A. Kuchewar, Dr. P. B. Nagarnaik / International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 www.ijera.com
Vol. 2, Issue 4, July-August 2012, pp.349-353

# "Comparative study on physico-chemical and microbiological efficiency of domestic water filters."

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## Abstract

**This paper presents the study of physico-chemical and microbiological efficiency of locally available low cost (branded/local) water filters used for household drinking purpose. In present work, 5 water filters were selected from local market. Water filters were charged with tap (municipal) water, well water, bore water and lake water samples (one after another) at 100%, 50% and 0% cartilage life of water filters for the period of 10 months from July'11 to April'12. Water sample testing was carried out as per Indian Standard specification for drinking water IS 10500-2004. The parameters pH, temperature, turbidity, alkalinity, total dissolved solid and coliforms count were recorded at 100%, 50% and 0% cartilage life of water filters for the source water i.e. tap water, well water and lake water. Flow rate and frequency of cleaning were also recorded for each water filter. Results shows all water filters are good for removal of organic impurities upto some extent. These water filters fail to reduce TDS, hardness, and chloride. Most water filters showed 95-98 % microbiological reduction efficiency. These finding suggest that efficiency of water filters should be more to remove micro-organisms from drinking water.**

**Keywords** – Water filters, physio-chemical efficiency, microbiological efficiency, coliforms, BSI Std., MPN test, cartilage life.

## Introduction

The topic of water filters is complicated because there are so many models available in market. (over 250 different models manufactured by more than 100 companies). The task of a good water filter is to remove all the unwanted pollutants and contaminants from the drinking water. There are various filter systems available on the market, and it is difficult to find out which system is the most suitable for our needs. As our exposure to environmental pollutants increases, so does our need for filtered, potable water. This study provides the information about quality, performance contaminant removal capabilities of water filter products.

The demand, sale and use of drinking water filters continues to grow rapidly in our country. There is increase in the demand of low cost water filters. The increased demand for these drinking water products is largely due to inadequate or non availability of reliable, safe municipal water in urban areas.

This study aims analysis of efficiency of domestic water filter available in market to remove physical, chemical and biological contamination from selected source of water. And rate them accordingly. Also to check whether they comply as per BIS std norms and live up to claims made by manufactures.

## Material and Methods –

The market survey was conducted to know most usable brand in India. The most popular brand available in Indian market was surveyed for the study. Lot of generic brands are also available but it was not possible to evaluate all of them. Due to its high contamination in supply water as well as in ground water, public are jumping to domestic water filters. Out of all available range the non-electrical water filters models in market are higher in sale because of their low cost and very convenient features. They are costing from Rs. 999/- onwards till Rs.4000/- shown in table no. 1.

Manufacturers are using different types of technologies to remove chemical impurities (organic and inorganic impurities) as well as microbiological. Most of offline models are using silver nano particles with activated carbon in different percentages and halogens (chlorine, bromine and iodine) for purification (table no.2). Water filters based on multiple intervention such as filtration / ultra-filtration / activated carbon adsorption / UV rays disinfection are available in the market which can be used to purify the water.

To compare 5 (five) water filters were purchase from the market (4 branded and 1 local brand) shown in table no. 1. General and technical specifications of all water filters are given in table no. 3 and 4. All the water filters ere checked upto 1500 lit., 3000 lit. and 4000 lit. i.e. upto 100% filtration life of filter cartilage shown in table no.6.Tap (Muncipal) water (Jawahar Nagar), well water (Narendra Nagar), bore water (Narendra Nagar) and lake water (Sakardara lake) were identified and selected as source of water for analysis of filters. The water sample was collected and analysis for the period of 10 months from July'11 to April'12. Regular samples were collected in sterilised glass bottles for bacteriological and various physic-chemical analysis of sample, the precleaned polyethylene bottle were

used. Prior to sampling the entire sampling container were washed and rinsed thoroughly with source water to be taken for analysis. The samples were analysis for different physical, chemical and bacteriological parameters i.e. (pH, temperature, turbidity, TDS, hardness, alkalinity and total coliuforms) according to the standard procedure mentioned in IS 10500-2004.

## Results and Discussion :

Results of laboratory testing of water filters for microbiological reduction from source water are summarized in table no.5. Initially Tap (Municipal) water sample were tested @ 100%, 50% and 0% cartilage life of water filter. It was observed that source water is (-)ve for coliforms and other physico-chemical parameters were within prescribe limit/range of BSI Std. Hence, to check the efficiency of domestic water filters, source water sample containing chemical and biological contamination were required. And these samples were collected from different sources such as well water, lake water and bore water from different localities in Nagpur city.

Water filter No.1, 2, 3 and 4 showed 98% to 99% efficiency in removal of microbiological load. Water filter No. 5 showed 95% efficiency in removal. Water filter No.1, 2 and 3 showed 90% turbidity removal efficiency, water filter no. 4 showed 80% and water filter no.5 showed 40% efficiency in turbidity removal. Among the different parameters considered temp, pH, TDS, total hardness remain unchanged before and post filtration. All water filters showed less Chloride, Hardness, TDS, Alkalinity removal efficiency.

These water filters were found effective in removal of physic-chemical impurities to some extent and biological impurities also. But flow rate of all water filters is very slow shown in table no.7 (Average flow rate 5 to 7 mins required per liter), which need to be improved. Water filters flow rate is given in table no.6. Flow rate is not uniform throughout the cartilage life of filter. It decreases considerably after 50% of cartilage life. Water filter no. 1 and 2 having auto switch off unit functioned properly. But get switch off before 1500 lit cartilage life of filter. Efficiency of all water filter decreases with time and amount of water filtered.

## Conclusion –

These water filters are only suitable for water quality as per BIS Standards.

These water filters are good at removal of organic impurities.

All the water filters cannot reduce TDS, Hardness

These water filters shows 99%-98% microbiological removal efficiency.

Flow rate is very poor which needs improvement.

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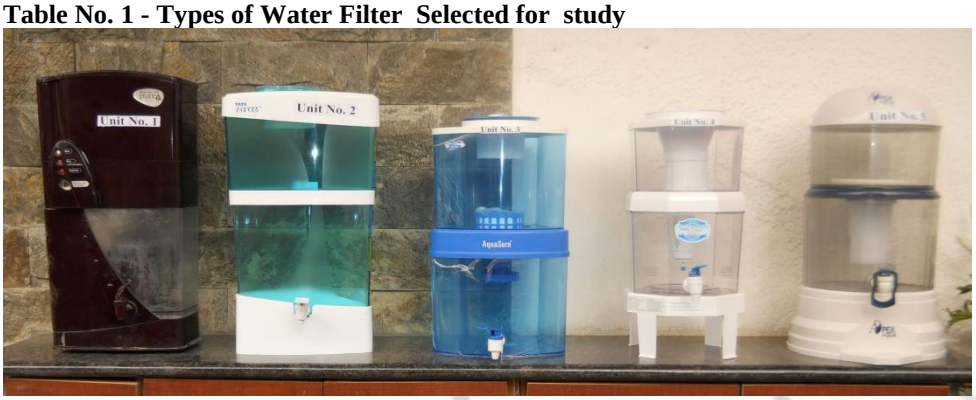
**Table No. 1 - Types of Water Filter Selected for study**




Unit No. 1; Unit No. 2; Unit No. 3 Unit No. 4 and Unit No. 5 (local Brand)

**Table No. 2 - Water Filter Cartilage**

| | | | | |
|---|---|---|---|---|
|  |  |  |  |  |
| Unit No. 1 | Unit No. 2 | Unit No. 3 | Unit No. 4 | Unit No. 5 (local Brand) |
| Purification Technologies | | | | |
| Chlorine (Trichloro cyanuric acid) | 0.8 % Silver with Carbon | Bromine (Penta Io dine Resin) Po ly-1-bromo-5-methyl-5 (4'- vinylp henyl) Hydantoin | Ultrafilter | Iodine (Penta Iodine Resin) |

**Table No. 3 - Water Filter Comparisons ( General)**

| | Unit No.1 | Unit No.2 | Unit No.3 | Unit No.4 | Unit No.5 |
|---|---|---|---|---|---|
| Type of Water Purifier | Storage | Storage Type | Storage | Storage Type | Storage Type |
| Storage Capacity (Litres) | 9 | 18 | 18 | 10 | 10 |
| **Methods of Purification** | | | | | |
| Norms /Std Followed | US EPA | US EPA | US EPA | US EPA | US EPA |
| Purification Stages | 4 | 5 | 3 | 4 | 4 |
| Pre-Filter Purification | ✓ | ✓ | ✓ | ✓ | ✓ |
| Silver-Impregnated Activated Carbon Purification | ✓ | --- | --- | --- | --- |
| Reverse Osmosis | ✗ | --- | --- | ✗ | ✗ |
| | | | | | |
| **Certification** | WQA | India, Uk, N | WQA | WQA | Applied for patent |
| Material of Body | Food Safe, Non-Toxic, Engineering Plastics | Food grade, non-toxic, engineering plastic | ABS Plastic | ABS Plastic | ABS Plastic |
| **Power Requirement** | | | | | |
| | | | | | |
| Power Required | ✗ | ✗ | ✗ | ✗ | ✗ |
| Auto Off Switch | Yes | Yes | No | No | No |
| | | | | | |
| Filter General & Technical Comparisons | | | | | |
| **Machine Features** | | | | | |
| | | | | | |
| Colours Available | Blue & Maroon | White and Sky Combi | --- | White | White |
| **Dimensions** | | | | | |
| Width (mm) | 290 | 300 | 274 | 280 | 280 |
| Depth (mm) | 260 | 282 | 274 | 230 | 230 |
| Height (mm) | 610 | 572 | 525 | 520 | 520 |
| Weight (Kgs) | 4.1 | 3 | --- | --- | --- |
| Storage Capacity (Actual) | 9 | 9 | 10 | 5.5 | 10 |
| Top | 9 | 9 | 10 | 4.5 | 10 |
| Bottom | 9 | 9 | 10 | 5.5 | 10 |
| Unique Feature | --- | --- | --- | --- | --- |
| Warranty Period (Years) | 6 months | --- | --- | 1 | 1 |

**Table No. 4 - Water Filter Comparisons ( Technical)**

| FEATURES | Unit No. 1 | Unit No. 2 | Unit No.3 | Unit No.4 | Unit No.5 |
|---|---|---|---|---|---|
| Purification Stages | * Non woven filer pad.<br>* Carbon Block<br>*Chlorine Tablets in the form of Trichloro cyanuric acid.<br>* Silver Impregnated GAC. | * Bag Filter.<br>* Carbon block packed with non woven filter cloths caped in plastic cell.<br>* Bromine Resin | Iodine and 0.4% Silver impregnated carbon | *Bag Filter (Non woven filter pad)<br>* Carbon block<br>* UF | *0.8% Silver Impregnation.<br>* Silica Sand<br>* Paddy Husk Carbon<br>* Calcium Sulphate as an Indicator |
| Stages | 04 | 05 | 03 | 03 | 05 |
| Certification | WQA | IMA | WQA | ISO:9001:2000, WQA | Applied for different Patenets |
| Storage Capacity Top | 09 | 08 | 10 | 07 | 9.5 ltr |
| Storage Capacity Bottom | 09 | 09 | 10 | 13 | 8.5 ltr without cartridge |
| Actual Storage Capacity | 09 | 09 | 20 | <10 (7-9 liter) | 7.8 ltr. With bulb |
| Avg. Flow Rate min./l Contact Time | 5-8 | 7-12 | <20 min. | 11->20 min. /Ltr. Varies and depend on Gravitational force | 12-30 min./ ltr. |
| Constant Flow Rate | No | No | Yes | No | No |
| Life of cartridge claimed | 1500 ltr. | 3000 ltr. | 1500 ltr. | 4000 ltr. | 3000 ltr |

**Table No.5 – Biological efficiency of water filters (Percentage Reduction)**

| | Total Coliforms Count | | | |
|---|---|---|---|---|
| **Water sample** | **Well water** | | | |
| **Cartilage life** | **100%** | **50%** | **0%** | **Avg.** |
| **Raw water** | **460** | **240** | **460** | |
| **Unit No.1** | **3** | **3** | **7** | **98.88%** |
| **Unit No.2** | **3** | **4** | **7** | **98.79%** |
| **Unit No.3** | **3** | **4** | **7** | **98.79%** |
| **Unit No.4** | **3** | **9** | **11** | **98.02%** |
| **Unit No.5** | **64** | **75** | **120** | **77.67%** |

**Note –** No coliforms was found in Tap (Municipal) water sample throughout test period.

| | Total Coliforms Count | | | |
|---|---|---|---|---|
| **Water sample** | **Lake water** | | | |
| **Cartilage life** | **100%** | **50%** | **0%** | **Avg.** |
| **Raw water** | **1100** | **1100** | **1100** | |
| **Unit No.1** | **3** | **3** | **7** | **99.61%** |
| **Unit No.2** | **3** | **4** | **7** | **99.58%** |
| **Unit No.3** | **3** | **3** | **7** | **99.61%** |
| **Unit No.4** | **4** | **7** | **11** | **99.33%** |
| **Unit No.5** | **43** | **75** | **93** | **93.61%** |

**Table No. 6- No. & Frequency of Water Sample Testing**
(As per product manual depending on Cartilage life)

| | | |
|---|---|---|
| 1st Sample Testing | Start | 100% cartilage |
| 2nd Sample Testing | Middle | 50% cartilage |
| 3rd Sample Testing | End | 5-10 % cartilage |

**Table No.7 - Avg. Flow Rate (per liter in mins)**

| Time (days) | F1 | F2 | F3 | F4 | F5 |
|---|---|---|---|---|---|
| 100% (1day) | 8 | 9 | 7 | 11 | 6 |
| 50%(11day) | 12 | 12 | 11 | 14 | 10 |
| 0% (13day | 15 | 16 | 15 | 19 | 13 |
| Average | 11.66 | 12.34 | 11 | 14.66 | 9.67 |