IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Performance Optimization of Conventional Rapid Sand Filter Using Brick and Wood Powder as Capping Material

[1]Niharika Rawat, [2]Manish Ghalwan

[1]Assistant Professor, [2]Assistant Professor
[1]Civil Department,
[1]Uttaranchal University, Dehradun, India

Abstract: In all traditional water treatment plants, rapid sand filters are very popular. The big issue that is connected with it is stratification, which limits the full usage of used sand beds. The goal of this article is to design such a filter which is efficient, economical and rate of filtration is high. Filtration is the major process in the purification of water as it prevents the entry of suspended particles, microorganisms (bacteria, viruses, and protozoan cysts), and heavy metals like iron, manganese present water.

Index Terms **- Rapid sand filter, stratification, capping material, water treatment, wood powder.**

I. INTRODUCTION

Filtration is a procedure that is commonly used after the process of extracting fine particles [1][6][7] from water. Rapid sand filters were first evolved during the 1890s, and improved plans were created by the 1920s. By the 1920s, they were generally utilized as a significant water purification technique. The first modern rapid sand filtration plant was designed and built by George W. Fuller in Little Falls, New Jersey. Filtration is an essential physical process to remove suspended particulate [14] and other impurities. These impurities consist of suspended particles, biological matter and floc. A bed of sand, coal or other granular substance is the material utilized in filters for public water supply [4][5]. The rapid sand filter or rapid gravity filter is a sort of filter utilized in water purification and is usually utilized in municipal drinking water facilities as a component of a multiple-stage treatment system.

The medium passed down in the conventional rapid sand filter is gravel and sand. The need of the modification of the conventional filter is done so that the effective results can be attained. The additional material is added above the sand layer which is called Capping, which could be of any material that is easily and naturally available in the surrounding. The plus point of using the capping is it increases the efficiency as the run length of the water passing [5] the modified filter increases. Sometimes admixtures like ferric chloride is also added which act like a disinfectant [6] and as a coagulating agent and increases overall efficiency. The contaminants in water can be categorized into following:

Suspended impurities: These contaminants are in dispersal of solid bits. Suspended impurities are like clay, algae, fungi, organic and inorganic particles etc.

Colloidal impurities: Dispersion of very finely divided pieces in water. As a matter of certainty all the colloidal pieces are electrically charged and endure in perpetual locomotion.

Due to these repulsing nature every bits remain in continuous locomotion and do not resolve. The color in water is because of the colloidal contaminants and the quantity of contaminants can be determined by color test [12].

Dissolved impurities: Some contaminants get liquefy in water whenever water moves over the rock surface, soil etc. These liquefy impurities may accommodate organic compounds, inorganic salts and gases etc.

II. LITERATURE REVIEW

Yu Ning, et. al. [1] checked the performance of modified rapid infiltration system treating domestic sewage using limestone media can maintain the efficient removal rates of contaminants and high HLR as well. It may be widely used in domestic sewage treatment. Ranjeet Sabale et al.[2] Improved Rapid Sand Filter to overcome these problems like improper backwashing mud ball formation, head loss increases in shorter run time. He observed that capping provided an efficient technique for increasing the performance of rapid sand filters in terms of head loss development, filter run length and turbidity removal efficiency. Bibhabasu Mohanty et al. [3] created one modified rapid sand filter using two capping materials (PVC granular & ferric chloride) and compare with traditional rapid sand filter. Both the materials are effective in removal of high turbidity and total dissolved solid concentration at a low cost. Snehal N. Chaudhari et al. [4] proposed a dual media filter capped with 'Crushed coconut shells'

which proves to the better alternative in respect of high filtration rate, high removal of turbidity and less backwashing requirement for filtration unit in treatment plant. Ranjeet Sabale et. al.[5] compared the conventional rapid sand filter with capped rapid sand filter. Depth of gravel is maintained constant (40cm) and sand medium is exchanged with capping material l(broken or crushed bricks and thermo cal material). Mohd Faizan et al.[6] this study for construction of modified filter PVC granules are used as capping material as well as ferric chloride is also used. Both these materials help in achieving.

III. PURPOSE OF THE WORK

The essential objectives are-

- To suggest more efficient filter design.
- To remove turbidity effectively.
- To increase filtration rate and runtime.
- To reduce backwashing requirement.
- To provide economical method for purification of water.
- To check efficiency of capping media.
- To make use of largely easily and naturally available material for capping.
- To check quality of water and its pollution extent on basis of parameters such as pH, turbidity, hardness.

IV. METHODOLOGY

3.1Grouping of water sample

Prior to testing, the samples are grouped from the water source. The samples were collected from Rispana River. The sample was collected from 12 different points namely (S1, S2, S3, S4, S5, S6, S7, S8, S9, S10, S11, and S12). These samples should be collected from such places so that they constitute the body of water from which they are collected. Some Materials Used is as:

Capping Material

The top 3cm is capping layer. Brick powdered and wood powdered in the ratio of 3: 0.5 is used. This means 3kg of brick powered mixed with 0.5 kg of wood powered.

Sand Layer

The second layer consists of sand layer whose height is 4cm. The size of sand used in modified rapid sand filter ranges from90 microns to 4.75cm.

Gravel Layer

Third layer is made up of gravel of height 8cm.Raw water is poured from the top and it passes all the layer and get collected in the lower empty tank which is the water used for drinking purpose. The raw water is collected from three different point's namely upstream, middle stream and downstream and different parameters are tested to get desired value as prescribed by Central Pollution Control Board for domestic supply.

Figure 1- Model of Modified Rapid Sand Filter

V. RESULT ANDDISCUSSION

The sample was taken from 12 different points of Rispana River, Dehradun. The sample is taken to the college lab where different types of tests have been performed. Turbidity is the shadiness of a liquid caused because of quantities of colloidal or suspended particles in water that are commonly undetectable to the unaided eye. Range of turbidity is 1 to 5NTU. Total dissolved solids (TDS) is the measurement of disintegrating inorganic and natural substances present in a fluid in a sub-atomic, ionized or miniaturized granular suspended structure. Acceptable restriction of TDS is 500mg/lt. The property of water which prevents the cleaner from being washed. It is caused by the carbonates and calcium and magnesium sulfate to water. Range from 121 to 180mg/lt as hard water. PH is a scale used to determine acidity or basicity. Permissible limit of pH is 6.8-8.Alkalinity is the position of water to withstand changes in the value of Ph. Acceptable limit of alkalinity of drinking water is 200mg/lt. Sulfates appear normally in these minerals, for example, barite (BaSO4), epsomite (MgSO4.7H2O) and gypsum (CaSO4.2H2O) are soluble in water and add to sulphur content in potable water. High dose is consumed in drinking water, then there may be objectionable taste or may cause laxative effect.

Table 5.1: Tested results with Turbidity, TDS, hardness and descriptive Statics

Sample	Turbidity	TDS	Hardness
S1	3.7	305.65	123.63
S2	4	312.81	125.68
S3	3.9	307.93	118.03
S4	3.4	302.08	112.75
S5	3.1	296.55	98.86
S6	3.3	301.11	97.67
S7	3.1	298.79	94.03
S8	3.3	299.68	89.94
S9	3	291.56	87.73
S10	2.9	286.98	86.40
S11	2.9	386.90	84.89
S12	2.8	287.98	87.89

Table 5.2: Tested results with alkalinity, sulphate, pH and descriptive Statics

Sample	Alkalinity	Sulphate	pH
S1	228.23	316.34	8.4
S2	232.67	312.98	8.8
S3	229.67	311.79	8.1
S4	223.89	308.92	8
S5	219.73	296.07	7.9
S6	219.95	295.25	7.9
S7	214.79	291.70	7.1
S8	217.63	288.09	7.5
S9	213.99	286.43	6.7
S10	207.93	284.73	6.1
S11	200.87	281.37	5.8
S12	202.61	279.37	6

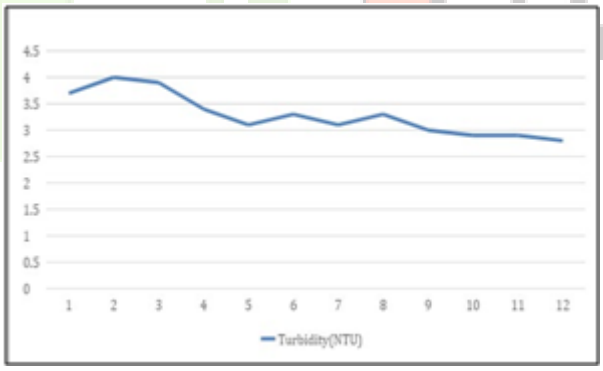

Figure 2- Turbidity Graph

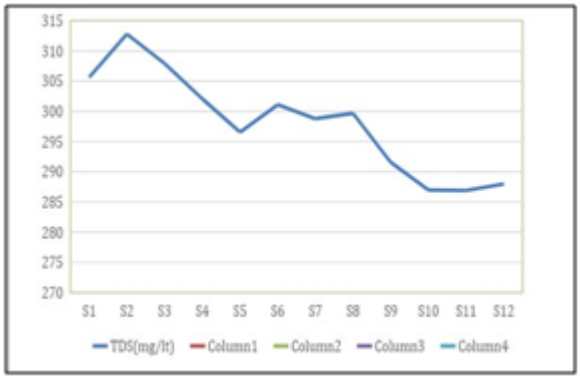

Figure 3- TDS Graph

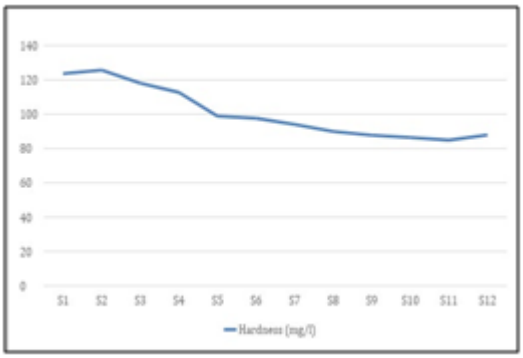

Figure 4- Hardness Graph

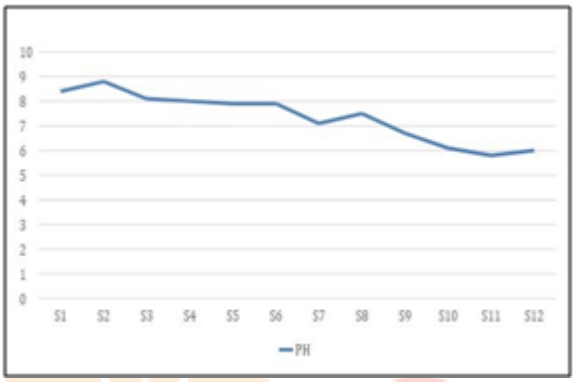

Figure 5- Ph Graph

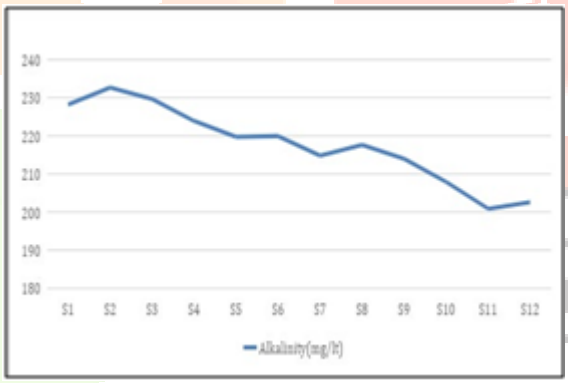

Figure 6- Alkalinity Graph

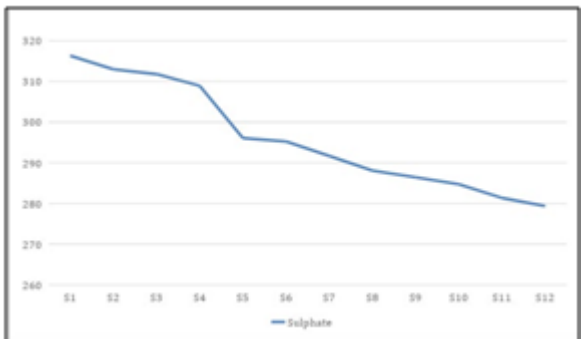

Figure 7- Sulphate Graph

VI. CONCLUSION

Overall, cost –effective and environmental friendly control measures are warranted for the research and development of low cost water filtration system. People are now aware of how to utilize the surrounding materials for their betterment and if they use them wisely they do not require too complicated and expensive measures to do the needful. The filtration tests developed in this study plays important role in the application of this procedure and future research work which can be conducted in this regard. Further evaluation of a state-of-art low cost water filtration system also suggest that this system can be upgraded by adding disinfectant through sterilization rods or solar paneled heating system to boil out the water for the more advanced level of purification.

.

REFERENCES

[1] Yu Ning,Yi-Lian Li "Performanance of modified Rapid infiltration system treating domestic sewage using limestone media", conference on electric technology and civil engg (ICETCE),Page-6080-6083,2011.

[2] Mr.Ranjeet Sabale, Sahil Mujawar,"improved rapid sand filter for performance enhancement", international Journal of science and research, vol-3,no-3,page-1031-1033,2014.

[3] Bibhabsu Mohanty,Gosai Beran.M,"Design and construction of a modified rapid sand filter for treatment of raw water", journal for Research,vol-3,no-3,page-9-13,2017.

[4] Snehal N.Chaudhary,Kalyani A. Bogawar," Modification in rapid sand filter with coconut shells as capping media", international journal for technological research in Engg,vol-4,no-12,page-2685-2688,2017.

[5] Ranjeet Sabale,Pragati Bodkhe,"Modified rapid sand filteration with capping",International Journal for research in applied science and engg tech.,vol-6,no-3,page-2209-2211,2018.

[6] L. Mohd Faizan, Mohdjehan, "Modeling and designing of rapid sand filter", International Journal of Advance Research in Science and Engineering,vol-7,no-10,page-203-208,2018.

[7] Munir, M. J., Kazmi, S. M. S., Wu, Y. F., Hanif, A., & Khan, M. U. A. (2018). Thermally efficient fired clay bricks incorporating waste marble sludge: An industrial-scale study. Journal of cleaner production, 174, 1122-1135.

[8] Kazmi, S. M. S., Munir, M. J., Patnaikuni, I., Wu, Y. F., & Fawad, U. (2018). Thermal performance enhancement of eco-friendly bricks incorporating agro-wastes. Energy and Buildings, 158, 1117-1129.

[9] Andrady, A. L., Pandey, K. K., & Heikkilä, A. M. (2019). Interactive effects of solar UV radiation and climate change on material damage. Photochemical & Photobiological Sciences, 18(3), 804-825.

[10] Joshi, K., Joshi, K. N., Diwakar, M., Tripathi, N. A., & Gupta, H. (2019). Multi-Focus Image Fusion using Non-Local Mean Filtering and Stationary Wavelet Transform. Int. J. Innov. Technol. Explor. Eng.(IJITEE)-Volume, 9, 344-350.

[11] Robbins, J. F. (2017). Optimization of the Hot Embossing Parameters and Sintering Characterization for Alumina/Berea Sandstone Sintering.

[12] Simpson, M. S. (2005). An investigation into the production and performance of low-technology ceramic filters for point-of-use drinking water treatment in developing countries (Doctoral dissertation, Newcastle University).

[13] Joshi, K., Joshi, N. K., Diwakar, M., Gupta, H., & Baloni, D. (2020). Cross Bilateral Filter Based Image Fusion in Transform Domain. Available at SSRN 3545083.

[14] Kota, S. K., & Rama, J. K. (2020). Impact of locally available sustainable materials on the overall economy of the construction sector–A review. Materials Today: Proceedings.