International Journal of Science, Environment
and Technology, Vol. 2, No 2, 2013, 258 - 266

ADVANCED THREE-IN-ONE WATER FILTER AND ITS ADVANTAGES

[1]K. C. Khandare, [1]S. R. Patil[*] and [2]R. S. Sawant
[1]Department of Zoology and [2]Department of Botany,
Dr. Ghali College, Gadhinglaj- 416502, Dist-Kolhapur (MS) India
E-mail: srp_zoo@yahoo.com (**Corresponding Author*)

Abstract: This study is dealing with designing, construction and efficiency of advanced three-in-one filter. Present model has been developed to provide efficient water filter and made considerable modification in traditional water filters. The study also deals with the testing the efficiency of water filtered through this filter by analyzing physico-chemical parameters like E.C., pH, alkalinity, total hardness, chlorides, microbial parameter for MPN along with cost effectiveness, both for the manufacture and maintenance. The filter is efficient to remove both chemical as well as microbial contaminants within a very low consumption of electricity.
Keywords: Three-in-one water filter, physico-chemical, microbial, efficiency.

Introduction

Water is essential to life on our planet; over 70% of the total water used in both rural and urban areas in India is from rivers, lakes, ponds etc. Along with surface water some people use water from open wells and bore-wells. This fundamental resource is of such importance because no living organism can survive without water. Hence there is extreme requirement of pure water necessary for all the human beings.

Potable water is defined as water that is free from diseases producing micro-organisms and chemical substances deleterious to health (Ihekoronye and Ngoddy, 1985). Unfortunately clean, pure and safe water only exists briefly in nature and is immediately polluted by prevailing environmental factors and human activities. Water from most sources is therefore unfit for immediate consumption without some sort of treatment (Raymond, 1992). Hence contamination of drinking water from any source is therefore primary importance because of danger and risk of water borne diseases (Edema *et. al.,* 2001 and Fapeta, 2000).

Water supplies continue to dwindle because of resource depletion and pollution, whilst demand is rising fast because of population growth, industrialization and urbanization (Falmenmark, 1994). This situation is particularly acute in the more arid regions of the world where scarcity and associated increase in water pollution, limited economic and social

*Received March 8, 2013 * Published April 2, 2013 * www.ijset.net*

development and are linked closely to the prevalence of poverty, hunger and diseases (Falmenmark, 1994). This situation demands for the efficient treatment for the healthy survival of human beings and to prevent water borne and water related diseases such as Cholera, typhoid fever, hepatitis etc.

It has also been known that inadequate water supply both in terms of quality and quantity couple with poor sanitation globally accounts for approximately 30,000 deaths daily, many of them are infants and 80% of such cases occur in rural areas (Ocheing and Otieno, 2006)

Filtration is one of the oldest and simplest methods of removing contaminants from surface water (Wegelin, 1996). Generally filtration method includes slow sand filtration and roughing filtration. The slow sand filters constructed in rural communities show that many of these filters have short filter runs and produce turbidity in the excess of WHO guideline values for drinking water (Jaylath, 1994). Reliable operation of sand filtration is possible when the raw water has low turbidity and low suspended solids (Graham, 1988). For this reason, when surface waters are highly turbid, ordinary sand filters could not be used efficiently.

Although there are a vast number of treatment methods, they have been found to have limitations such as effectiveness in removing contaminants and disinfecting water and high operation and maintenance costs (Earwaker, 2006) and hence there is need for the development of such more efficient filter to remove chemical as well as microbial contaminants from the polluted water. To remove all the limitations extensive research has been conducted and developed efficient filter through which turbidity, chemical as well as microbial contaminants can be removed.

An ideal water treatment for developing countries should be able to remove all chemical and microbial contaminants in single filtration process. These filters should reduce contaminants to acceptable levels while retaining their permeability and reactivity over extended periods (Mahalangn *et. al.* 2011).

Three-in-one water filter is one of the parts of emerging technologies being developed from locally available materials for making water free from all types of contaminants in rural as well as urban areas.

Construction of filter

The advanced three-in-one water filter contains three filtration units which are arranged in linear manner, namely, filtration unit, boiling unit and cooling unit as shown in

Figure I. All of these units play an important role in the filtration process and able to remove chemical and biological contaminants.

a) Filtration Unit

Among three vessels, top one is used as filtration unit in which four layers of natural filtering sources have arranged. First layer is of charcoal which removes most of toxic materials by absorption. Second layer made up of gravels, which are considered to be biological filters through which some bacteria are removed from the water by sedimentation process. Third layer consists of alum which is one of the important layer through which turbidity is reduced to 80-85%. Alum is having capacity to absorb turbid causing materials present in the water and last layer consists of sand in which some amount of microbial load is reduced. Water passing through these four layers is collected and passed to next vessel through copper outlet.

b) Boiling Unit

Boiling unit is considered to be an important unit in this advanced three-in-one water filter where all microbial contaminants are removed. The construction of boiling unit is made in such a way that water passed from filtration unit enter into boiling unit through inlet made up of copper and stored into the vessel of boiling unit where 1000 watt copper electric coil is used for boiling the water and thermostat is fixed as indicator to indicate the water temperature up to 100^0 C. when water starts boiling automatically electrical coil switches off and green indicator is switched on and when electric coil switches on, red light indicator is switched on.

Through this vessel two outlets are attached, where one is for passing vapour formed during boiling. It is at the top of boiling unit and second outlet is attached at bottom of boiling unit through which hot water is passed to cooling unit, mean while another sub outlet is given to second outlet for hot water.

c) Cooling Unit

This is bottom most unit where both vapor and hot water are collected through two different outlets from boiling unit. The first outlet from boiling unit with water vapor is coiled to the vessel arranged in cooling unit and threw cold water; vapors are condensed to form pure water which is free from all contaminants, especially free from biological contaminants which cause related diseases like typhoid, cholera, hepatitis etc. in cooling unit. Along with pure filtered water warm water also obtained after cooling in at cooling unit for some extent.

In this way from this advanced Three-in-one filter three different benefits are obtained and the prime benefit is to get pure water for drinking purpose. Along with this one can get boiling water and warm water for different domestic uses.

Results and Discussion

Cost and maintenance of filter

Cost and maintenance is considered to be one of the primary parameter next in mind. This is useful in qualifying the cost effectiveness of the filter devices. The initial cost of the device is considerably affordable for all people if manufactured in bulk quantities and comparatively maintenance cost is also very low.

Physico-chemical Analysis

Physico-chemical parameters like E.C., pH, alkalinity, total hardness and chlorides were analyzed (Table I) and compared with regular tap water, water from other branded water filter and finally with WHO accessible limits.

Electrical Conductivity

E. C. of water from Three-in-one advanced water filter was 0.18 µmhos/cm, regular tap water and branded water filter were 1.2 µmhos/cm, which indicates it was reduced in advanced three-in-one water filter. The higher electric conductivity values may be due to the natural concentration of ionized substances present in water and due to higher dissolved solids. The range of E. C. in water is permissible according to the guidelines of WHO.

pH

pH of water from advanced three-in-one water filter is 7.55 which is less than that of regular tap water (7.65) and branded water filter (7.75) where it got increased. According to WHO guidelines the range is under permissible limit.

Alkalinity

The sewage and domestic wastes are sources of organic matter and decomposition of these organic matters by microbes leads to formation of CO_2 in water which increases the concentration of carbonates and bicarbonates, increasing the level of alkalinity of water (N. Shiddamallayya and M. Pratima, 2008). Alkalinity in water gives unpalatable taste (Goel, 2006).

In present investigation the value of alkalinity of water sample from advanced tree-in-one water filter was 72 mg/l which is less than that of tap water (80 mg/l) and branded water filter (80 mg/l). It indicates that advanced tree-in-one water filter can efficiently reduce alkalinity from tap water than that of branded water filter.

Total hardness

Total hardness is characterized by calcium and magnesium. The adverse effects of total hardness are formation of kidney stones and heart diseases (Freeda Grana Rani *et. al.,* 2003, Sastry and Rathee, 1998).

In present investigation total hardness of sample water from advanced three-in-one water filter was 210 mg/l which was initially 360 mg/l in tap water and comparatively more reduced than that of branded water filter (360 mg/l)

Chloride

High chloride values may be due to organic wastes from animal origin and domestic wastes (Ch. Debala *et. al.,* 2009) and the excess chloride in drinking water may induce heart failure (Brooker and Johnson, 1984) and hypertension (Hussain and Ikbal, 2003). In present investigation it has been found that the chloride level is considerably reduced by advanced three-in-one water filter to 176 mg/l from tap water (204 mg/l) which is also less than that of branded water filter (184 mg/l).

Microbial Analysis

Microbial analysis is one of the very important with respect to different disease causing agents. In present investigation the Most Probable Number (MPN) for presumptive total coliform count has been obtained and it has been revealed that advanced three-in-one water filter efficiently removed all coliforms and the count showed is nil, which was initially 19 cells/ml in tap water and 14 cell/ml in water from branded water filter. Hence it has been concluded that the advanced three-in-one water filter efficiently removed all microbial contamination from the water.

Statistical Analysis

Total time required for boiling two liters of water is 1 minute and 40 seconds while the amount of water boiled within 1 hour is approximately 120 liters. Thus the electricity required to boil 120 liter water is 1 unit and the cost of 1 unit in rural area is about 2 rupees. Amount of distilled water obtained from 120 liters of raw water is 2400 ml approximately. Hence in terms of electricity also it is affordable to common people.

Conclusion

Advanced 3-in-1 filter is efficient filter to eliminate chemical and microbial contaminants from the water than that of other branded water filters. The cost of manufacture

and cost of maintenance will be reduced than that of branded water filter if production is made in large quantities.

Acknowledgment

Authors are thankful to Mr. Sakhare S. C., Mr. Khandare G. A., Mr. Kamble G. A., Mallikarjun Khandare and Abhijeet Borgalli for their constant encouragement and support. Thank goes to Mico Industries, Udyam Nagar, Kolhapur for their constant Guidance for construction of instrument. Thanks are also to teaching and non teaching staff of S. M. High School, Basarge.

References

[1] Brooker, M.P. and Johnson, P.C. (1984), Behaviors of phosphates, nitrates, chlorides and hardness in 12 well and river, *Water Res.*, 18 (9): 1154-1164.

[2] Ch. Dabela Devi and D. Usha Anandi (2009), Assessment of water quality for agriculture-A case study of Madhavara Lake in Bangalore. *Nat. Envi. Poll. Tech*., 8 (4): 755-760.

[3] Earwaker P. (2006), Evaluation of household biosand filters in Ethiopia. Master of Science thesis in water management (Community water supply), Institute of water and environment, Cranfield University, Silsoe, United Kingdom.

[4] Edema M.O., Omemn A. M. and Fapeta O.M. (2001), Microbiology and physico-chemical analysis of different sources of drinking water in Abeoknta, Nigeria, *Niger J. Microbiol,* 15 (1): 57-61.

[5] Fapeta O. M. (2000), Comparative analysis of different sources of drinking water in Abeoknta south L. G. A., Ogan state (B. Sc. Thesis), UNAAB Abeoknta, p 44.

[6] Felkenmark M. (1994). The dangerous spiral: near future risks for water related eco-conflicts. In proceedings of the ICRC Symposium “Water and war: Symposium on water in Armed Conflicts”, International committee of the Red Cross, Montreux, Swizerland, 21-23 November 1994, pp 16.

[7] Freeda Grana Rani D, Thamaraiselvi, C. and Ebanasar, J. (2003), Cited in study of probability of water in cement industrial area, Ariyalur. *Jr. Indus. Poll. Contl.*, 17 (2): 257.

[8] Goel P.K. (2006), Water pollution: causes, effects and control, 2nd edition MacMilan publishers, London, 154-232.

[9] Graham N (Ed) (1998), Slow sand filtration, recent developments in water treatment technology, Elis Horwood limited/ Wile and sons Chichester England.

[10] Hussain J. and Ikbal H. (2003), Evalution of drinking water quality of the village situated near Banas, Rajasthan. *Indian Jr. Envi. Protec.* 23 (6): 640-645.

[11] Ihekoronye Al and Ngoddy P. O. (1985), Integrated food sciences and technology for the tropics, MacMilan press, London, Oxford, pp 95-195.

[12] Jayalath J. (1994), Algae removal by roughing filter, 20th WEDC conference 1994, Manual on water supply and treatment, CPHEE, Ministry of Urban Development of India, New Delhi, 1991 pp 495.

[13] N. Shiddamallayya and Pratima (2008), Impact of domestic sewage on freshwater body, *Journal of environmental biology*, 29 (3): 303-308.

[14] Ochieng Gm and Otieno FAO (2006), Verification of wegelin design criteria for horizontal flow roughing filters with alternative filter materials, *Watersa* Vol. 32 January.

[15] Raymond E. (1972), Le problame dis ean dans le monde (Problems of water), EB and sons Ltd. UK. Pp 123-126.

[16] Sastry, K.V. and Rathee, P. (1998), Physico-chemical and microbiological charecteristics of water of village Kenneli (Dist-Rathak), Haryana, *Proc. Academy of Environmental Biology*, 7 (1): 103-108.

[17] Themba O. Mahlangu, Lazzy Mpenyana-Monyatsi, Maggie N. B. Momba and Bhekie B. Mamba (2011), A simplified cost-effective biosand filter (BSFZ) for removal of chemical contaminants from water. Journal of Chemical Engineering and Material Science, Vol. 2(10): 156-167.

[18] Wegelin M. (1996), Surface water treatment by roughing filter, A design, construction and operation manual, Swiss Federal Institute for Environmental Science and Technology (EAWAG) and Department Water and Sanitation in Developing Countries (SANDEC).

Figure I: Diagrammatic representation of construction of Advanced three-in-one water filter.

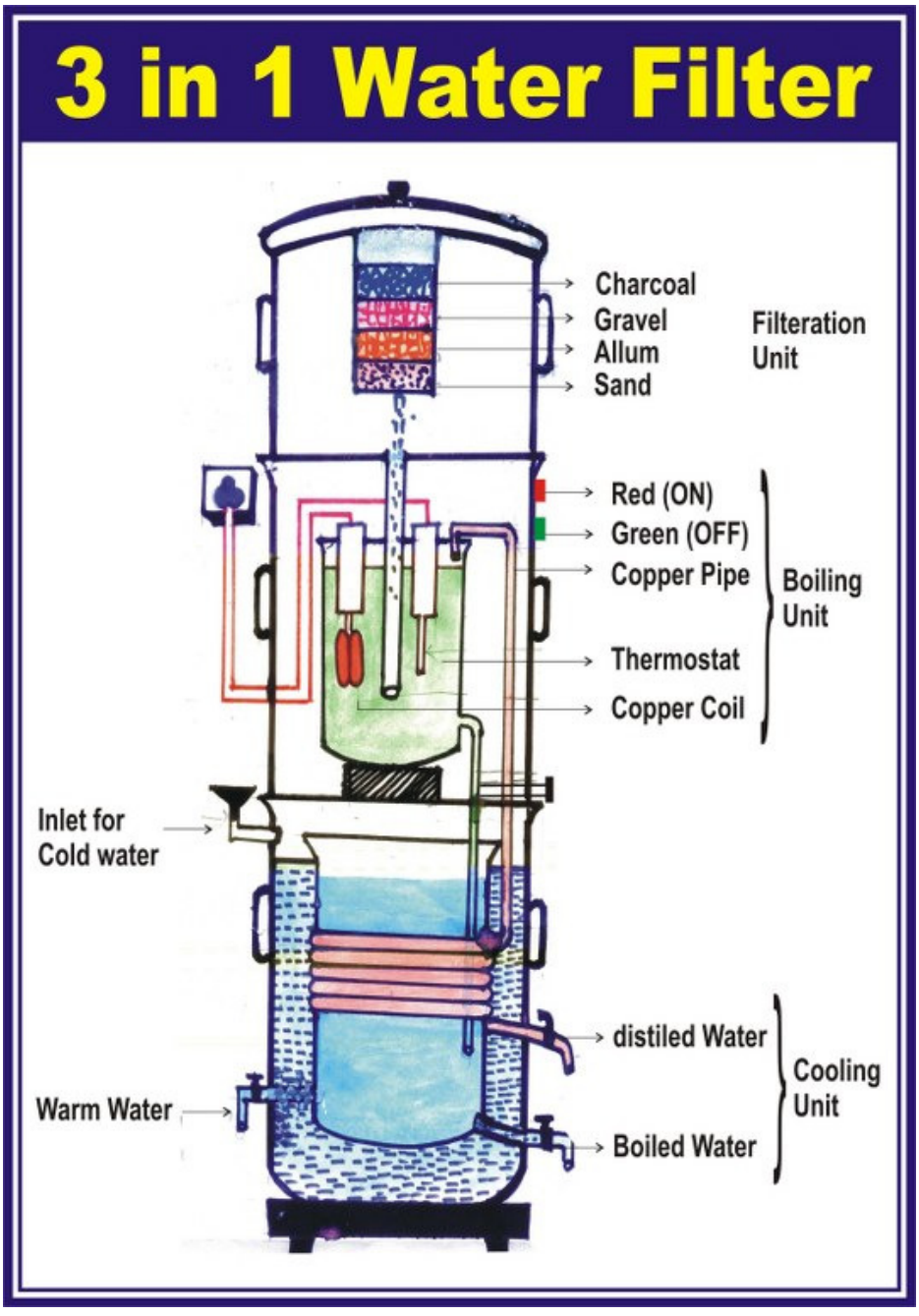

Table I: Physico-chemical parameters of different water samples compared with advanced three-in-one filter.

Parameters	**Tap water**	**Branded water filter**	**Advanced Three-in-one water filter**	**WHO standards**
pH	7.65	7.75	7.55	6.5-8.5
E.C.	1.20	1.20	0.18	6.5- 9.2
Alkalinity	80	80	72	200
Hardness	360.0	360.0	210.0	500
chlorides	204.0	184.0	176.0	250-600
Coliform bacteria	More than 19	More than 14.	Nil	

Note: All parameters in mg/l except pH, E. C. in mhos/cm and coliform bacteria in colonies.