

# Fabrication of Plastic Water Filter and Testing with Slow Sand Filtration Method.

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## ABSTRACT

Water is described as a universal solvent which is the most abundant and useful compound that nature has provided. Two main sources of water are: surface and underground water. Among the many essential elements for the existence of human beings, animal and plants, water is rated as one of the most important elements for human living. Man can survive for weeks without food but a few days without water.

Sand has been used to purify water for over a thousand years; and it still remains the dependable methods of making water fit for drinking. The idea of water sand filtration can be seen when water taken from sandy river beds is generally pure, because it has percolated through the sand grains where harmful bacteria are removed.

As a result of high demand for quality and clean water by the society, various means to meet this demand have been constructed. Though, many of these means are not easily accessible by some communities, due to unavailability, high cost, or complexity of usage. This has led to the design and construction of water filters which can be accessible by all communities. Data obtained from our laboratory results clearly shows that an appreciable degree of treatment had taken place when the designed filter was used.

(Keywords: potable water, filter, fine sand, filtration)

## INTRODUCTION

The problem of supplying adequate amounts of water for distribution to the public is not limited to the construction of water works. Many water borne diseases have been traced to defects in the operating procedure used in water treatment. Any

untreated water contains active micro-organisms. Many of these microbes are harmful include the pathogenic fecal bacterial which poses the greatest health hazard (detected by the presence of *Escherichia coli* (*E. coli*)).

Filtration is the process by which water is purified by passing it through a porous medium. In slow sand filtration, a bed of fine sand is used through which water percolate downward. Due to the fine grain size, the pore of the filter bed is small. The suspended matter present in the raw water is largely retained in the 0.5 – 2 cm part of the filter bed through electrostatic process. This allows the filter to be cleaned by scraping away the top layer of sand or by flushing. The filter cleaning operation need not to take more than a day but after cleaning, one or two more days are required for the filter bed to again become fully effective. A simple water filter working on the principle of slow sand filtration was improved upon. The filtration water treatment involves physical, chemical and biological changes that transform raw water into safe as specified by international standards for drinking water (WHO).

## LITERATURE REVIEW

In 1980, it was declared that 1981 to 1990 should be the International Drinking Water Supply and Sanitation decade by the World Health organization. It was described by International Reference Centre for Community Water Supply and Sanitation that slow sand filtration is one of the most suitable for the removal of pathogenic organisms (IRC, 2001).

The process of supplying of water to Amsterdam, Holland is purified simply by passing it through the ridges of sand on the coast. It is essential that the sand remain clean and is not allowed to dry

so that the active ingredients in it will not depreciate in value (Anderson, 2003).

Ogedengbe, 1985, stated that some particles can be grounded and heated to eliminate bulk of the volatile materials and then activated to develop proper pore structure for absorption. He stated that the absorbent promotes sedimentation and absorption process during water filtration. In 1988 the principles behind slow sand filtration through electrostatic attraction has the most effective, but it occurs only between particles having opposite electrical charges. It is this that removes bacteriological content and does not remain there unchanged; it is transformed by bio-chemical and bacterial activity (Hofkes, 1988).

Ezeoma, 1988, also supported claims by Ostreyko which was noted in 1980 that active absorbents could be obtained by subjecting carbonaceous materials as coconut shells and strong fruit Kernels to some specific heat treatment.

### **Purpose of Water Treatment**

As essential as water is to life, it could be dangerous if not purified hence the need of water treatment to render it safe for drinking and domestic use. Most important, is the removal of pathogenic organisms and toxic substances such as heavy metals causing health hazards. Other substances may also be removed or at least considerably reduced, these include suspended matter causing turbidity, odor, color, hardness, and excessive carbon dioxide, corroding concrete and metal parts in the distribution system.

Many water-borne diseases have been traced to defects in the operating procedures used in water treatment plants (Camp. 1999). Wagner and Lanoix reported that in the past, there had been plenty of outbreaks of typhoid fever, cholera, guinea worm, and epidemic jaundice due to breakdown of treatment systems. Water is very vital in the environment and it is very important that it should be treated before use (Charles, 2001).

Even in the United States, twenty per cent of water-borne disease causes have been attributed to deficiencies in the operation of treatment plants. With treated water, the risk of water-borne disease is greatly reduced if not totally eliminated. Various treatment processes have been

developed. Some serve as a single purpose while other serves multiple purposes. These processes include aeration, coagulation and flocculation, sedimentation, filtration (it may include slow sand, rapid sand and pressure filtration) and disinfection (Craun and Mc Cabe, 1973).

### **Important Uses of Water**

**a. Biological Importance:** Two-thirds of the human body is constituted of water. The organs of the body cannot satisfactorily perform such functions as digestion, circulation, excretion etc. without adequate water in the body.

**b. Industrial Application:** It's most important use as an engineering material is in steam generation. Water is equally important in power generation as in hydro-electricity. It is also used as coolant in power and chemical plant. In the areas of atomic energy and steel production, water is widely used. The construction industry finds water vital in forming concrete motors slaking lining and other structural materials.

**c. Chemical Industry:** Most chemical products have water either as a major component or as an important part. Beverages such as beer, wine, fruit drinks, ice cream, soft (minerals) drink, etc. contain not less than 50% water. Certain adhesives, inks, paints, cosmetics, and soaps contain between 30% - 50% water as ingredients which help to reduce cost. Water is also widely used in bleaching and washing in textile and paper industries. In addition, water is used in most factories for cleaning factory floors, machines and for laundry imposes.

**d. Agricultural Use:** The use of irrigation to boost crop production makes use of water as an important input. Water is essential for the survival and well-being of farm animals. Fish breeding is only possible where water is in adequate supply as water is actually the home of fish. Certain feeds and drugs used for animals are compounded with water as an essential component. With water, general cleanliness and good sanitary conditions of farms are made possible by using it for washing, etc.

**e. Other Uses:** Mankind depend on water for safe and conducive, living by using it for washing, bathing, manufacturing, fire-fighting, recreational use, transportation, and other purposes (Okpobisi, 1998).

## Standards of Water Quality

Various laboratory tests which involve both physical and chemical test were carried out on different samples of water and compared to standard set down by International Reference Centre for Community Water Supply and Sanitation (IRC, 2001). It was stated by IRC that the levels of coliforms present in acceptable

drinking water should be less than 10 per 100ml sample; and the number of fecal *E. coli* should be less than 2.5 per 100ml sample.

Further guidelines for quality of drinking water standards for community water supplies: are presented below. The World Health Organization established minimum criteria for drinking water (WHO, 1998).

**Table 1: Water Related Diseases.**

Disease	Pathogen
Typhoid	<i>S. Typhi</i>
Bacterial Dysentery	<i>Shigella sp. Campylobacter sp., E. coli</i>
Cholera	<i>Vibrio cholera</i>
Amoebic Dysentery	<i>E. histolytica</i>
Dracotiasis	<i>D. medinensis</i> (guinea worm)
Schistosomiasis	<i>S. mansoni</i>
Schistosomiasis	<i>S. japonicum</i>
Schistosomiasis	<i>S. heamatobuim</i>
Gastroenteritis	Rotaviruses
Paratyphoid	<i>S. paratyphi</i>

Source: Medical laboratory Manual for Tropical Countries by Monical Cheesbrough.

**Table 2: Drinking Water Standards.**

Water Quality Parameter	Measured as	Highest Desirable Level	Maximum Permissible Level
Total dissolved solids	mg/l	500	2000
Turbidity	FTU	5	25
Color	mg pt/l	15	50
Iron	mg Fe <sup>+</sup> /l	0.1	1.0
Manganese	mg Mn <sup>++</sup> /l	0.05	0.5
Nitrate	mg NO <sub>3</sub> /l	50	100
Nitrate	mg N/l	1	2
Sulphate	mg NO <sub>4</sub> <sup>2-</sup> /l	200	400
Fluoride	mg F <sup>-</sup> /l	1.0	2.0
Sodium	mg Na <sup>+</sup> /l	120	400
Arsenic	mg AS <sup>+</sup> /l	0.05	0.1
Chromium (hexavalent)	mg Cr <sup>6+</sup> /l	0.05	0.1
Cyanide (free)	mg CN <sup>+</sup> /l	0.1	0.2
Lead	mg Pb/l	0.05	0.10
Mercury	ng Hg/l	0.001	0.005
Cadmium	mg Cd/l	0.005	0.0100
Taste	--	--	--
Chloride	Cl/l	200	600
Zinc	Zn/l	5	15
Calcium	Cl/l	75	200
Magnesium	Mg/l	30	150
Sulphate	SO <sub>3</sub> /l	200	400
Total hardness	CaCO <sub>3</sub> /l	100	500
Nitrate	NO <sub>3</sub> /l	45	-
PH Value	pH meter	7-8	6.5-9

Source: World Health Organization (1998).

## **Conventional Water Treatment Process**

### **(a) Sedimentation**

This involves settling and removal of suspended particles that take place when water is in, or flows through a filtering medium. It is a gravitational process where heavier particles are settled down. It is the most widely used operation. When the impurities are settled down by gravity and natural segregation process, the operation is called Open Sedimentation. When a chemical is added to catalyze aggregation and settling of finely divided suspended matter, colloidal substances, and large molecules, the operation is called coagulation (Charles, 2001).

### **(b) Coagulation and Flocculation**

Coagulation and flocculation provide the water treatment by which finely divided and suspended and colloidal matter in the water is made to agglomerate and form flocs. Colloids are 'stabilized' (kept in suspension) by electrostatic repulsion and dehydration. Common coagulants are aluminum sulfate (alum); ferric chloride (iron salt); silicon, bentonite, etc. However, alum is by far the most widely used coagulants (IRC, 2001).

### **(c) Filtration**

Filtration is a process used in separation to remove impurities from drinking water by passing the raw water through a selective medium called filter or septum. Filter media are medium through which there is a selective passage of materials. Filtration helps in removal of pathogenic organisms from water; most especially the bacteria and viruses responsible water related diseases. In addition to this, control of color, pH, and turbidity are also affected by suitable filtration methods (Jackson, 2000).

### **Different Filtration Processes used are Plate and Frame Filtration**

This is achieved by the use of cloth as the filter medium. The assembly is built on hollow frames. It is effective in the removal of 'cake' and that is why it is suitable for industrial preparation of juice from fruit.

**(a) Reverse Osmosis Filtration:** In its own operation, composite membranes are designed to provide high flux, good impurities rejection and Microbiological resistance (Fil Tec Corp, 1989).

**(b) Rapid Sand Filtration:** This process makes use of coarse sand and gravel as filtering media. Filtration rate is high. Rapid Sand Filtration does not give highly bacteriologically safe drinking water since fast filtration process takes place which does not allow much settlement of impurities.

**(c) Slow Sand Filtration:** This process uses different grades of sand and gravel as filtering media. Filtration is low due to presence of fine sand on top layers. The filtrate is free from pathogenic organisms to a great extent. It is used in communities where water supply is impaired by contamination of pathogenic bacteria and viruses such as typhoid and paratyphoid fevers, cholera, and dysentery (Ogunba et al., 1987).

Slow sand filtration is highly efficient in reducing the total bacteria content by a factor of 1,000 to 10,000 and the *E. coli* content by a factor of 100-1,000. A well-operated slow sand filter will remove protozoa such as *Endamoeba histolytic* and helminths such as *Schistosoma heamatobium* and *Ascaris lumbricoides*. Trouble-free operation is possible when the average turbidity of the raw water is less than 5 FTU, with peak values below 20 FTU and occurring for periods of a few days only (Ho Fhes, 1981).

The theory behind slow sand filtration is based on electrostatic attraction and it occurs only between particles having opposite electrical charges. Clean quartz sand has a negative charge and is, therefore, unable to absorb negative charged particles such as bacteria, colloidal matter of organic origin, anions of nitrate, phosphate, and similar chemical compounds. During ripening period of a slow sand filter, only positive - charged particles are adsorbed, such as: carbonates, iron and aluminum hydroxide and cations of iron and manganese. Adsorption of positive charged particles will continue to a stage that over-saturation occurs. The overall charge of the filter bed grain coatings then reverses and become positive, after which negative-charged particles will be attracted and retained.

After the initial ripening period of nitre bed will exhibit a varied and continuously varying series of negative and positive charged n coatings that are

able to absorb most impurities from passing water. The matter accumulates on the filter sand grains does not remain there unchanged, it is transformed by bio-chemical and bacterial activity. Soluble ferrous and magnesium compounds are turned into insoluble ferric and manganese oxide hydrates that become part of the coating around the sand grain. Organic matter is partly oxidized thus providing the energy needed by the bacteria for their metabolism (HOFKES, 1981).

### **Alternative Filtration Techniques**

Filtration as techniques of separation has a wide application. Different liquid-solid separation devices make use of separating filtration processes. Okpobisi, 1998, described filtration as process which involves impure water passing through beds of fine sand, coarse sand and large granular materials. As water percolates through these beds un-dissolved particles are removed. Gesner Hawley, 1971, defined filtration as the process of separating suspended solids from a liquid by 'forcing' the mixture through a porous barrier.

From operation and controls of water treatment processes there are four types of water filters, which one sufficiently different to require separate discussion. It is essential that the selection of any one type be based on consideration of local factors as well as the advantages and disadvantages of each type. For economic and suitability purpose the porous barriers one of various types and particular ones are chosen after taken into consideration the nature of constituents to be filtered and other pertinent factor (Cox, 1971).

### **Various Filter Media And Their Uses**

There are different filter media used for filtration. Filter media are the various medium through which selective passage of materials takes place.

### **Features and Applications of Some Water Filters**

Water filters are devices used to purify water or reconditioning devices that make water to be suitable for drinking, fire control, also in engineering purposes and industrial use as in boiler and other plants (*Chemical Processing Journal*).

Various filters used in water treatment which are in existence are:

- (a) Slow sand filters
- (b) Rapid sand filters
- (c) Presses filters (i) Chamber press  
(ii) Plate and frame press.
- (d) Pressure leaf filters (i) Horizontal type  
(ii) Vertical type
- (e) Top outlet tubular filters
- (f) Micro strainer
- (g) Reverse Osmosis Filters.

Taking into consideration the objectives of this research work and comparative analysis of various water filters in existence, five water filters were selected and studied closely.

**Table 3:** Some of the Media and Their Applications.

Filter	Uses
1. Metal fabrics/Screens	For handling toxic materials
2. Pressed felts and cotton	Used to filter gelatinous materials paints
3. Non-Woven fabrics (polyester, nylon)	Used for gravity separation of oils
4. Rigid porous media (eg. graphite, sintered 1 stainless steel)	Used for clarification
5. Goths for Coarse Fabric	Use in pressure filters and fruit juice filtration.
6. Thick sludge/slurries	Used in Vacuum or suction filters
7. Ceramic membrane (mainly alumina)	Used in water treatment plants
8. Sand and gravel	Used in gravity filters
9. Diatomaceous Earth filters	In clarification of liquids in water of low turbidity
10. Micro strainers	Used when plankton is present

**Source:** Charles Cox - Operation and control of water treatment, (1973).

## **KIND OF FILTERS**

### **Rapid Sand Filters**

These filters are designed to operate at much higher rate than slow sand filter. Another name of it is "mechanical filter", because the original units had mechanically operated rakes to assist in agitating the sand during the washing process. Water flows through the sand by gravity.

The various units of rapid sand filter should be designed so as to be coordinated into whole plant in accordance with the basic plan. It is essential for the character of the water, the proposed rate of filtration, the size of the plant and the anticipated reliability of the operators to be considered in relationship to one another.

Specifications of the filter bed for rapid sand should be selected with care, with due regard to the anticipated effectiveness of pre-treatment, the rate of filtration and the depth of sand. When unit rate of filtration is 4.8m/h, the sand effective size is in the range of 0.40 - 0.50mm to secure reliable filtration. For higher rates of filtration, the size should be between 0.50 and 0.7mm. A factor of safety is provided by a sand depth of 0.75-0.90m. The minimum depth should not be less than 0.6m (Rox, 1960).

The normal rate of filtration is 80mm/min of filter area. Rates range from 40 to 200 mm/min. The lower rates provide factors of safety but naturally results in need for larger filters.

### **Merits of Rapid Filter**

- (i) Its construction is simple
- (ii) The flowing rate of filtration is generally high, between 40 and 200 mm/min.
- (iii) It is useful in treatment of very turbid river water

### **Demerits of Rapid Sand**

- (i) It is not as efficient as slow sand filter in the removal of pathogenic organism e.g bacteria, and viruses.
- (ii) It is more difficult in maintenances compare to slow sand filter because backwashing is necessary for clearing.

## **MATERIAL & METHODS**

### **Choosing The Most Appropriate Filter**

Having considered different kinds of filters, it was considered that slow sand filtration method of filtering is the most appropriate type for this research work. This can be deduced from the following reasons:

- (i) It has the highest efficient means of removal of pathogenic organisms that is water related diseases.
- (ii) It is the most useful means of removing suspended particles by coagulation and flocculation.
- (iii) It is cheapest in construction.
- (iv) Materials employed are locally gotten.
- (v) Easy to operate and produced by rural house wives and urban dwellers.
- (vi) Maintenance is easier through backwashing method.
- (vii) Materials used are not susceptible to corrosion of chemical processes of water.

This research is incomplete without saying that, though the slow sand filtration has some limitations, but the efficiency surpassed these limitations, this explains why it is said to be the best method of water filtration.

### **Principle Of Slow Sand Filtration**

In slow sand filtration, the removal of impurities from the raw water is brought about by a combination of different processes such as sedimentation, adsorption, straining and; most importantly, biochemical and microbial actions. (Hofkes, 1981)

Filtration is the process whereby water is purified by passing it through beds of sand which contains slime organisms on the sand grain.

Absorption is the removal of suspended solids, together with colloidal and dissolved impurities around the filter bed grains or through physical mass attraction and electrostatic attraction (IRC, 2001).

In electrostatic attraction, particles with opposite electrical charges are absorbed. Quartz sand being negatively charged removes flock of carbonates, iron and aluminum hydroxide as well as cat ion of iron and Manganese. Reversal of overall charges results in removal of positively charged particles such as bacterial, colloidal matter of organic origins, anions of nitrate phosphate and other similar chemical compounds. Addition of activated charcoal to the top layers of the bed is an improvement in the absorption process, lowering of turbidity, increase coagulation; flocculation, purifying acids, recovering solvents and decolorizing of liquids. It must be able to wet easily.

The biochemical activity is useful in meaningful method of reducing morbidity due to enteric disease which is becoming widely acknowledged. Previous studies have established that the entire diseases caused by intestinal bacteria are caused exclusively by the fecal contamination of water and food materials (Ogunola, 1980).

### Design Of Filter Tank

For the actual design of a slow sand filter tank, four dimensions have to be chosen in advances; the depth of the filter bed, the grain size distribution of the filter material, the rate of filtration, and the depth of supernatant water (IRC, 2001)

The filter tank is a cylindrical like sheet of height 27cm by 27cm diameter. It has a cover which can be removed to pour in raw water. The tank is divided into two parts; the upper part helps in spreading raw water over the filter bed. The bottom screen is to hold the filter media at the base of the tank and filtered water passes through it. The bottom screen is 26cm from the base, the distance which serves as reservoir for the filtrate.

### Design Of Filter Media

A mixed filter media of different sizes of sands will be arranged in order below:

- (a) Activated charcoals of roughly 0.01 - 0.02mm
- (b) Fine sand of effective grain size 0.02 - 0.05mm

- (c) Coarse sand of effective grain size 0.02 - 0.05mm.
- (d) Activated carbon.
- (e) Small size gravel of effective grain size 1.5 - 2.5mm.
- (f) Big size gravel of effective grain size 2.6 - 30mm

Arrangement is from top to bottom in order: a→b→c→d→e→f. Total layers is of depth 10.5cm.

### Construction of Tank

A plastic container of equal cross-sectional area was used; the diameter of the container is 27cm. The top part is fitted such that it can be removed for maintenance. The perforated upper part, which contains the filter media, was filled with different grades of sand and gravel. A tap was fitted to the lower part of the filter to receive the filtered water.

### Capacity of the Tank

Following the design model for the filter bed:

Length of bed 10.5cm  
 Diameter of the bed, d, = 27cm  
 Length of water space above beds = 14cm

The cross sectional area of the filter bed can be gotten from  $\Delta A = \pi/4 * d^2$

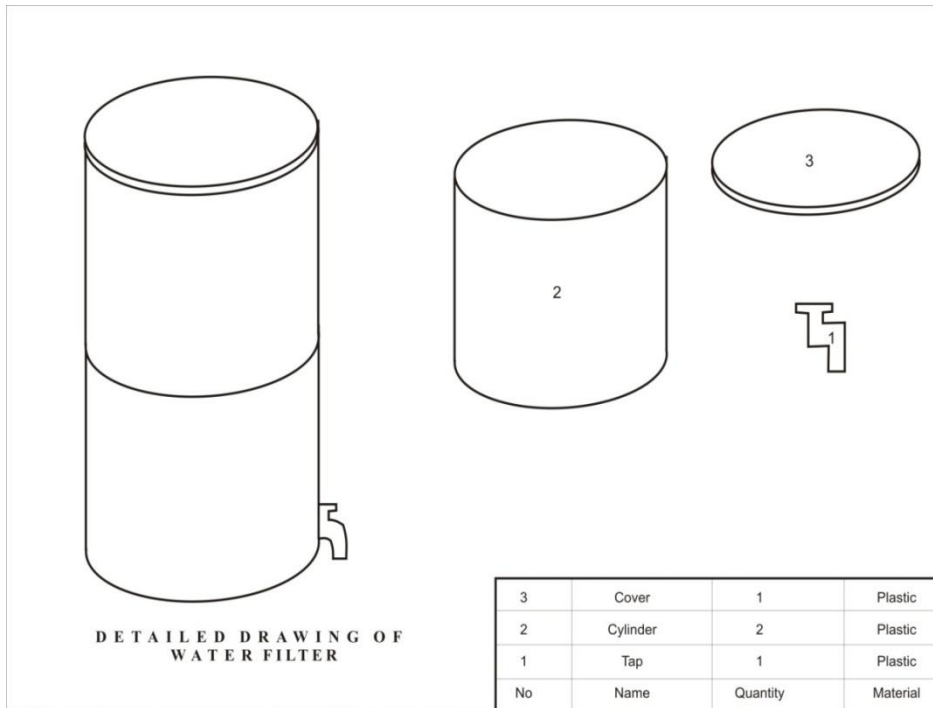
$$\text{Now, area of water flow} = \pi/4 * 27^2 = 572.63\text{cm}^2$$

1 litres	= 1000cm <sup>3</sup>
35 litres	= 35000cm <sup>3</sup>

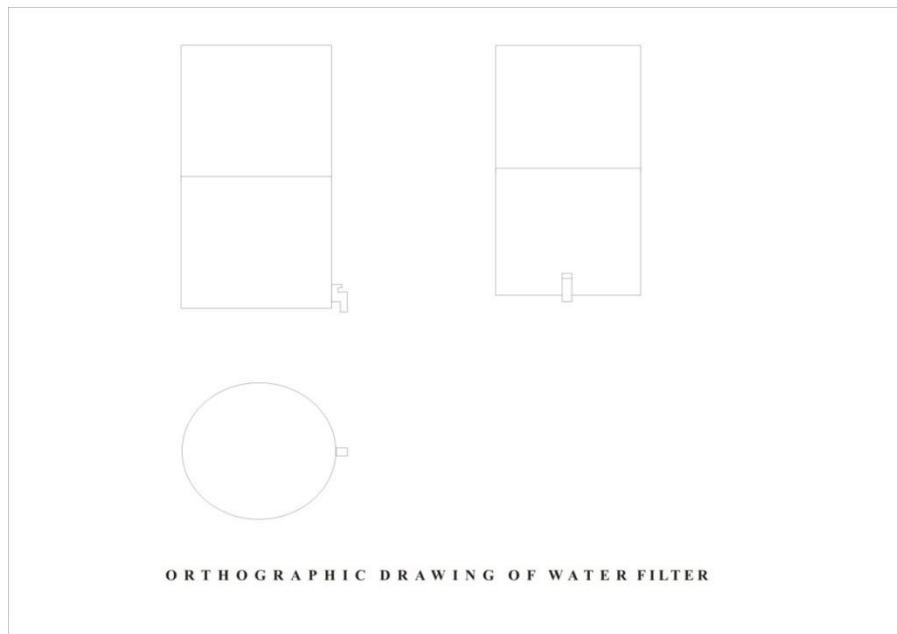
Now, 2 litres flow for 8 minutes

$$\text{Volume of filter water} = 572.63\text{cm}^2 \times 14\text{cm} = 8016.8\text{cm}^3$$

$$\text{Rate of flow} = 8016.8\text{cm}^3 / 8 \text{ minutes} = 1002.1\text{cm}^3/\text{minutes}$$



**Figure 1:** Detailed Drawing of Water Filter.



**Figure 2:** Orthographic Drawing of Water Filter.



**Table 3.1: Bacteriological Analysis of Raw Water.**

	Grain Stain	Spore Staining	Motility	Microscope
<i>E. coli</i>	Nil	Light green	Nil	Light Stain

**Table 3.2: Physical and Chemical Analysis of Raw Water.**

Characteristics	Raw Value
Color	42 mg pt/l
Temperature	30°C
pH	7.9
Total Hardness	84 mg/l
Calcium Hardness	48 mg/l
Calcium ion	21.30 mg/l
Chloride ion	49 mg/l
Magnesium ion	31.20 mg/l
Iron	0.4
Coagulation	60 mg/l
Calcium Carbonate	200 mg/l

**Table 3.3: Treated Water Analysis Results from the Designed Filter.**

Characteristics	Raw Value
Color	8 mg/pt/l
Temperature	30°C
pH	7.3
Total Hardness	73 mg/l
Calcium Hardness	40 mg/l
Calcium ion	15 mg/l
Chloride ion	20.0 mg/l
Magnesium ion	15.23 mg/l
Iron	0.13
Coagulation	20 mg/l
Calcium Carbonate	96 mg/l

**Table 3.4: Bacteriological Analysis.**

	Grain Stain	Spore Staining	Motility	Test	Microscope
<i>E. Coli</i>	Nil	Nil	Nil		Absent

**Maintenance of the Filter**

The bed of the filter was designed for the use of local house wives and the children who require simplicity.

Operating the filter for 18 hours is also efficient and prolongs its life span. In situation that the filter is to be changed, the following steps are useful.

- (A) Top part should be removed and wash.
- (B) Layers of filter bed are removed gently.
- (C) The bottom part is washed.

- (D) New layers of clean sand and gravel are re-arranged and place activated charcoal on the filter bed.

**RESULTS AND DISCUSSIONS****Raw Water Analysis**

Results obtained from the laboratory examination of the raw water are outlined Tables 3.1-3.4.

When the results of the raw water were compared with the standard WHO, given data, the results show that the raw water was not suitable for drinking. There was still need for an improvement

in parameters of water, in addition to an improvement in bacteriological content. For the filter to be efficient, it must be able to bring about treatment that will render the water fit for drinking.

### **Treated Water Analysis**

When the filtrate collected from the designed filter was analyzed, the results (Table 3) were obtained.

### **Operation of the Tank**

Water to be filtered will be poured through the top screen which spreads it on the filter bed. Percolation will be coupled with some active slime ingredients present on the skin of the sands will bring about filtration. After some minutes filtered water will be collected inside the reservoir.

### **FLOW THROUGH POROUS MEDIUM**

As we talk of different flow of liquids and gasses in filtration we have laminar flow conditions at any point in the fluid do not change with respect to time (Massey, 1983):

$$\frac{\delta v}{\delta t} = 0 \quad (1)$$

The French engineer Darcy Henry (1803-58), published result from which he deduced Darcy's law. Darcy's equation is given below:

$$V = \pm C \frac{dp}{dx} \quad (2)$$

where:

V is steady mean velocity ( $m^3m^{-2}h^{-1}$ )

It is a fact that, from laboratory results that an appreciable degree of treatment had tremendously been gotten when the designed filter was used.

1. From the data after treatment, the water becomes unobjectionable using the designed filter.
2. There is a tremendous elimination of bacteria present in the water especially *E. coli*.

3. The pH value after using the filter was okay.
4. Rate of filtration is slower using the designed filter.
5. Absorption through electrostatics is higher and efficient with the filter.

### **Qualities Of Drinking Water**

Potable water should be free from all pathogenic organisms, dissolved poisonous chemical substances of all kinds' objectionable gases and dissolved minerals which impact excessive hardness to water.

It should be colorless and odorless, portability of water can be determined after analyzing various qualities. The analysis includes chemical, bacteriological and microscopic parameter. For unused sources, the physical and chemical parameters could provide adequate information as to portability of water (Holfkes, 2000).

### **Physical Parameters**

The attractiveness of water to human senses is determined by physical parameters. Commonly physical parameters are color, taste, turbidity, total solids, and temperature.

Color is an appeal to sensation which is the true appearance of water sample. The color has no sanitary significance. It must be unobjectionable (Girout, 1999).

Water odor and taste are caused by the presence of excessive and inorganic substance. They are said to be objectionable or unobjectionable as they have no influence to the passage of light through water. Turbidity of water is the measure of interference caused to the passage of light through water. Turbidity is not detrimental to water portability unless the turbid water contains diseases causing organism.

### **Pathogenic Parameters**

Water may still contain large numbers of bacteria and yet still be safe for drinking as long as human pathogens are lacking. Water from stream and lake which contain multitudes of autotrophs and

saprophytic heterotrophs is potable as long as human pathogens are lacking (Ogundana, 1989).

### **Chemical Parameters**

Analyzing chemical parameters have wide application in determining the adequacy of water supplies.

Chemical parameters could be divided into:

- i. Toxic substances
- ii. Substances which affect the acceptability of water.
- iii. Substance which are hazardous to the health.
- iv. Substance which indicate pollution.

Some substances when present in water affects its acceptability as a domestics supply, although it may sometimes not cause health hazards to the people consuming it. There are some that are hazardous to health, such as fluorides and nitrites; excess of fluorides may cause dental flourishes.

### **CONCLUSION**

The following conclusions can be made from this research. The slow sand filtration method is the most suitable among several treatment processes, locally available materials were used in the construction.

Moreso, the depth and capacity of filter bed were increased which made it to be more efficient to an appreciable degree. In conclusion, despites the fact that water gotten from the tap has undergone some treatments, it still needs to be filtered for it to be safe for drinking. An efficient filter tank having more capacity using slow sand filtration method with inclusion of activated charcoal and the filter bed length increased have been produced.

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