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Review Paper to Develop a Dual Media Filter using Pumice Stone

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Abstract: *Energy Consumption Water purifiers also consume energy, both in their production and operation. Systems that use processes such as reverse osmosis or ultraviolet filtering to cleanse water rely on electricity that often comes from coal-powered plants. This means that purifiers indirectly contribute to increased carbon emissions. You can't pick and choose what gets filtered. Depending on how you look at it, a whole house water filtration system may be everything you wanted, or too much of a good thing. Meaning, you can't pick and choose what water outlets are purified. Impurities in the water are divided in to colloidal matters such as suspended solids and dissolved solids. The presence of some dissolved solids is necessary for health but there regular consumption with high concentration leads to health problems. As per Indian standard the desirable and permissible limits of suspended solids are 1NTU and 5NTU respectively for dissolved solids is 500 mg/l.*

Keywords: Energy Consumption

I. INTRODUCTION

Rapid sand filter is high rate filtration technique is commonly use in developing countries for treating large quantities of drinking water. It is relatively sophisticated process usually requiring power operated pumps for backwashing or cleaning a filter bed and flow control of the filter outlet.

In rapid sand filter finer media at top and coarser media at bottom. In this media while water is passing through finer media suspended solids are retained on finer media. The Pores are clogged due to this filtration rate is decrease and it does not give filtration thought the depth. To have a effective filtration throughout the depth dual media filter is used. Dual media consists of more than one material that is in addition to sand, anthracite coal is used. But the availability of anthracite coal is less and its cost is high.

In rapid sand filter only physical impurities that is suspended solids and dissolved solids are remove. We required to provide separate unit hence to provide this large area, more times and cost is required. To overcome this problem in the proposed study, we are going to provide dual media filter for removal of suspended solids and dissolved solids. In dual media filter along with sand we are replacing anthracite coal by pumicestone.

II. WHAT ISPUMICE?

Pumice is a light, porous, volcanic stone with a large surface area. It is easily and cheaply found in nature or some kinds of waste. Pumice is composed of highly micro vesicular glass pyroclastic with very thin, translucent bubble walls of extrusive igneous rock. Pumice is commonly pale in color, ranging from white, cream, blue, or grey, to green-brown or black. It is formed when volcanic gases exsolving from viscous magma nucleate bubbles, which cannot readily decouple from the viscous magma prior to chilling to glass. It is a common product of explosive eruptions and commonly forms zones in upper parts of silicic lavas. Pumice has an average porosity of 90%, and initially floats on water. Pumice has been widely tested and used in water treatment as an adsorbent, filter bed and support media, thus pumice stone would be a suitable candidate as an adsorbent.

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Table 1: Analysis of geology of pumice.

Constituent	Percentage Present (%) SiO_2
Al2O3	61.5
CaO	15.49
MgO	5.9
Fe2O3	2.65
K2O	8.4
LOI (lost of ignition)	1.65

2.1 Benefits Of Pumice For Water Filtration

- Improved filtration rate.
- Better filtration bed expansion.
- Less energy consumption.
- Less intensive backwash requirement.
- Low cost filter refurbishment.

2.1 Objective

A. Objective of the Work

1. To study different conventional filter media systems.
2. To search for efficient and economical replacement for conventional filter media.
3. To develop experimental setup of dual media filter.
4. To design a water filter using pumices stone for an Apartment.
5. To develop pumice stone filter for individual house.
6. To test and study the quality of raw inlet water.
7. To test and study the properties of filtered water from the developed model.

B. Scope of Project

1. This study concerns analysis of reinforced concrete moment resisting open frame, open frame with braces and open frame with shear walls only, using Staad Pro program. The effect of brick infill is ignored.
2. This study involves a theoretical 12 storey building with normal floor loading and no in fill walls.
3. The comparison of fundamental period, base shear, inter-storey drift and top-storey deflection is done by using Response Spectrum analysis, which is a linear elastic analysis

III. LITERATURE REVIEW

Study Performance of Pumice as a Filter Bed Material under Rapid Filtration Condition. BY - Burhanettinfarizoglu, Bulentkeskinler Publishing Year :- (April-2003)

In this paper deep bed sand filters are used extensively in drinking water and wastewater treatment. In this study, sand and pumice were used as a filtration media under rapid filtration conditions and performance results for both were compared. Turbidity removal performance and head losses were investigated as functions of filtration rate, bed depth and particle size. Under the same experimental conditions such as 750 mm bed depth, 7.64m3/m2.h flow rate and, 0.5-1.0 mm grain size, turbidity removal rates for sand and pumice were found to be 85-90% and 98-99%, respectively. Furthermore, the head loss for sand and pumice were found to be 460 mm and 215 mm, respectively. The results obtained have shown that pumice has a high potential for use as a filter bedmaterial.

Comparison of Single and Dual Media Filtration in a Full-Scale Drinking Water Treatment Plant. BY - A. Zouboulis, G. Traskas , P. Samaras. Published Year :- 2017

In this paper drinking water treatment plant processes include mainly the stages of coagulation–flocculation, sedimentation, and gravity filtration through granular media. The aim of these methods is the aggregation of suspended solids and colloids in order to form settlableflocs, which can be removed more easily in the sedimentation basins.

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According to the literature, it was expected that the dual-media filter bed would operate more effectively, because they can function as a progressive sieve, which can trap the larger solids within the coarser (top) anthracite layer, whereas the smaller particles would be trapped deeper within the (bottom) sandlayer.

Effect of Supernatant Water Level on as Removal in Biological Rapid Sand Filters. By – J. C. J. Gude, K. Joris, K. Huysman Published Year :- 2015

In this paper current groundwater treatment facilities, mostly relying on aeration-filtration configurations, aim at the removal of iron (Fe), ammonia (NH4þ) and manganese (Mn). However, recently water companies expressed the ambition to also reduce arsenic (As) concentrations in these rapid sand filter.

Removal of Hardness Agents, Calcium and Magnesium, by Natural and Alkaline Modified Pumice Stones in Single and Binary Systems by Mohammad Noori Sepehr, Mansur Zarrabi. Published Year :- 2015

In this paper natural and alkaline modified pumice stones were used for the adsorption of water hardening cations, Ca2+ and Mg2+. The adsorbents were characterized using XRF, XRD, SEM and FTIR instrumental techniques. At equilibrium time and for 150 mg/L of a given cation, removal efficiencies were 83% and 94% for calcium and 48% and 73% for magnesium for raw and modified pumices, respectively. The optimal pH for raw and modified pumices were found to be 6.0, leading to the removal of 79 and 96% of calcium and 51 and 93% of magnesium by 10 g/L of raw and modified pumice adsorbents, respectively. Maximum adsorption capacities were 57.27 and 62.34 mg/g for Ca2+ and 44.53 and 56.11 mg/g for Mg2+ on the raw and modified pumices, respectively. Ca2+ and Mg2+ adsorption capacities of the pumice adsorbents decreased in the presence of competing cations. Less than 300 min were needed to achieve 99 and 92% desorption of the adsorbed Ca2+ and 100 and 89% of the adsorbed Mg2+ from the natural and modified pumices, respectively. After treating synthetic water solution simulating an actual water stream with the alkali-modified pumice, total hardness of the treated sample met the required standard for drinking water, namely below 300 mg/L of CaCO3 (297.5 mg/L). The studied pumice adsorbents, and especially the treated pumice, can be therefore considered as promising low cost adsorbents, suitable for the removal of hardness ions from drinkingwater.

3.1 Problem Statement

1. In areas where bore well water is available and there is no supply of corporation water or filtered water. Because of using bore well water it affects health of people and also people suffer from skin diseases.
2. Water filter needs electricity for operation and working and it needs continuous supply for water filtering.
3. Installation and operational cost is high of water filter.
4. The maintenance cost is high for water filteration system.

IV. METHODOLOGY

First of all literature survey is being carried out to study the how to improve dual medial filter by advance material in way of removal of turbidity as well as TDS. It has been observed that the pumice stone having absorbent property. So we can carry forward our research in this field. Then the materials which we have to used for the dual media filter is selected and the properties of those materials are studied. After completing the study we are going to fabricate the experimental setup and then perform the test.

The working processes of the selected methods are as follows:

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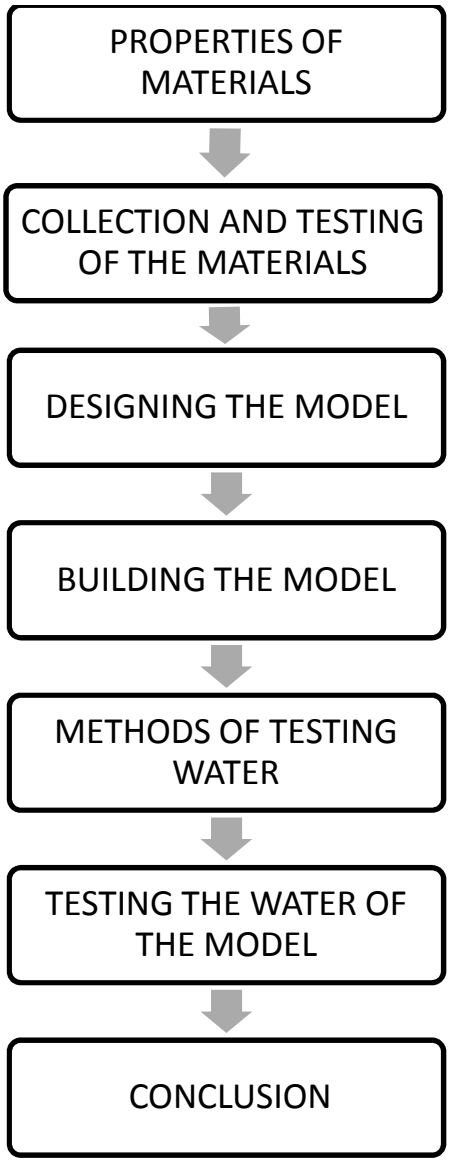

4.1 Materials and Properties of Materials

A. Pumice Stone Pieces

- Density – 0.25gm/cm^3
- Depth – 500mm
- D_{10} –0.8-1.4
- Cu-1.4-1.8

B. Sand

- Specific gravity –2.36
- Depth –300mm
- D_{10} –0.45-0.6
- Cu –1.42-1.7

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Fig.4.1. Pumice Stone

Fig. 4.2. Sand

Gravel–

Fig. 4.3. Gravel

The role of gravel layer in a filter system has several functions. It supports the sand permit the filtered water to move freely. Also used as base media in filter system.

- Size –4mm
- Depth –100mm

Standard Value of Dual Media Filter-

Table 2: Standard value of dual media filter

Description	Dual media filter Range	Typical value
1. Sand		
Depth (mm)	150 – 500	300

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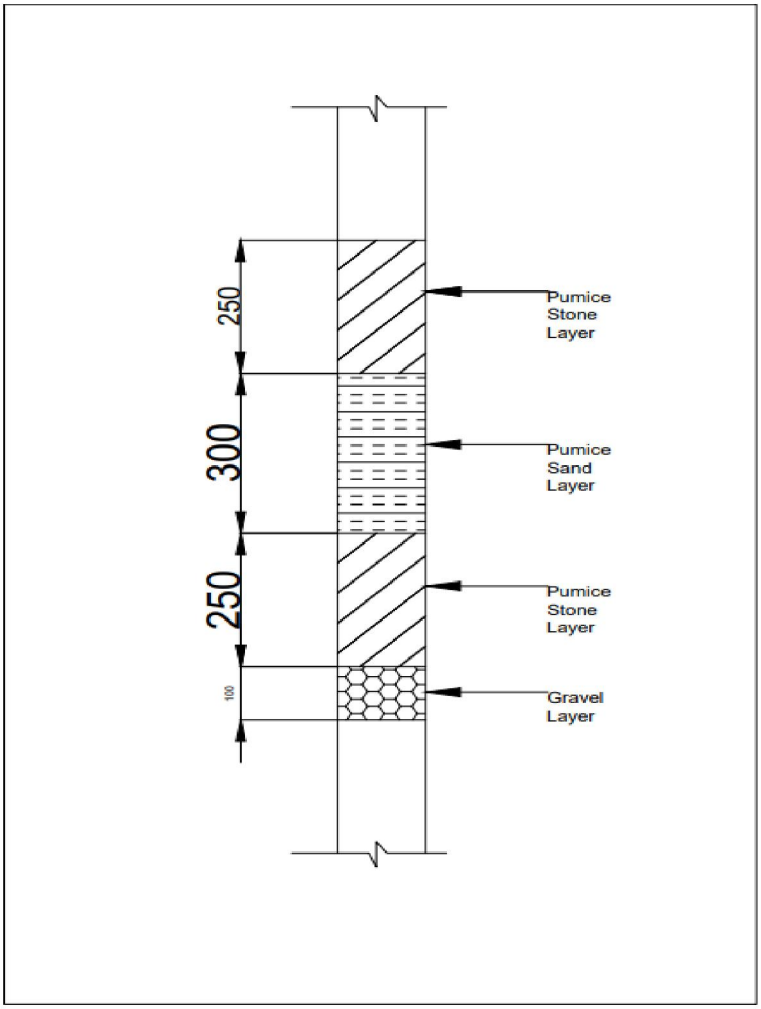
D10	0.45 – 0.6	0.5
Cu	1.42 – 1.7	1.6
2. Antracite coal		
Depth (mm)	400 – 600	500
D10	0.8 - 1.4	1.00
Cu	1.4 – 1.8	1.6

Filtration Rate of Dual Medial Filter – 80 – 400lit./m^2/mins.

4.2 Diagram of Filter Media



4.3 Design of Model

1. It consist of PVC pipe having length 1.5 m and diameter.
2. First at bottom of PVC pipe place gravel of depth 100 mm and it is act as a base material.
3. Then provide pumice stone pieces of 250mm thick layer.
4. Then provide sand layer of 300 mm thick.

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5. At the top again provide pumice stone pieces 250mmthick.
6. At top maintain water head.

4.4 Test to Conduct on Materials

Test on Aggregate

- Specific Gravity Determination by Pycnometer.
- Sieve analysis, particle size determination.

Test on Pumice

- Specific Gravity Determination by Pycnometer.
- Sieve analysis, particle size determination.

Test on Sand

- Specific Gravity Determination by Pycnometer.
- Sieve analysis, particle size determination.

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