International Journal of Scientific Research & Engineering Trends
Volume 6, Issue 2, Mar-Apr-2020, ISSN (Online): 2395-566X

Review Paper on Pumice for Removal of Turbidity and Total Dissolved Solids from Water

UG Student Omkar A. Magar, UG Student Tushar A. Kale, UG Student Manadr S. Baporikar, UG Student Sujata A. Manale, Asst. Prof. Abhishek C. Shirle
Dept. of Civil Engineering
Trinity Academy of Engineering, Kondhwa, Pune

Abstract – **Pumice stone is used in construction industries & biomedicine also. Pumice stone is scouring, scrubbing & polishing material available in powder form as well as pumice stone. From recent studies, it is conclude that pumice stone is used in water & wastewater treatment process. As per literature review it is seen that by using the adsorption property pumice stone we can remove Cadmium (Cd), dye & color many other pollutant like heavy metal (Co+2, Cu+2, Fe+2, Cd+2) and earth cations like (Na, K, Ca+2 Mg+2) .In other hand pumice stone has been used as filter media and biological treatment.**

Highlights

- **Physical and chemical properties of pumice stones.**
- **High filtration rate.**
- **Quality of water after performance.**
- **Economical and less time consuming for filtration.**

Keywords – **Pumice Stone, Sand, Turbidity, Total Dissolved Solids, Low Cost, Performance.**

I. INTRODUCTION

Pumice stone is a volcanic rock and its a formed from volcanic lava and it can also found at different places around the world. Pumice is light weight, high porosity and 60%-70% silica (SiO2) contain in pumice stone. Organic and inorganic Organic and inorganic water pollutants can effectively remove due to the adsorbent property of pumice stone [6]. Pumice stone has large surface area. It is easily and cheaply found in nature. Pumice having highly micro vesicular glass pyroclastic with very thin, translucent bubble walls extrusive igneous rock. It is solidified when volcanic gases exsolve from viscous magma nucleate bubbles, which cannot easily separate from viscous magma proceeding to chilling to glass. Pumice can float on water because of its porosity i.e. 90%. Various tests are conducted on pumice stone and it is use in water treatment as a adsorbent, filter bed & support media. Pumice is low-cost material having porous structure and large surface area and broadly available and simply proceed and modified. [2].Pumice can be amply found in such country like India, Italy, Turkey, Greece, and Spain, on Rocky Mountains. Pumice mainly consist of SiO2 and others essential compounds in the range of 13.5-17.2% of A12O3, 2.4-10% of K2O and small amount of TiO2, CaO, MgO and Na2O. Pumice having high proportion of silica they cause negatively charge on pumice surface and it easily absorb heavy metals [1].

The occupancy of fluoride in drinking water in acceptable concentration known as essential constituent for human health, especially children's below 8 years of age. Fluoride concentration is exceed they causes serious health problems like thyroid, mottling of teeth. The main source of fluoride from water is air and soil. The maximum permissible limit of fluoride in drinking water is 1.5ppm and the permissible value is 1.0ppm recommended by WHO.[2] Calcium- the large amount of calcium concentration present in water causes osteoporosis and kidney stones, Cancer, hypertension, and obesity.Magnesium- From experimental and epidemiological we know the magnesium deficiency implicated in pathogenesis of hypertension [9].

There are the several methods for removal of excess Total dissolved solids (Ca, Mg, Fluoride) from drinking water such as reverse osmosis, ion exchange, coagulation, precipitation and electro coagulation. In a abundant amount of material such as activated alumina, redmud, quartz, and fly ash they suggest for adsorption of fluoride. However the recent year studies have been devoted to low coast material such as local mineral sorbent effectively removal of pollutant from water and that low cost material is pumice [2].

II. BENEFITS OF PUMICE FOR WATER FILTRATION

1. Improved filtration rate.
2. Better filtration bed expansion.
3. Less energy consumption.
4. Less intensive backwash requirement.

5. Low cost filter refurbishment.

III. APPLICATION OF PUMICE STONE

Pumice has different purposes and this is use for centuries in the world. There are several industrial applications such as textile and detergents are well known. Pumice has a good and low-cost adsorbent capacity and it adsorb lots of metals, organics, and dyes. Pumice surface filled with OH groups and oxygen bridges, which would function as adsorption spots. Its surface basically contain of oxygen, nitrogen, hydrogen, halogen, Environmental engineering has started to research and use of pumice stone for waste, air, and water treatment using various properties such as adsorptive, dehydration, and catalyst characteristics of pumice. Adsorption process is most important process to remove metals, organic matter, dyes, etc [1].

IV. PUMICE AS A FILTER MEDIUM

According to sand filter media, pumice has a higher ability to use as a filter bed material for deep-bed sand filters which use in drinking water and wastewater treatment. Rate of turbidity removal of sand and pumice were found to be 85–90% and 98–99% with the conditions of 750 mm bed depth, 7.64 m3/m2/h flow rate, and 0.5−1.0 mm grain size, respectively [8].
Pumice plus sand—gravel media filters also increased the filtration period according to the sand—gravel media filters as well [10].

V. MATERIALS AND METHODS

1. Materials

The coefficient of uniformity and effective size of the sand and pumice is 0.32 mm and 1.75, and 0.28 mm and 1.78. Before using the filter media is the completely cleaned with tap water and the pumice is soaked for the 72 hr. The pumice was stated to have bulk and material densities of 360 and 2,400 kg/m3, respectively. Through measurement, the bed porosity of the pumice media is established about 0.48, and depend on this the grain porosity of the pumice is calculated 0.37 [11].

Fig .1. Pumice Stone.

2. Experimental methods

Sand-gravel and pumice is developed in four different grain-sized filtration materials through sieving (0.5–1mm, 2–4mm, 4–8mm, and 8–12.5mm). The soil particles are sieved through 75lm and used as a suspended material. The pumice is transported from Ercis region in Turkey. After that Sieved materials at different sizes are washed through tap water. Then washed materials are filled in the filter column in seven layers. The form filling of each layer is similar as the filter column type (Fig. 1). In this the thickness of layer is arranged as 40% (L-4), 30% (L-3, L-5), 15% (L-2, L-6), and 15% (L-1, L-4) of total length of filter column. The selected size of layers should not mix with another layer. The filter bed material was sand–gravel for F-1, F-2, F-6 and F-7 filter types, the pumice was used for the F-3, F-4, F-8, and F-9 filter types (Table 1). In F-5 type, pumice was used in the half of the filter column and first media in which the water flow. Because the pumice was thought as a pretreatment material, the filter bed material was pumice for L-1, L-2, and L-3, while sand-gravel was used for L-5, L-6, and L-7. The filter bed material in L-4 of the F-5 filter type was pumice for the top 170mm of this layer, while sand–gravel was used for the bottom 170mm. In F-5 filter type, the latest filtration step was completed with sand-gravel. The highest pressure and the largest column diameter were tested on the F-5 filter type [10].

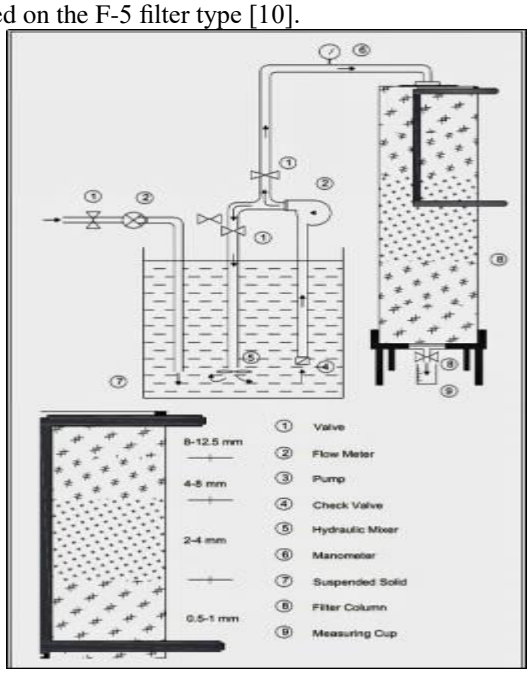

Fig.2.Experimental Setup.

Table -I: Media filter type tested in the experiment

Filter Type	Coiumn diameter(mm)	Bed material
F-1	200	Sand-gravel
F-2	200	Sand-gravel
F-3	200	Pumice
F-4	200	Pumice
F-5	200	Pumice plus Sand-garvel
F-6	150	Sand-gravel
F-7	150	Sand-gravel

F-8	150	Pumice
F-9	150	Pumice

VI. RESULT AND DISCUSSION

The result of experiment is indicate that 55 to 98% of HDTMA absorbed by pumice. The result display treatment with the earliest concentration of HDTMA (2mmol l-1) absorbs fluoride about 92% and materializes to be excellent loading to remove fluoride. The result of application of pumice on removal of fluoride are shown in above table[2].

Table-II: Removal efficiency with respect to size of pumice.

Type of pumice:	SMP0.5	SMP1	SMP2	SMP3
Removal efficiency:	70	80	92.5	87

The experimental study of contact time shows that adsorption of fluoride is maximum is 60 min. It is seen that pumice shows capacity of adsorption for fluoride is only 20%[6].

Properties and size of used material for column experiment are given in above table. The materials are fine sand, coarse sand and pumice[13].

Table no 3: Physical characterictics of filter media

	Size	Effective Size	Porocity
Fine sand	0.4-0.8	0.47	0.35
Coarse sand	1.4-2.0	1.51	1.66
Pumice	2.3-3.4	2.51	0.80

VII. CONCLUSION AND FUTURE OUTLOOK

The study gives result the application of pumice is efficient for removal of fluoride from water. The study shows that pumice is low cost, highly effective and easily available in world for water purification [6].The volume of high total out flow is noticed in filter media. The use of low surface area pumice causes high solid removal efficiency [10]. Adsorption process composes the highest ratio of the research, with the particular focus on doping materials on pumice.

REFERENCE

[1]. Deniz Izlen Cifci, Sureyya meric, Review on pumice for water and wastewater treatment, (2015) 1–13.

[2]. Ghorban Asgaria, Babak Roshanib, Ghader Ghanizadehc , The investigation of kinetic and isotherm of fluoride adsorption onto functionalize pumice stone, J . 217-218 (2012) 123-132.

[3]. M. Malakootian, M.Moosazadeh, NYousefi, A. Fatehizadeh ,fluoride removal from aqueous solution by pumice stone. J of ENV SCI & TEC Vol. 5(4), pp. 299-306, April 2011.

[4]. A.I.M.Ismail,O.I.El-Shafey, M.H.A.Amr, and M.S.El-Maghraby , Pumice Characteristics and Their Utilization on the Synthesis of \Mesoporous Minerals and on the Removal of Heavy Metals, International Scholarly Research Notices Volume 2014, Article ID 259379, 9 pages.

[5]. BilgehanIlkerHarman,&Mesut Genisoglu Synthesis and Characterization of Pumice-Supported nZVI for Removal of Copper from Waters, Advances in Materials Science and Engineering Volume 2016, Article ID 4372136, 10 pages.

[6]. G. Deepthi Reddy, B. Anusha , M. Noorjahan ,MD.A.Khayyum , A Low Cost Modified Porous Lava (Pumice Stone) for Water Purification Vol. 4, pp. 1–5, 2015.

[7]. Mohammad Noori Sepehr, Mansur Zarrabi, Hossein Kazemian, Abdelatif Amrane, Kamiar Yaghmaian, Hamid Reza Ghaffari , Removal of hardness agents, calcium and magnesium, by natural and alkaline modified pumice stones in single and binary systems, Journal of Elsevier, 2013, 274, pp.295-305. 10.1016/j.apsusc.2013.03.042.

[8]. Burhanettin Farizoglu, Alper Nuhoglu , Ergun Yildiz & Bulent Keskinler , the performace of pumice as filter bed material under rapid filtration condition · April 2003.

[9]. WHO (world health organization) report / guideline on Hardness in Drinking-water, WHO/HSE/WSH/10.01/10/Rev/1.

[10]. Yasemin Kuslu a & Ustun Sahin, A comparison study on the removal of suspended solids from irrigation water with pumice and sand–gravel media filters in the laboratory scale, Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41.

[11]. K. Ghebremichael, L. D. Wasala, M. Kennedy and N. J. D. Graham , Comparative treatment performance and hydraulic characteristics of pumice and sand biofilters for point-of-use water treatment , Journal of Water Supply: Research and Technology—AQUA | 61.4 | 2012.

[12]. Mekonnen Birhanie Aregu*, Seyoum Leta Asfaw and Mohammed Mazharuddin Khan , Identification of two low-cost and locally available filter media (pumice and scoria) for removal of hazardous pollutants from tannery wastewater. Aregu et al. Environ Syst Res (2018) 7:10.

[13]. J.C.J. Gude*, L.C. Rietveld, D. van Halem, Removal in rapid filters:Effect of pH, filtration, velocity and media size (2018).