International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 06 | June 2020 www.irjet.net p-ISSN: 2395-0072

Review Paper on Use of Filters for Household Use

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Abstract - Huge cost is involved in water treatment process, thus this results in using untreated water for drinking purposes in many rural and urban areas in India. The use of untreated or contaminated water for drinking purpose results in causing water born diseases like Diarrhea, Typhoid, etc and is seriously affecting the human health. Various types of potable filter are available and in use nowadays for removal of suspended particle and chemical removal can be done using them. In this review paper: types of filters, material & material configuration used and filtration process involved is reviewed.

***Key Words*: types of filters, material, material configuration and filtration .**

1. INTRODUCTION -

The Earth's surface has around 71% water which is mostly saline. Water is also present in the ground, air and within living organisms (**Glieck et al**). To survive living being need water so water is very precious which everyone needs. Even though, 97 per cent of the earth is surrounded by water, only three per cent is fresh and reaming two thirds of this is frozen form and the remaining unfrozen is mostly also found as groundwater, and a small fraction present above the ground or in the air. (**Ramappa1 et al**). Water is prime life sustaining natural resource and it cannot be created like any other products or commodities. It is a nature's gift to all living beings on the earth. Water is life. Unfortunately planet is running low on water conservation and safe water so it is necessary to use it carefully and reuse it as much as possible. So it is important to use naturally available water carefully. Nearly three quarters of people in the world now use piped water supplies on premises to an increase from 2.3 billion to 4.2 billion over the same period. While the number of people without an improved source has declined substantially but 663 million people still used unimproved sources in 2015, and among these, 159 million relied on surface water (**WHOCEF 2017**).

Water is the main constituent in our body. Human body composed mainly of water on average about 70%. Human being brain needs about 85% of water; liver requires about 90%, blood need 83% and even the bones need 35%. Therefore, consuming enough water in our daily life to stay hydrated and healthy is very important. According to the World Health Organization (WHO), over 1.34 billion people lack access to safe drinking water supplies. (**Lakota et al**). Water is one of the universal substances, which is used alike by all the living species to sustain life. To drink clean and pure water is necessity of human being. We rely on clean water but nowadays availability of clean water is reduced so clean water should be made available for living beings. The changes in climatic pattern has affected the river and other water bodies eventually it is affected the tap water so it is necessary to keep water bodies clean so to get potable water out of it and its use accordingly(**Chandrakala et al**). Water shortage is huge problem in rural and urban areas. The huge cost is involved in water treatment process, thus result using untreated water for drinking purposes in many urban areas in India. The use of untreated or contaminated water for drinking purpose results in causing water born-diseases like Diarrhea, Typhoid, etc and is seriously affecting the human health. The wastewater disposal from residential as well as industrial/commercial sources also is an important concern now a day. (**Bibhabasu et al.**).

1.1 Filtration

The process of passing water through material to remove particulate and other impurities, including floc from the untreated or contaminated water is called filtration. These impurities consist of suspended particles (fine silts and clays), biological matter (bacteria, plankton, spores, cysts or other matter) and floc. The material which is used in filters for public water supply is normally a bed of sand, coal, or other granular substance (**Bourke et al.**). .Although filtration with respect to industrial applications varies significantly. Porous membrane or medium is used upon which solution or suspension is passed and thus the solid particles are retained on the medium's surface or within the pores of the medium, while the fluid, referred as filtrate, passes through.(**Taghizadeh et al**).

Filtration operates entirely on particle or droplet size (and, to some extent, shape), such that particles below a certain size should pass through the barrier, while larger particles are retained on or in the barrier can be removed later. Various type of potable filter are available nowadays they are used for removal of suspended particle and chemical removal can be done using

them. (**Mohanad et al)**. Filtration is commonly the mechanical or physical operation which is used generally for separation of solids from fluids (liquids or gases) by using various medium through which only the fluid can pass. A wide range of mediums are being used out of which membrane filtration is gaining importance nowadays. California in the US supplies drinking water by membrane filtration through public water supply systems **(Padmaja et al.**). Slow sand filter is been used since recent days and works effectively on gastrointestinal disease over years first used by Britain and then by other European countries .Various medium are used in slow sand filter for removal of turbidity ,various different layer to absorb the pathogen accordingly are used .(**Gary et al.**)

1.2 Type of filter

The household biosand filter (BSF) is one of the world's most utilized system and also it is point-of use (POU) water treatment. Using this technique various pathogen may get trapped and thus the safe water is obtained by water treatment process. Here there is feasibility of using ferrocement for construction. During filtration pathogens are believed to be trapped from water then the natural die-off happens followed by adsorption, absorption and predation by other microscopic organism's biological action. (**Nathan et al.**). Membrane filters are widely used nowadays for purification of both drinking and sewage water. For drinking water, membrane filters can remove virtually all particles larger than 0.2 um. Membrane filtration is further categorized into nano filtration, ultra filtration, microfiltration and reverse osmosis. A pressure is applied on one side of membrane eventually membrane severs as driving force to separate the suspended matter from solution. Membrane is used as driving force to separate into permeate and retentate. Permeate is usually pure water, whereas the retentate is a concentrated solution that must be disposed of or treated by other methods. (**Padmaja et al.)**.

Slow sand filtration is a simple technique to operate and also a low cost, efficient and reliable technique and used in various reason successfully to remove microorganisms and pathogen in drinking water since 1900. Slow sand filtration has been applied for the removal of waste water contaminant few studies also show it is beneficial in removing NO_3–N from drinking water (**Sukru et al.**). The slow sand filtration system is composed of various shallow layers of stones and gravels beneath a deep layer of sand .Layers are arranged in a way that pathogen gets attached to them. Apart from desalination and reverse osmosis, the slow sand filtration is considered to be the most effective single treatment for drinking water purification. It is used for water supply to large cities as well as in small villages and even for use in individual household the slow sand filtration system with the activated charcoal layer can be adopted as domestic waste water treatment technology as it is low cost treatment can be used in developing and low-income countries since the percentage removal of the treated heavy metals is high (**Isaac et al.**). Rapid sand filters are usually used after the process coagulation and flocculation and they are mainly utilized to remove turbidity. Rapid sand filters differ from slow sand filter in grain size used only and that's the main difference. That is, large sand grains are used in rapid filters, while smaller-grained sand is used in slow filters. Rapid sand filters are generally of sand grains with sizes between 0.6 and 2.0 mm in diameter (**Nuratiqah et al.**).

Carbon nanotubes membrane is also considered as effective medium nowadays for filtration process. Carbon nanotubes membrane are used for water treatment .So carbon nanotubes are basically allotrope of carbon rolled up as graphite sheet in tube like shape they may be single or in multilayer . They are generally used for removal of various salts and also they are used for the pathogen removal. Carbon nanotubes membranes were found to resist the biofilm formation and bacterial removal **(Ihsanullah et al.).**

2.1 Material used

Porous concrete was used as media of filtration. In the experimental work 130 blocks of concrete were used. Various combination of sand , cement ,water configuration used .Water cement ratio used are 0.45 ,0.55 ,0.65, 0.6 , 0.5 . Various aggregate mixing condition were used and Cement used were of alumina cement and polymeric cement .The material used were efficient in bacterial removal and also impact on turbidity (**Taghizadeh et al.**). Activated carbon is generally used for heavy metal removal due to its electrostatic attraction of heavy metal ions and also it has adsorption capacity thus it is used to adsorb Mn & Fe. The use of carbon filter use is increasing due to its effectiveness hence used for the treatment of water. According to the research it is very efficient in removal of Mn and Fe. Use of GAC in potable water is expensive but use of sugarcane bagasse-based activated carbon (SBAC) and rice husk-based activated carbon (RHAC) as low cost treatment thus it can be used accordingly (**Nuratiqah et al.**). The fly ash is collected from the sugar industry is also used in water treatment. In the experiment the fly ash passing through 2.36mm retained on 1mm was used. It is washed with the distilled water and dried to the sunlight. Fly ash is used as good adsorbent and also it is effective in removal of various particles. It reduces turbidity and fluoride and also effective in removes hardness as compared to activated carbon (**Chandrakala et al.**) .

Zeolites are obtained in natural and synthetic crystalline solid structures consisting of aluminum, silicon, and oxygen. The structure of zeolite is of cavities which are used in trapping the small molecule effectively help in particle removal. Zeolites are

effective in removing chemical contamination from water. Zeolites can be used for removal of heavy material from waste water which is contaminated. Zeolites can also replenish the naturally occurring minerals that are often lost in the filtration process, but also they are important for taste and consumer well-being **(Megan Colcannon et al.**). Active charcoal carbon filters are used as most effective at removing chlorine, sediment, volatile organic compounds (VOCs), and most of them have positive effect on taste and removal of contaminates from water. Charcoal is the most widely used media. It is used for bacteria removal and also removes various dissolved impurities present in water that is especially salt. Typical particle sizes of impurity that can be removed by carbon filters range from 0.5 to 50 micro-metres. (**Lakota et al.)** . Bioretention media include wood chip for water retention and silt and clay also used to remove the moisture retention and sand promotes filtration .Thus this media is easily available and used widely The media are cost efficient as well locally available (**Chunbo et al.**) .

2.2. MATERIAL CONFIGRATION USED

Paper gives idea about quality of water flows through the taps for drinking is gaining attention from public as it is not safe to consume at times. Filter media used is sand, bioball, zeolite, silica, and activated carbon. Turbidity is maintained 1 NTU and Iron content reduced from 0.09-0.12 Fe mg/L. to 0.02-0.04 Fe mg/l from the test performed (**Mohanad et al.**) The Bio-Sand Filter (BSF) was built using plastic filter. The height of the filter is 100 cm which is followed by diffuser plate its thickness is 300 mm then next, is the filtration sand layer of sand size is 0.7 mm it was laid up to 550 mm in height. It is used for pathogen removal and also suspended particle. The size of the gravel is 12mm and lay with 50mm height. The BSF flow rates are within the recommended limits. As compared to other filter BSF provide safe drinking water. BSF generally needs zero energy. Process is trapping, predation, and adsorption and followed by natural death .Thus BSFs removes 5.00-64.00 % of heavy metals and 90.00-99.99% of turbidity. (**Saravanan1 et *al*.)**

The removal efficiency of solid particles from raw water by activated crushed glass media is high and compression on its efficiency with sand media. In this study, Activated Crushed Glass Media (AGM) grade 2 and 14/25 is used. This consists of a cylindrical filter column with a height of one meter and 0.2 m diameter is made from two compartments. The filter column is filled with two layers of gravel in which the bottom layer is the coarse gravels with a height of 10 mm and the top layer is fine gravel with a height of 6mm.The results showed that, the gravel with 14/25 sand media produced greater head loss compared with the gravel. AFM improves water clarity by a 25% reduction in NTU. AFM removed at least 30% more particles from the water than sand media. AGM also showed high result in removal of solid particle from raw water. (**Al-Aibi1 et al**). A biosand filter consists of a concrete box that is filled with layers of sand and gravel. A biological layer (often called a biolayer) of slime, sediment and microorganisms gets developed at the sand surface and removes the suspended particle (**Yeuven et al.).** The aim of this paper is to provide low cost filter. The red clay ,crushed brick and lime stone were used as filter medium Combination of these were used and the one with more efficiency was used and suggested This all material are supper cost efficient combination and easily available . Combination of lime stone and red clay showed best result. Water consist of Fe and Mn .Fe and Mn ions can be removed by physicochemical or biological treatments. Fe and Mn ions can be removed by BAF system. Media used for a BAF include submerged and floating aerator or fixed film reactors. Microorganisms in the form of biofilms are utilized to remove organic and inorganic matters (**Nuratiqah et al.)** Bio retention modified media consists of modifier, soil, sand, and organic matter. This was applied to clean rainfall runoff. The composition of modified media includes modifier (to increase sorption capacity) Woodchips (to improve water retention) and organic matter content like silt and clay (to increase moisture retention), Sand promotes effective infiltration thus using this water can be filtered and also it is cost effective. (**Chunbo et al.)**. In this bio sand layer is applied which is less in cost easy to maintain and also easy to operate. Through a combination of biological and physical processes that take place in the bio-layer and within the sand layer, pathogen are trapped and removed in this layer. Layer also has bio sand followed by gravel .Desirable result are obtain. Various parameter like $_{P}$H, TDS, and metals where in limit after treatment (**Saravanan et al.).**

3. CONCLUSION

Thus this paper gives us information about various filters and the filtration process .This will help to refer various filtration technique and material used in process of it .

REFERENCES

1. Al-Aibi1, S M. Al-Rukabie, J S. Sharif A ,O . Ajar ,D Y.Hameed , B .Mahood, O. Monjezi ,A. A . (2018) Removal Efficiency of Solid Particles from Raw Water Using AFM Grade-2 Media: Case Study. Journal of chemical engineering and Process technology, 9, 1 – 8.
2. Bibhabasu Mohanty, Akik Shah, Chintan Rudani, Naisargi Patel & Rinkal Patel. Design and Construction of a Conceptual Single Unit Filtration System for Water and Wastewater Treatment(2017) IJSTE - International Journal of Science Technology & Engineering ,3, 34-39

3. Chandrakala B J ,Vasudha D R, Mohammed Y,Aravinda H B. (2017) Purification of Water Using Low Cost Adsorbents-Fly Ash and Activated Carbon IJSART ,4, 1237 -1242.
4. Chunbo Jianga, JiakeLia, HuaienLia, YajiaoLib (2019) . An improved approach to design bioretention system media . Ecological Engineering, 125-133.
5. Gary S. Logsdon, Roger Kohne, Solomon Abel, and Shawn LaBonde (2002) Slow sand filtration for small water systems. J. Environ. Eng. Sci ,1,339-348 .
6. Gleick, P.H., 1993. World Fresh Water Resources. Oxford University Press, New York.
7. Ihsanullah (2018) Carbon nanotube membranes for water purification: Developments, challenges, and prospects for the future . Separation and Purification Technology
8. Isaac Mbir Bryant and Roberta Tetteh-Narh (2015) Using Slow Sand Filtration System with Activated Charcoal Layer to Treat Salon Waste Water in a Selected Community in Cape Coast, Ghana..Journal of advanced chemical engineering, 5,3-8.
9. K.Padmaja1, Jyotsna Cherukuri2*, M.Anji Reddy3 . (2014) Conventional to Cutting Edge Technologies in Drinking Water Purification - A Review. International Journal of Innovative Research in Science, Engineering and Technology,3, 9375-9375.
10. K.B. Ramappa1, B.S. Reddy2 and Savita K. Patil3 (2014) Water conservation in India: An Institutional perspective. Eco. Env. & Cons., 303-311.
11. Lakota, A. Ahire, P. Dabholkar, P. Dhadambe, V .Gharat, G.(2016). Comparative Analysis of Design of Water Filter for Rural Areas. International Journal of Innovative Research in Advanced Engineering, 6, 23-27.
12. Megan Concannon , Joseph Genga , Pramod Jonwal , Avnish Kumar , Priyanshu Meena Peter Nash ,Mary Sheehan (2018) Designing a Water Filtration Device to Remove Chem ical and Biological Contamination in Mandi District . WPI
13. Mohanad el-harbawi1, Aida azwana bt. sabidi1, Ezzah bt. kamarudin1, Amiran b. abd hamid,Suhaizal b. harun, Ahmad b. nazlan, Chin xi yi Design of a portable dual purposes water filter system . Journal of Engineering Science and Technology Vol. 5, No. 2 (2010) 165 – 175.
14. Nathan B. Arnold . (2015) Household biosand water filters: materials, capacity, and temperature effects on performance
15. Mr. Noel Bourke(1995) Water treatment manuals filtration Environmental Protection Agency
16. Nuratiqah Marsidi, Hassimi Abu Hasan, Siti Rozaimah Sheikh Abdullah A review of biological aerated filters for iron and manganese ions removal in water treatment (2018) Water Process Engineering ,1-12
17. Safely managed drinking water - thematic report on drinking water 2017 UNICEF.
18. Saravanan,S P . Gobinath ,R.(2015) Drinking Water Safety through Bio Sand Filter . A Case Study of Kovilambakkam Village, Chennai. International Journal of Applied Engineering Research, 10,254-262.
19. Sukru Aslan , Hatice Cakici(2007) Biological denitrification of drinking water in a slow sand filter. Journal of Hazardous Materials, 253–258.
20. Taghizadeh, M, M . Torabian, A. Borghei, M. Hassani , A.H . (2007) Feasibility study of water purification using vertical porous concrete filter. Int. J. Environ. Sci. Tech, 4 , 505-512
21. Zhao, Y. Wang,X. Liu ,C. Wang, S. Wang,X. Hou ,H .W ,Jinging .H,Li . (2019). Purification of harvested rainwater using slow sand filter with low cost material Bacterial community structure and purifying effect. Science of total environment ,674, 344-354.