EVALUATION OF CARBON AND MEMBRANE WATER FILTERS BASED ON ACCUMULATED TOTAL SUSPENDED SOLIDS

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APPROVAL SHEET

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A water filter is a device that removes impurities from water by means of a fine physical barrier. In most cases, filters are being used to remove TSS (Total Suspended Solids) from water for different purposes. There are many types of water filters but common water filters used at households are called domestic water filters. These filters can be attached directly to a tap, attached to the domestic water supply before the tap, or at the point of use when traveling.

The aim of this study is to measure how much total suspended solids can carbon and membrane water filters filter per volume of water (milligrams per liter).

The weight of each filter was recorded prior to filtering. Then each filter was made to filter one liter of water from the research lab of PSHSWV and were dried afterwards. Then the weight of each filter after drying was recorded. The difference in their weight would represent how much TSS they were able to filter.

The carbon water filters and membrane water filters were able to filter a mean amount of 611.547 milligrams per liter and 127.935 milligrams per liter of total suspended solids, respectively. Each water filter was able to filter a different amount of total suspended solids. The carbon water filters had a greater gain in weight compared to the membrane filters.

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Chapter 1
INTRODUCTION

A. Background of the Study

A water filter is a device that removes impurities from water by means of a fine physical barrier, either by chemical or biological processes. In most cases, filters are being used to remove TSS (Total Suspended Solids) from water for different purposes such as for potability. There are many types of water filters. Each type are used for a particular reason, but common water filters used at households are called domestic water filters, which removes metals such as lead. Water filters can be used for preventative health reasons in the case of harmful substances, to improve the taste, color and odor of drinking water. These filters can be attached directly to a tap, attached to the domestic water supply before the tap, or at the point of use when traveling. All types of water filters provide water that is free of total suspended solids. However, it cannot reassure that the water that is filtered is completely free of impurities and therefore it cannot be an assurance that the water can be safely consumed. The aim of a water filter is to remove impurities from water so that it will be clean and potable. Using a simple water filter in houses can provide you with clean and safe drinking water provided by a simple water filter.

The domestic water supply often contains impurities that make it smell bad. The water may also contain bacteria and other microorganisms that may cause diseases. Consequently, water from natural sources must be removed of all impurities before it can be potable. Filtration is the most common and simplest way to cleanse water of impurities.

B. Statement of the Problem

This study investigated the capacity of two types of common water filters to filter suspended solids.

C. Objectives of the Study

This study aimed to measure how much total suspended solids each water filter can filter per volume of water (milligrams per liter).

D. Research Design

Independent Variables	Dependent Variables
Types of water filter - Carbon - Membrane	Amount of TSS filtered (milligrams/Liter) from water.

E. Significance of the Study

The study aimed to find out which of the two filters can filter more total suspended solids per volume of water, so that people may know which is better. Water should be clean and free of any impurities so that it will be safe to drink, since it is an important part of the daily lives of humans. It must be ensured that it is clean and free of impurities. Using a better type of water filter helps in giving humans cleaner water. This study can benefit everybody.

F. Scope and Delimitation

In this study, only membrane water filters and carbon filters were used. And only one parameter of the water was measured, which is the total suspended solids that were filtered. The water sources were the faucets found in the research laboratories of Philippine Science High School Western Visayas campus.

E. Definition of Terms.

Filtration- is a technique used either to remove impurities from an organic solution or to isolate an organic solid (orgchem.colorado.edu).

In this study, filtration referred to the separation of suspended particulate matter found in the research lab water from the water by means of using water filters.

Carbon water filter- a carbon water filter can be any type of water purification system that uses carbon to remove impurities. Sometimes called point-of-use or domestic drinking water filters. Carbon water filters generally use either granular activated carbon or carbon blocks for purification, both of which remove impurities through a process called adsorption.

In this study, carbon water filter was one of the types of water filters that were used and investigated.

Membrane water filter- the medium in which the fluid stream is passed for purposes of filtration (Parker, 1974).

In this study, membrane water filter was one of the types of water filters that were used and investigated.

Total Suspended Solids (TSS) - defined as the portion of solids that is retained on a filter (Wright, 2009).

In this study, TSS refers to the filtered solids in milligrams per liter filtered from the water using the membrane and carbon water filters.

Water Filter- a type of filter used to remove impurities from the water supply (http://wordnetweb.princeton.edu, 2010)

In this study, water filter refers to the two types of water filters (membrane and carbon water filters) that were used.

Chapter 2

REVIEW OF RELATED LITERATURE

A. Water Filter

A water filter is a type of filter used to remove impurities from the water supply (poets.notredame.ac.jp, 2010). A water filter is a device which removes impurities from water by means of a fine physical barrier. Filters can clean water for irrigation, potability, for aquariums, for swimming pools, and for everyday use. But the main purpose of a water filter is to remove Total suspended solids or TSS from water.

A.1. Types of Water Filters

There are many types of water filters; each one being used for a particular reason. A common water filter is one that is being used at households, also called domestic water filters, which remove chemicals such as chlorine and lead from water. These filters can be attached directly to a tap, attached to the domestic water supply before the tap, or at the point of use when traveling.

A.1.1. Membrane Filter

This filter is one of the most common domestic water filters available. It uses a fine physical membrane. It is commercially available in most hardware stores. It is usually a white, thick membrane attached to a rubberized material so it can be attached to a tap. It utilizes pure filtration to filter water.

A.1.2. Carbon Filter

This filter is not as common as the membrane filter but it is also commercially available in hardware stores. It is usually a black membrane attached to a rubberized material so it can be attached to a tap. It utilizes adsorption in filtering water.

A.2. Water Filtration Process

The water filtration process always removes impurities and bad odor from water. This allows the filtered water to be consumed without any total suspended solids in it. There are many water filtration processes available today. Each one has a unique method in filtering water that makes it different from the rest. But all of them provide clean and safe potable water. Reverse osmosis is the most used and trusted process in the water filtration; it is also the most efficient and is an expensive way to filter water.

B. Total Suspended Solids

B1. Definition of TSS

Total suspended solids are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life. High TSS in a water body can often mean higher concentrations of bacteria, nutrients, pesticides, and metals in the water (Murphy, 2007).

B.2.Measurement of TSS

For clean water sources, the water run through the filter must be greater than one Liter. It depends on the degree of cleanliness. Less than one Liter of water for denser and dirtier samples, and more or less one Liter for water that is not too clean or too dense.

Chapter 3

METHODOLOGY

A. Gathering of Equipment and Materials

A.1. Equipment Needed

- Faucet-mounted water filter and carbon filter (three of each)
- Source of water (PSHSWV Research Lab)
- Faucet connected to the source of water
- Oven
- Digital weighing scale
- Desiccator
- Desiccant
- Forceps

B. Weighing of Water Filters before Filtration

The foam of the membrane filters was removed from its rubber part which is used to attach the filters to the faucet. This was done to prevent the melting of the plastic part of the filter when it was heated for drying. The oven was pre-heated until its temperature was about 103.5°C. When it was already hot inside the oven, the foams were placed inside the oven in order to remove the moisture from them. The filter foams were heated inside the oven for five minutes. The filter foams were removed after five minutes and were transferred to the dessicator using forceps.

The transferring from the oven to the desiccator was done very fast to avoid any moisture from the atmosphere to cling to the filter foams and add to their weight. The filters were placed inside the desiccators for about five minutes for them to cool to room temperature without any moisture from the outside atmosphere absorbed. The filter foams and the carbon filters were weighed using the digital weighing scale for precise and accurate measurement of their weights. Their weights were recorded. To ensure an accurate and precise weighing of the filter foams, repeat the procedure three times until the weights of the filters are almost exactly the same for each filter.

C. **Filtering of Water and Measurement of TSS(Total Suspended Solids)**

The membrane and carbon water filters were attached to the faucet. Then the faucet was opened to let water pass, 1 Liter of water was passed through, this was calculated by placing a 500mL beaker below the filters and when it was filled up twice, then 1 liter of water had passed through. The filters were removed from the faucet, were then placed inside the oven pre-heated at 103 °C for one hour to remove all water from the membrane filters. The carbon filters were exposed to direct sunlight for many hours since the plastic part of these filters would melt inside the oven. The filter foams were then placed inside the dessicator to let the foams cool to room temperature. When not exposed to sunlight, the carbon filters are stored inside the dessicator along with the membrane filters to avoid moisture from the atmosphere.

Then the filters were weighed, and the weight of the TSS was determined by subtracting the weight of the filter prior to doing the filtration process from the weight of the filter after the filtration process. TSS is reported in milligrams per Liter (mg/L) and calculated using this formula:

Let A= weight of the filter + filtered residue (in mg).

B= weight of the filter before letting it filter (in mg).

TSS= (A-B) * 1000 / sample volume (L)

Chapter 4
RESULTS AND DISCUSSION

The study aimed to determine how much Total Suspended Solids each water filter could filter per volume of water. Three replicates of carbon and three replicates of membrane water filters were used. Each filter was pre-weighed before they were made to filter one liter of water. The volume of water from the research lab faucets served as the controlled variable in the study. The membrane filters were dried using the research lab oven. The carbon filters were dried by being exposed to sunlight for long hours. The filters were weighed again so the amount of TSS filtered by each filter could then be calculated.

A. Results

The carbon water filters and membrane water filters were able to filter a mean amount of 611.547 milligrams per liter and 127.935 milligrams per liter of Total Suspended Solids, respectively. (Mean of three replicates for carbon filters; mean of two replicates for the membrane filters because one of the membrane filters was only able to filter 7.63 milligrams per liter of TSS and so it was not included in the computation of the mean.)

B. Discussion

Each water filter was able to filter a different amount of total suspended solids. The carbon water filters had a greater gain in weight compared to the membrane filters. It was observed that although the carbon filters had been exposed to direct sunlight for many hours there were still traces of water droplets inside the plastic container of the carbon filters. Carbon filters use the method called adsorption to filter TSS from water. Carbon surface, that of charcoal which is the primary component of the carbon filter, is hydrophobic, so it repels water. These carbon materials can absorb a wide variety of substances (Nagarajan and Jaiprakashnarian, 2009). While the membrane filters foam utilizes its small pore size to be able to block the common sediments like dirt from water from passing through. The more commonly used membrane filter has a pore size of 5 microns (http://www.thewaterexchange.net/carbon-water-filters.htm, 2010), which is small enough to filter dirt, rust, sand, sediment and silt found in

water. While the carbon filters have pore sizes which range from 0.3 to several thousand nanometers (Nagarajan and Jaiprakashnarian, 2009).

Though the mean gain in weight of the carbon filters is much heavier than that of the membrane filters, they cannot be compared directly. Since the sun drying method was not very effective in removing all the water from the carbon filters. Some of that gain in weight of the carbon filters is actually water and not filtered solids. But for the membrane filters, all water was removed, thus the gain in weight is composed entirely of filtered solids. So it is recommended that for future studies, the same method should be used for both carbon and membrane filters so that all excess water will be properly removed and it would not add to the weight of filtered solids. It is also recommended to use more parameters such as dissolved oxygen and pH in comparing different types of water filters.

CHAPTER 5

SUMMARY, CONCLUSION AND RECOMMENDATIONS

This study determined which type of water filter would filter more Total Suspended Solids.

This study aimed to measure how much total suspended solids each water filter filtered per volume of water; and to compare the values that were gathered after data gathering were compared.

A. Summary of Findings

The carbon water filters and membrane water filters were able to filter a mean amount of 611.547 milligrams per liter and 127.935 milligrams per liter of total suspended solids, respectively.

B. Conclusion

The carbon water filters and membrane water filters were able to filter different amounts of total suspended solids.

C. Recommendations

Based on our findings, the following recommendations are presented:

1.) To use the same drying method for both types of water filters to ensure that all water filters are free of any remaining water after drying.
2.) Other water sources to be used in comparing different types of water filter.
3.) To measure other water parameters in comparing these filters.

APPENDIX A

RAW DATA

A. Weights of Water Filters Before Filtration (grams)

Membrane Water Filter

	Filter 1	Filter 2	Filter 3
Replicate 1	1.9418	2.0700	1.5804
Replicate 2	1.9424	2.0699	1.5801
Replicate 3	1.9423	2.0696	1.5800
Mean Weight	1.9422	2.0698	1.5802

Carbon Water Filter

	Filter 1	Filter 2	Filter 3
Replicate 1	36.1353	33.9148	35.4346
Replicate 2	36.1353	33.9148	35.4346
Replicate 3	36.1354	33.9148	35.4346
Mean Weight	36.1353	33.9148	35.4346

B. Weights of Water Filters After Filtration (grams)

Membrane Water Filter

	Filter 1	Filter 2	Filter 3
Replicate 1	2.0568	2.2125	1.5877
Replicate 2	2.0562	2.2118	1.5874
Replicate 3	2.0552	2.2111	1.5874
Mean Weight	2.0561	2.2118	1.5878

Carbon Water Filter

	Filter 1	Filter 2	Filter 3
Replicate 1	36.8670	34.5759	35.8769
Replicate 2	36.8671	34.5758	35.8766
Replicate 3	36.8668	34.5756	35.8764
Mean Weight	36.8670	34.5758	35.8766

Appendix B

Plate no.1 Membrane filter after filtration.

Plate no.2 Carbon filters being exposed to direct sunlight.

Plate no. 3 Membrane filter being weighed using the digital weighing scale.

Plate no. 4 Membrane filters inside the dessicator.

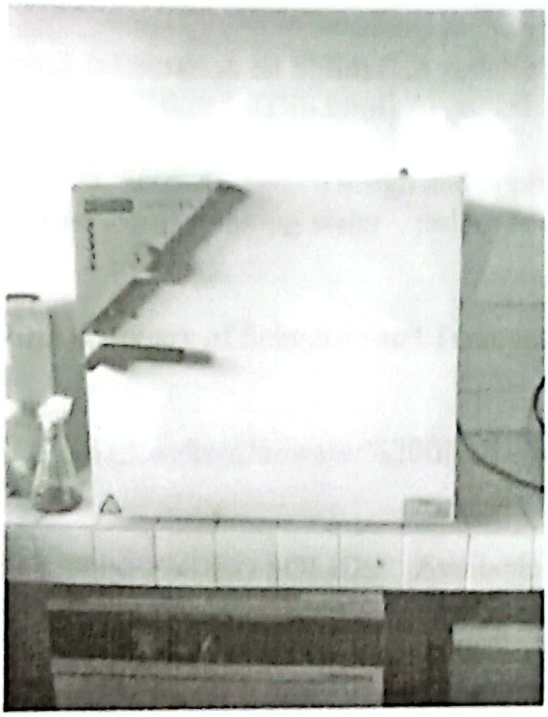

Plate no. 5 Membrane filters oven dried at 109.5 degrees Celsius.

Literature Cited

Murphy, S. 2007 April. "General Information on Solids." Available: [http://bcn.boulder.co.us/basin/data/NEW/info/TSS.html] Accessed: March 1 2010

Nagarajan B., Jaiprakashnarain GB. 2009 August. "Design and application of nano silver based POU appliances for disinfection of drinking water". Indian Journal of Science and Technology 2(8):5-8

Parker, SP. 1974. Mcgraw-Hill Dictionary of Scientific and Technical Terms 5th Edition.

WordNet Search - 3.0 Available: [http://wordnetweb.princeton.edu/perl/webwn?s=water%20filter]. Accessed: March 1 2010

Wright, C. 2009 June. "TOTAL SUSPENDED SOLIDS" Available: [ftp://ftp.dep.state.fl.us/pub/labs/lds/sops/4492.pdf] Accessed: Febuary 27 2010