

‘A REVIEW ON PERFORMANCE OF SLOW SAND FILTER FOR WATER PURIFICATION BY PARTIAL REPLACEMENT OF NATURAL SAND BY M-SAND’

Aman Ag¹, Fardeen P F², Anil D³, Bharat⁴, Spoorthy S S⁵

^{1,2,3,4} UG Students, Dept. Of Civil Engineering, Dayananda Sagar College of Engineering, Bengaluru, Karnataka, India.

⁵Professor, Dept. of Civil Engineering, Dayananda Sagar College of Engineering, Bengaluru, Karnataka, India.

Abstract – Use of natural sand in slow sand filter has been widely used, but because of its less availability & high contamination there is an attempt to replace natural sand partially with m-sand in filter media. Since various properties of natural sand and m-sand are identical, in this paper we have studied the possible outcomes by partial replacement of natural sand with m-sand.

Key Words: Slow sand filter, M-sand, Partial replacement, filter media, possible outcomes.

1. INTRODUCTION

The partial replacement of natural sand by m-sand in a filter is an adaption of the traditional slow sand filter, which has been used for community water treatment for almost 200 years. This adapted version of filter is smaller and intermittent use, making it suitable for households. The filter container can be made of concrete or plastic and has been filled with layers of specially selected and prepared sand and gravel.

Presently, the natural sand availability is very less, and the consumption of natural sand in large amount from these sources can badly affect the environment which is already in a bad condition. Therefore the usage of natural sand has to be limited and replaced by alternative materials which has almost same characteristics compared to natural sand. Thus in this paper by studying the properties of m-sand we study about what can be the possible outcomes.

Principle of a slow sand filter

The basic principle of the process is very simple. Contaminated freshwater flows through a layer of sand, where it not only gets physically filtered but biologically treated. Hereby, both sediments and pathogens are removed. This process is based on the ability of organisms to remove pathogens.

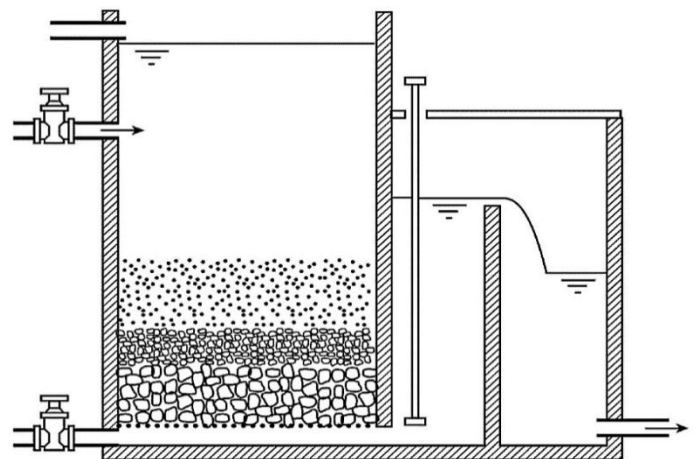


Fig1:-Design of a slow sand filter (source:-
www.environadfacts.com)

2. MATERIALS

An enclosure tank of fixed dimension working as filter body, natural sand and m-sand of different sieve sizes and potable water taken either from a pond or a lake.

Sand: River sand and m-sand of uniformity coefficient varying from 3 to 5 and effective size of IS sieve 2.36mm passing was 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.

Gravel: It should be hard durable and free from impurities, properly rounded and have a density of about 1600kg/m³. It supports the sand and allow the filtered water to move freely towards the under drains.

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

3. METHODOLOGY

1. The water sample was collected for the filtration process from the lake.
2. The filter tank consist of coarse aggregate, natural sand, and charcoal at a depth of 15 cm each and of above mentioned size that is required for the filtration.
3. The water to be filtered was allowed to pass through the filter beds.
4. At the top of filter tank, a constant head of water was maintained and is being collected at the bottom.
5. The collected water has been further taken for several chemical test such as turbidity, pH, alkalinity, chloride content and hardness. Then according to the theoretical knowledge about m-sand the analysis had to been done.
6. Further graphs plotted showing variations at different m-sand percentages.

4. CHEMICAL COMPOSITION

To study about the behavior of natural sand & m-sand chemical characteristics it is necessary to have a brief knowledge about the chemical composition which will help us to interpolate the results.

Constituents	Quarry Dust (%)	Natural Sand (%)
SiO ₂	65.73	82.37
Al ₂ O ₃	19.31	8.23
Fe ₂ O ₃	5.27	1.39
CaO	3.64	2.79
MgO	2.16	1.47
Na ₂ O	Nil	1.63
K ₂ O	2.26	1.81
TiO ₂	1.28	Nil
Loss of ignition	0.35	0.31

Fig-2: Chemical composition of quarry dust & natural sand (source:-www.researchgate.net)

5. EXPECTED OUTCOMES

The chemical tests which was done on collected water are pH, turbidity, alkalinity, chlorides & hardness. We considered three trials on each setup. There are basically 4 setups; tank consisting completely of natural sand & 5, 10,

15% replacement of natural sand by m-sand respectively. Thus from the above chemical composition of materials we can expect certain results that can be obtained from the test.

Based on the above figure (fig.1) we can expect that the resulting filtered water from partially m-sand replaced filter would be less turbid due to irregular shape of m-sand particles that would aid in sedimentation deposition phenomenon of filtration process.

The alkalinity, pH, chloride and hardness are expected to increase due to the higher CaO, MgO (and other) alkali content. Also there is a chance of increase in salt content as m-sand will be manufactured from granites and other quarry rocks.

COST BENEFIT ANALYSIS:- While comparing it with respect to cost it can be seen that the cost of natural sand per ton cost is around 3000/- while the cost of m-sand per ton is 1600/-. In this study we have tried to replace the natural by m-sand; the cost of placing of a slow sand filter has been decreased.

TABULAR COLOUMN 1

SL NO.	PARTICULARS	COST OF SAND PER FILTER
1.	Complete natural sand	40/-
2.	5 % m-sand with natural sand	34.08/-
3.	10% m-sand with natural sand	32.166/-
4.	15 %m-sand with natural sand	30.31/-

6. CONCLUSION

Based on the study of several resources available about slow sand filtration and m-sand ,we can conclude generally as the quality of water filtered from partially replaced m-sand filter would have to be compromised as compared to complete natural sand filtered water. Yet, the filtered water from the partially replaced m-sand filter would be within the permissible limits of drinking water standards. Also, by the cost benefit analysis we can say that partial replacement of m-sand would be economical. Hence we can say that partial replacement of natural sand by m-sand may be used for water filtration with

considerable quantity of natural sand presence that would help in conserving at least a little of natural sand.

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 jain A.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.
- 6) Marco Eissen, donata backhus . Environmental science and pollution research 2011, 1555-1556
- 7) Gadgil A, Drinking water in developing countries. Annual review of water and environment 23:253-286