Lab - Purifying Water

Purpose: To separate the impurities from a sample of river water using various techniques, producing as much "clean" water as possible, and then determine the purity of the final sample.

Procedure

1) Obtain approximately 100 ml of river water, provided by your teacher. Measure its volume precisely with a graduated cylinder. Record the value (with units) in your data table.
2) Examine the properties of your sample: color, odor, clarity and presence of solids. Record your observations in the "Before Treatment" section of your data table.

Destruction of Microorganisms

Natural water samples will always contain some microorganisms. Although some of these microorganisms are not harmful, the majority can cause humans to become sick. Chlorination is the process of adding chlorine to break the cell membrane of the microorganisms.

3) Add 8 drops of chlorine bleach to the water sample. Swirl/stir the water with the bleach. Allow the water sample to sit for five minutes for process to work.
4) Observe the properties of the remaining water and measure the volume of the water. Record your observations and data. Save the water for the next procedure.

Flocculation and Settling

Flocculation is the process of adding a material to water that attaches to colloidal particles in the water. These colloidal particles are light and typically will not settle to the bottom over time. However, by adding alum, the colloidal particles will floc (stick) together and then settle to the bottom.

5) Place a piece of weighing paper on the scale and zero/tare the scale. Add 1.00 grams of alum to the weighing paper.
6) Pour water into a beaker. Add the alum to the water sample. Stir for 2 minutes.
7) Allow water sample to settle. This process can sometimes take up to 15 minutes. When sediment has settled, decant the liquid. Carefully, without disturbing the sediment at the bottom, pour the water sample out of the beaker into another container. Stop pouring when the water is all out, or before the sediment begins to pour out.
8) Dispose of the sediment as instructed by your teacher. Observe the properties of the remaining water and measure the volume of the water. Record your observations and data. Save the water for the next procedure.

Sand Filtration

A sand filter traps solid impurities that are too large to fit between sand grains.

9) Using a straightened paper clip, poke multiple small holes in the bottom of the paper cup.
10) Add 2 cm gravel to the cup, then 4 cm of sand, and then 1 more cm of gravel on top of the sand. (The bottom gravel prevents the sand from washing through the holes. The top gravel keeps the sand from churning up when the sample is poured in.) Run some tap water through the cup to wet the sand and gravel, so no water from your sample is lost wetting the sand and gravel.
11) Gently pour the sample to be filtered into the cup. Catch the filtrate (filtered water) in a beaker as it drains through.
12) Dispose of the used sand and gravel according to your teacher's instructions. Do not pour sand or gravel into the sink.
13) Observe the properties of the remaining water and measure the volume of the water. Record your observations and data. Save the water for the next procedure.

Charcoal Adsorption/Filtration

Charcoal adsorbs (attracts and holds on its surface) many substances that could give water a bad taste, odor or cloudy appearance.

14) Fold a piece of filter paper as shown by your instructor. Place the folded filter paper in a funnel. Wet the filter paper slightly so it adheres to the funnel. Place funnel into a 250 ml Erlenmeyer flask.
15) Place one scoop of charcoal in a 125 ml Erlenmeyer flask.
16) Pour the water sample into the flask with the charcoal. Swirl vigorously. The gently pour the liquid through the filter paper. Keep the liquid level below the top of the filter paper – no liquid should flow between the filter paper and the funnel.
17) Observe the properties of the remaining water and measure the volume of the water. Record your observations and data. Save your "purified" water sample for the post-lab activities.

Data Table

	Color	Clarity	Odor	Presence of Solids	Volume
Before Treatment					
After Chlorination					
After Flocculation & Settling					
After Sand Filtration					
After Charcoal Adsorption					

Post Lab Activities

1) Test the electrical conductivity of the purified water samples. This test checks for the presence of dissolved, electrically charged particles in the water. Compare the results of the electrical conductivity test of your purified water to that of tap water and distilled water. Was there any difference between the purified water and the other water samples?

2) Test the purified water sample for colloidal particles floating in the water. The Tyndall effect will display any microscopic particles floating in the water sample. Run a pen laser through the side of a beaker and into the water sample. If the laser can be seen through the water, then small microscopic particles are floating in the water. If the laser is not seen running through the water, then the water does not contain these particles. Compare the results of the Tyndall effect test of your purified water to that of tap water and distilled water. Was there any difference between the purified water and the other water samples?

3) Look at a of your water sample through a microscope. Place several drops of your water on a microscope slide. Then, place a cover slip on the slide. Examine the water sample through the microscope, adjusting to the highest setting. Determine whether there are any live microorganisms in the water sample.

Calculations

Complete the following calculations. Record your work and answers in your notebook.

1) What percent of the original river water sample did you recover as "clean" water?

2) What volume of liquid did you lose during purification?

3) What percent of your original river water sample was lost during purification?

Data Analysis:

Collect the data for the percent recovered from each of the other lab groups.

1) Construct a histogram showing the percent recovery obtained by all lab groups in your class. To do so, organize the data in equal subdivisions such as 90 – 99 %, 80 – 89%, and so on. Count the number of data points in each subdivision. The use the number to represent the height of the appropriate bar on your histogram. Insert the histogram below:

2a) What was the largest percent recovery obtained by a lab group in your class?

b) What is the lowest percent recovery?

c) What is the range of this data?

3) What was the average percent recovery for your class?

4) Another important measure is the median, or middle value of a set of data? What is the median percent recovery for your class?

Questions

1) Is your purified water sample "pure" water? How do you know?

2) Compare your water purification experiences and data with another group. Were your experiences similar? How should the success of the teams be judged?

3) How would you improve the water purification procedures you followed so that a higher percent of purified water could be recovered?

4a) Estimate the total time you spent purifying the water sample.

b) In your view, did that time investment result in a large enough sample of sufficiently purified water? Explain.

c) If you spent twice the amount of time in purifying your sample, would the extra time give you a higher quality water? How about 10 times more time? Explain.

Conclusion