3D PRINTED WATER FILTERS

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Using 3D Printing To Make Clean Water More Accessible

INTRODUCTION

As of today, over 1.1 billion people suffer from a lack of resources to clean, usable water. **The current areas without clean water are left ravished by various microbiological diseases.** The purpose of our project is to focus on portability and cost efficiency to create a portable, efficient filter system that utilizes the combination of size exclusion and activated carbon filtration.

Examples of contaminated water, a key aspect of apparatus testing

METHODS

Size Exclusion

- S.E filtration utilizes porous, tiny holes as the main source of filtration to separate larger microbes from water.
- Disposes of larger metals and other large contaminants

Activated Carbon

- Activated Carbon has a complex "root" system with adsorptive capabilities
- Slightly positive Van der Wahl forces affix atoms and molecules to the AC (Known as Physical Adsorption)

Method Combination

Combining size exclusion and chemical activation provide more room for any particles that passed through one method, to be disposed of inside the next method.

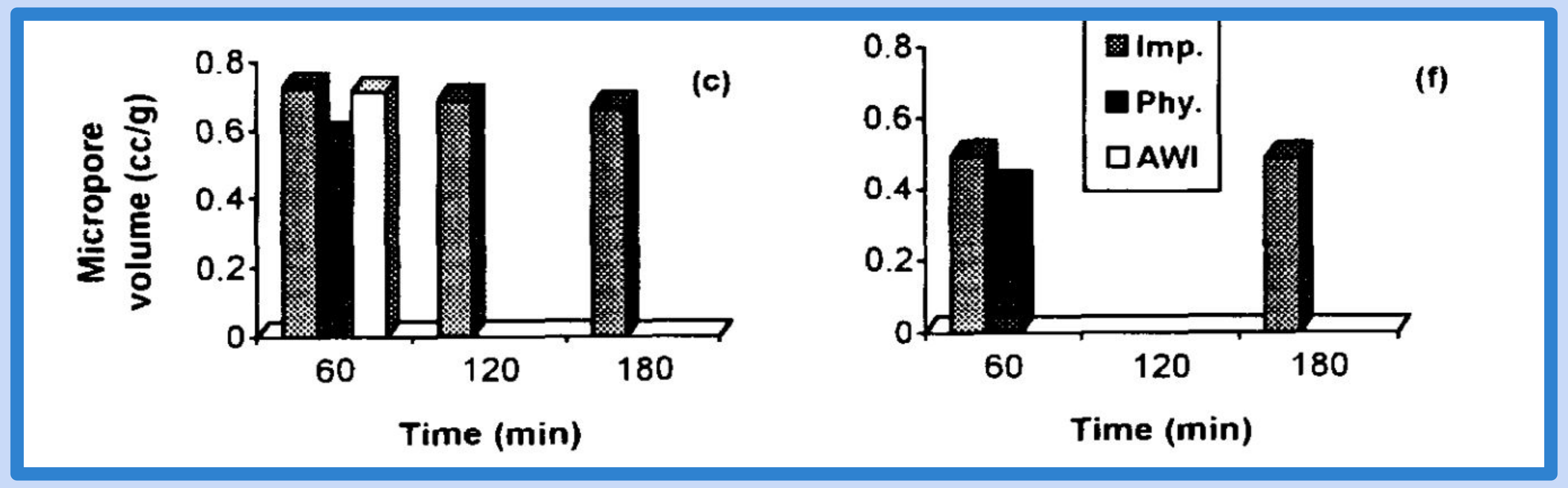
RESULTS

Apparatus

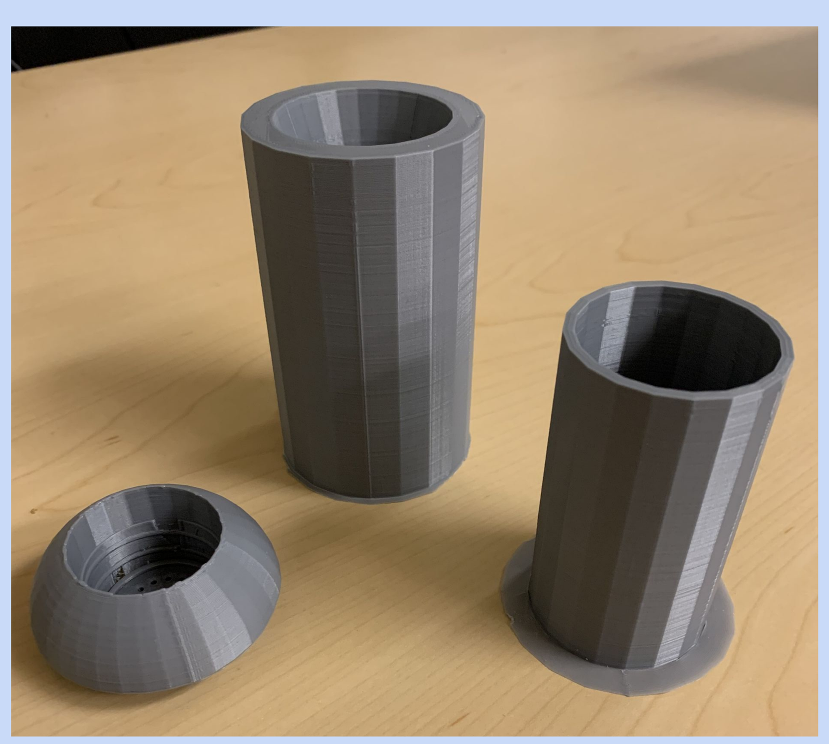
- Decided upon 3-D printed apparatus for cost-efficiency
- Received assistance from upperclassman with experience in 3-D printing
- Through Tinkercad, designed models for our apparatus
- Created various versions, discarding superfluous structures and other blemishes, polishing our filtration system until a final product was coalesced.
  - Most cost-efficient model achieved

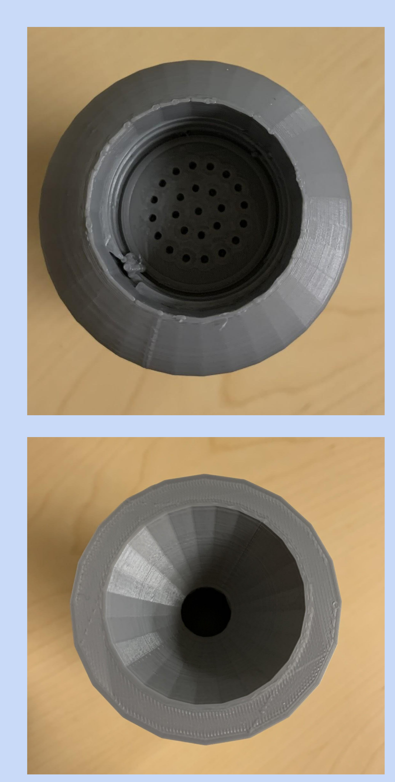
Materials for Activated Carbon

1. Deliberated agricultural byproducts as the carbon precursor that we would utilize.
- Substantiated by venerable scientists as being effective
2. Decided that Potassium Hydroxide (KOH) would be used as solution for making of activated carbon
- Cost effective (~$3.50/lb) in comparison with Zinc Chloride (~$100/lb)



This is a study on activated carbon produced by macadamia shells. Microporosity shows effectiveness of activated carbon. The left shows zinc chloride and right shows potassium hydroxide. KOH holds up well and is the better choice for cost efficiency (Ahmadpour 1997).





In the Fall semester of 2019, we successfully 3D printed our Apparatus through a hierarchical "Russian Doll" concept with three distinct components: the top posses the initial size exclusion porous holes that then connects to the middle layer which contains the pocket holding activated carbon. This all then sits in the last component that has one last size exclusion film that excretes the contents out the filter

Our primary material ABS plastic, a basic plastic used in most 3D printers, for the printing of the filter apparatus costs about $1.15-1.25 per pound. Our apparatus had a weight after printing of about 12 ounces, which means that the price of production is about $0.86 per unit. In consideration of the cost efficient production of a novel filter apparatus, our unit has the ability to be both portable and cost efficient.

CONCLUSIONS

WHAT DOES THIS ACCOMPLISH?

Our completed project would allow for cost efficient production using 3D printer technology and remain both portable and efficient in removing pollutants such as Lead and bacteria

EFFICIENCY

The approach of utilizing two separate forms of filtration within one compact and cost efficient apparatus would allow for minimal material to be used for production and provides a reasonable alternative for successful filtration of polluted water which was accomplished through a lightweight printed model

WHERE TO NEXT?

Furthering the testing of the efficiency of the apparatus against a variety of different metals and bacteria such as *E. coli* would provide further data and observations that could be used to improve and expand the potential of our apparatus through UV Vis Absorption Spectroscopy. The examination Heavy metals and *E. coli* concentration would be the next crucial stage in determining the efficiency of our completed apparatus

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