My Research Question was how does the grade of sand impact the pH level in a natural Earth Filter?

Purpose: I was trying to figure out the best grade of sand in a natural earth filter because I wanted to see how I could optimize the filter as it is cheap and I also did it because I was interested in Natural Earth Filtering. My hypothesis was If I decrease the grade of sand, then the acidity level will be closer to neutral because the lower grades of sand cover more surface area than higher grades of sand.

What Has Been Done: There have been many things done similar to my topic, more specifically filtering. We use filters for getting clean water to drink and use in our lives. Natural filtering is more recently being used for taking out metal ions and other non-drinkable items out of the water.

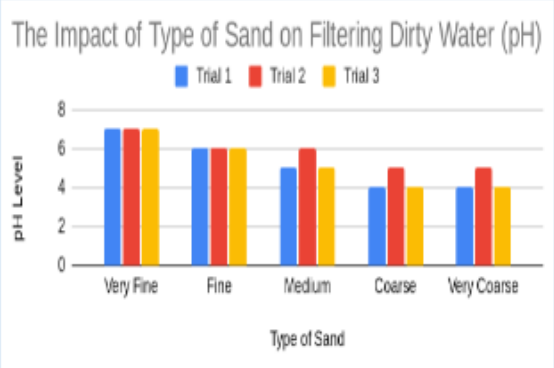
Background Research: The basics of a sand filter is that as the water passes through the layers of the filter, its quality ends up improving. It also ends up improving because as the water goes through the sand it filters out the bigger particles, letting only the clean sand through. These particles include things like dirt and contaminants that are big (ex Chlorine, Chloramines Bacteria and microorganisms). This process happens for thousands of layers of sand throughout the filter.

Methodology: First I had to create the filters. The order from top to bottom went cotton, charcoal, sand, and then pebbles. I put all of these items in a 2 liter bottle, but the bottom was cut out so I could add in the materials. After I made a stand for the filters. The “legs” were made up of 2 bricks and a piece of wood on top. The wood had 5 holes in it to keep the filters. I also put fitted styrofoam on top of the wood so it would stand up better. After I kept a plastic cup underneath the filter and put in the water. I rigged the water with vinegar so the pH started at 4. I then waited for 20 seconds after the water started to drip before I pulled the cups out and measure pH. I continued repeated these steps for all 3 trials.

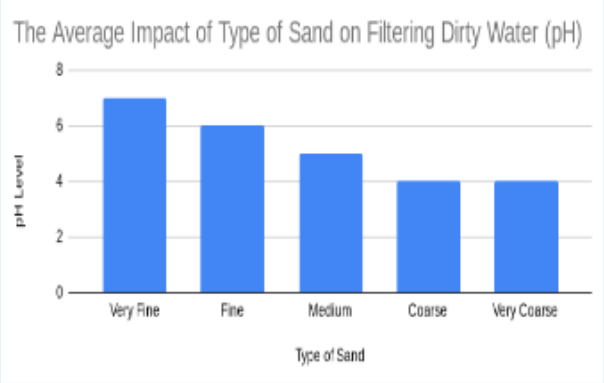
Variables: My independent variable was my grade of sand put in and my dependent variable was the pH level. For the whole experiment I needed to keep the Filter Design, Quantities of items the same (Besides Sand) and I need to keep the pH scale, and reading consistent. I did run 3 control runs with tap water that started with a pH of 7. After running the water through the filter, the water maintained a pH of 7. I did it for all five of the filters and the result stayed consistent.

Data: I collected my data used pH as my measurement. I used a pH kit off of Amazon which came with pH sticks and a pH scale. To take the pH I would dip the pH stick in the water for 10 seconds before taking it out. After I would compare the color change to the scale itself. It has 4 color metrics which makes it easy to see what the pH really was. I originally decided to keep my information/data in a Google Spreadsheet so I could easily make graphs. It was also convenient to make observations throughout the experiment.

Data Analysis & Results



This Graph Shows the Full Trial Data



This Graph Shows Just Averages from my data set

The Impact of Type of Sand on Filtering Dirty water (pH)				
Type of Sand	Trial 1	Trial 2	Trial 3	Average
Very Fine	7	7	7	7
Fine	6	6	6	6
Medium	5	6	5	5
Coarse	4	5	4	4
Very Coarse	4	5	4	4

This Data Table shows my results in a numerical format, including the average of ph at the far right column.

Context with Literature: My Results are supported by the other literature in the field of filtering. It is backed up by data, and my experiment supports that same data as well. This basically means that to optimize and earth filter, you have to use the finest levels of sand available. My results are address my research question how does the grade of sand impact the pH level in a natural Earth Filter because I was trying to find the best size of sand for an earth filter. I could then use my data and easily see that the best size of sand is smaller/finer sand.

Conclusion: My hypothesis was “If I use decrease the grade of sand then the acidity level will be closer to neutral because the smaller grades of sand have more surface area than bigger grades of sands with the same volume. My data supported my hypothesis because the lowest grade of sand, the very fine sand had an average pH of 7 and as the grade of sand increased, the acidity level increased. The reason that I got the results I got was because the small sand particles cover a higher surface area for the same amount of volume compared to sand with higher particle sizes. I also observed that the very fine sand had the slowest time to filter completely and because of this the water spend more time in contact with the sand, making it filter bette. If I did this experiment again I would change the amount of sand for each filter using the very fine sand to see what changes it makes.

Application: I could think of a few ways we could apply this filter. For one, it would help people who are in a tough survival situation. At least having knowledge of the filter could make you gather resources and create the filter. But the idea I think is better for this filter is for places where there is low funding. In places like these, they wouldn’t the money and access to clean. Drinkable water. However because the filter is so cheap, it could help these nations in getting better water access.