A Review on Biosand Filter

Assit. Prof. Irshad Shaikh[1], Nilesh Gadekar[2], Pramod Masure[3], Mahadev Mule[4]
Department of Civil Engineering
[1]Assistant Professor,DPCOE,Wagholi, Pune, Maharashtra, India
[2, 3, 4]UG Student,DPCOE,Wagholi, Pune, Maharashtra, India

Abstract-*Rapid urbanization all over the world has resulted in an increase in water treatment technologies. But, in rural India, where 70 percent of India's population lives, irregular electric supply and poor economic condition of people are major obstruction for use of now days available advanced water treatment technologies. So Biosand filter is one of the good option. This paper reviews the study of various research works that had been done, in order to modify biosand filter for better treated water quality.This study emphasis on biosand filter.*

Keywords-Biosand filter, Throughput volume, Flow rate, MPN, Turbidity, Biolayer thickness,Biolayer

I. INTRODUCTION

In Manydeveloping and under developing countries are facing water problems due to lack of clean supplied water. It is reported that more than 1.1 billion people are suffering health problems for consuming unsafe water. About 74% of India's total population, currently about 1.25 billion, live in rural areas. More than one third of the water available to them is not potable. In a grim reminder that poor quality of drinking water leads to serious health problems.

The potential for contamination during transport and storage makes the challenge of providing safe drinking water even greater in case of decentralized water distribution system. So points of use (PoU) water treatment technologies are preferred. Commercial purifiers are not affordable to poor people in developing countries like India due to higher capital and operating costs. Dependency of these purifiers on electricity is also a hindrance to the use of such purifiers.

Biosand Filter (BSF) is one of such PoU technologies. It consists of a container with lid and diffuser basin which is filled with layers of sieved and washed sand and gravel. Lid is used to cover the container and diffuser is used to distribute the feed water evenly over entire surface and avoid the disturbance of biolayer. There is a standing water height of 5 cm above the sand layer. A biological layer of microorganisms develops at the sand surface, which contributes to the water treatment. Contaminated water is poured into the top of the filter on an intermittent basis. The water slowly passes through the diffuser, and percolates down under gravity through the biolayer, sand and gravel. Treated water naturally flows from the outlet. The biolayer is the key pathogen removing component of the filter. Without it, the filter is significantly less effective. The water from the filter can be used during the first few weeks while the biolayer is being established, but disinfection is recommended during this time.

II. MODIFICATION OF BSF

The efficiency of current BSF process is limited to use on raw water with low turbidity. High turbidity water, commonly used as a drinking water source in developing countries, is defined as having turbidity >50 NTU in the Guidelines for Drinking Water Quality(DWQ). Also the weight of conventional BSF is high. So there is need to modify conventionally used BSF. So this paper reviews the study of various research works that had been done, in order to modify BSF for better treated water quality. For convenience their work is divided in following categories and its review is taken in forgoing paragraphs.

III. LITERATURE REVIEW

1. Sarkar1 L&. Biswal S.K 2015, studieddifferent types of charcoal mixture such as bamboo, coconut and wood and carbon mat as an important filter media was used for the modification of BSF. The filter had seven layers with gravel, sand, carbon mat and charcoal which were responsible for filtration process. Different turbid iron rich water samples were collected from tube wells and river of various locations of Khordha district, Odisha . The charcoal based BSF showed better performance towards the removal of iron and turbidity. The modified BSF showed higher removal efficiency of chloride, calcium and magnesium but also enriched water with minerals like sodium, potassium a maintain pH of water 6.88 to 7.34 which is suitable for drinking water.

2. Divelbiss D.W, 2012, had studied to measure the effect of various environmental health factors and household demographics on the operation and maintenance of the Bio sand filter and diarrhea health burden in the region.

Filter operation and maintenance, adequate sanitation, improved water supply, soap present in the home, and additional water treatment has a positive effect on proper filter operation and maintenance. The direction and magnitude suggest that households who practice keeping soap available for use also tend to maintain their filter properly. Therefore, households that are already accustomed to completing personal hygiene practices may also be willing to accept new solutions to improve their water quality

3. Ahammed M M&Davra K 2011, modified BSF by introducing a10-cm thick layer of iron oxide-coated sand (IOCS). Long-duration (about four months) tests were conducted to compare the performance of the modified BSF with the conventional BSF. Water from two different sources was used in the study: i) Tap water collected from tap of Environmental Engineering Laboratory of the Civil Engineering Department of SardarVallabhbhai National Institute of Technology, Surat, India and ii) canal water from an irrigation canal near ONGC Colony, Surat, India.. The filter media had an effective size of 0.23mm and a uniformity coefficient of 3.1. Result of the laboratory experiments with full scale household filter showed that conventional BSF had a low bacterial removal efficiency during the maturation period .introduction of iron oxide coated sand layer could improve the performance of the BSF by at-list 1log10 unit throughout the filter run. Filtration of water through BSF and MBSF did not result in any significant changes in physico-chemical quality of filtered water, and all remained within the drinking water quality guideline values.

4. Themba O. M, 2011, modified BSF with the addition of zeolites. Deionized water together with environmental water (surface water and groundwater with low and high turbidity). Results indicated removal of up to 80 calcium, 89 magnesium, 99 iron, 56 arsenic, 54 fluorides, 96 turbidity, 37 nitrates and 41% total organic carbon. Higher turbidity (r = 0.024) and chlorophyll a (r = 0.566) concentrations resulted in a decrease in the flow rate of the filter which was between 1.74L/h and 19.20 ℓ/h. Higher chlorophyll a concentrations resulted in higher turbidity (r = 0.609).

5. Fiore1 M M1, Minnings K2 and Fiore3 L D; 2010, studied BSF in which water for analysis was collected from wells, filter spouts and storage buckets. Laboratory analyses were performed on water samples using the membrane filtration method to determine Escherichia coli colony forming units (CFUs) bacterial removal efficiency for the filters was 80%. Recontamination was an important problem and reduced the overall efficacy (from well to storage bucket) to 48%.household were generally satisfied with their filter's performance, citing improved health and better tasting water.

6. Dr. David Manz2008, examined several factors affecting the flow rate of the BSF as well as schmutzdecke disturbance, volume of water treated, and previous microbial loading to determine their effect on removal of microbes. The water is collect from river water, reservoir the microbial removals, based on the difference between the microbial concentrations in the raw water and the concentrations in the filtrate, may appear artificially high.to0.7 to 0.8 void volume. conclude that the volume of each charge should not exceed the void volume of the filter, and should probably be less, approximately

7. 7.TommyNgai, 2003,developed BSF at Massachusetts Institute of Technology to simultaneously remove arsenic and pathogens from tube well water. The average arsenic removal for the ABFs containing 5 kg iron nails is 93%. Total coliform and E. Coliremoval for all filters are reasonable at 58% and 64% respectively. Iron removal is excellent at >93%. Flow rate is very high at 14L/hrs.

IV. DISCUSSION

It can be seen from various contributions made in above mentioned paragraphs that, many researchers have identified the issues related with modifying BSF in different ways. Operational, material and constructional changes are the major changes made in conventional BSF in order to modify. Filtered water quality depends upon raw water turbidity. From material changes it was found that sand coated with iron oxide gives better treated water quality than uncoated sand. Also from literature it is clear that the relationship between various parameters such as flow rate, feed water turbidity and biolayer thickness does not exist. So there is scope to develop such relationship which will help in modifying BSF to meet the drinking water standards

V. CONCLUSION

In India any of such works haven’t dealt with great extent so far, the issue of Modifying BSF is handled by various researchers mostly at foreign countries. Modified BSF should not only be economical but also meet the drinking water standards. It should also be suitable for feed water of high turbidity and withstand the feed water quality variation. It would be helpful to have review of the work done in modifying BSF and apply the results to improvise

conventionally used BSF. The study will also create many research avenues in the water treatment in light of BSF.

REFERENCES

[1] Abhilash T. Nair, M. MansoorAhammed and Duithy George "Modified BSF for Simultaneous Removal of Bacteria and Arsenic" Civil Engineering Department S. V. National Institute of Technology, Surat – 395 007, India

[2] BSF Construction Manual.August2012

[3] A CAWST TRAINING MANUAL September 2009 Edition

[4] Lopa Sarkar1, S. K. Biswal1, R.K.Panigrahi1 and Bikash Sarkar2. "Estimation of Filtration Potential of an Effective BSF for Removal of Iron, Turbidity from Various Sources of Water" Centurion University of Technology and Management (CUTM) Bhubaneswar ,Khordha, Odisha-752050,India. 2ICAR Research Complex for Eastern Region, Patna, Bihar,India. http://dx.doi.org/10.12944/CWE.10.2.31:June 06, 2015) Vol. 10(2), 656-662 (2015)

[5] Daniel William Divelbiss,*, Dominic Louis Boccelli, Paul Allan Succop and Daniel Barton Oerther "Environmental Health and Household Demographics Impacting Biosand Filter Maintenance and Diarrhea in Guatemala: An Application of Structural Equation Modeling" School of Energy, Environmental, Biological, and Medical Engineering, College of Engineering and Applied Science, University of Cincinnati, Cinccinnati, Ohio 45221, United States Revised: November 12, 2012 Accepted: November 15, 2012

[6] M. MansoorAhammed , KomalDavra "Performance evaluation of biosand filter modified with iron oxide-coated sand for household treatment of drinking water" Civil Engineering Department, S V National Institute of Technology, Surat – 395007, India Desalination 276 (2011) 287–293. Received in revised form 25 February 201 1Accepted 24 March 2011 Available online 6 May 2011

[7] Themba O. Mahlangu1, Lizzy Mpenyana-Monyatsi2, Maggie N. B. Momba2 and Bhekie B. Mamba1* "A simplified cost-effective biosand filter (BSFZ) for removal of chemical contaminants from water" Accepted 29 September, 2011. Journal of Chemical Engineering and Materials Science Vol. 2(10), pp. 156-167, November 2011 Available online at http://www.academicjournals.org/jcems ISSN-2141-6605 JCEMS ©2011 Academic Journals DOI: 10.5897/JCEMS11.041

[8] M M Fiore1, K Minnings2, LD Fiore31University of Michigan, Ann Arbor, Michigan, USA2Undergraduate student, Nicaragua3Boston University Schools of Medicine and Public Health, Boston, Massachusetts, USASubmitted: 29 March 2010; Revised: 7 June 2010; Published: 24 August 2010Fiore MM, Minningts K, Fiore LD "Assessment of biosand filter performance in rural communities in southern coastal Nicaragua: an evaluation of 199 households" Rural and Remote Health 10: 1483. (Online), 2010. http://www.rrh.org.au ISSN 1445-6354

[9] J. A. D. Rodrigues1*, A. G. Pinto1, S. M. Ratusznei " Enhancement of the performance of an anaerobic sequenting batch reactor treating low-strength wastewater through implementation of variable stirring program rate" Departamento de EngenhariaQuímica e de Alimentos, Escola de EngenhariaMauá, InstitutoMauá de Tecnologia (IMT), PraçaMauá Brazil E-mail: rodrigues@maua.br ISSN 0104-6632 Printed in Brazil Vol. 21, No. 03, pp. 423 - 434, July - September 2004