity.
- The pH was also changed during this filtration process.

IX. REFERENCES

- [1] "Performance Optimization of Conventional Rapid Sand Filter Using Brick and Wood Powder as Capping Material" | Niharika Rawat, Manish Ghalwa | Assistant Professor of Civil Department, Uttarakhand University, Dehradun, India, IJCRT (2021)
- [2] Dr. Faez alkathili & dr. Monther alalousi "Using crushed bricks as top layer in gravity multimedia filtration" Global Journal of Researches in Engineering: E Civil And Structural Engineering Volume 16 Issue 3 Version 1.0 Year 2016
- [3] Umesh M, "Use of Coconut Shell as Capping for Sand in Rapid Sand Filter".
- [4] Ansari Mubashshera Awais, " Designing Rapid Sand Filter By Using Coconut Shell for a Village", 2017.
- [5] Mota Manoj H, "Improvement of Performance of Rapid Sand Filter using Coconut Shell as Capping Media". International Journal of Science and Research, 2012.
- [6] .Snehal N Chaudhari, "Modification in Rapid Sand Filter with Coconut Shell as Capping Media", International Journal for Technological Research in Engineering, 2017.
- [7] Shilpa S Ratnoji, " A Study of Coconut Shell – Activated carbon for filtration and its comparison with sand filtration", International Journal of Renewable Energy and Environmental Engineering, 2014.
- [8] P.M.A Odira, " Performance of Crushed coconut shell Dual media filter".2007.