NAME PERIOD DATE

WATER TREATMENT

Driving Question

What are some processes used in water treatment, and what contaminants are they effective in removing from water?

Materials and Equipment

- pH sensor
- Conductivity sensor
- Turbidity sensor
- Beaker (4), 150-mL
- Beaker (5), 50-mL
- Activated charcoal, 2 g
- Paper napkins (9), dinner, white, smooth
- Lint-free lab tissue
- Soda bottle, empty, 500-mL
- Distilled Water, 500 mL
- Wash bottle
- "Wastewater" sample, 500 mL
- Waste container
- pH calibration buffers, pH 4 and 10
- Stirring rod

Background

Water treatment concerns facing agriculture are complex due to competing demands for water resources. This includes; irrigation, navigable waters, recreation, wildlife, municipal uses all of which may have different management regulations and practices. Water sources include, ground and surface water, treated water from cities and industry. Major issues such as wastewater storage on swine and diary as well as vegetable/fruit wastewater recycling are being carefully analyzed. Wastewater management is key in being success in today's Agriculture operations. Treatment technologies that are used in the Agricultural industry are: filtration, biological treatment, aeration, mixing, reverse osmosis and disinfection.

Procedure

1. Put on your safety goggles.

2. Pour 100 mL of the a well stirred "wastewater" sample into each of four 150-mL beakers.

3. Label the beakers as follows:

    - Beaker 1 "Untreated"
    - Beaker 2 "Activated Charcoal"
    - Beaker 3 "Sedimentation"
    - Beaker 4 "Agglutination"

4. Set the beaker labeled "Sedimentation" aside for approximately 30 minutes. Why is it important to ensure that the beaker labeled "Sedimentation" is not touched or moved during these 30 minutes?

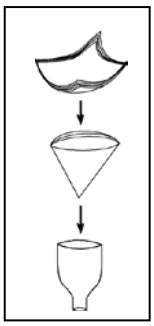
5. Put 2 mL of the 4% swimming pool clarifier solution in the beaker labeled "Agglutination" and use the stirring rod to thoroughly mix the pool clarifier into the wastewater.

6. Predict how each water treatment method will cause a change in the parameters of the wastewater. Use words such as increase, decrease, lighter, darker, clearer, cloudier, stronger smell or less odor. Record your predictions in Table 1.

Table 1 : Predictions

Water treatment method	**pH**	**Conductivity**	**Turbidity**	**Odor**	**Appearance (color, transparency)**
Filtration					
Activated charcoal filtration					
Agglutination					
Agglutination followed by filtration					
Sedimentation					

7. Make a filter as follows:



   a. Cut off the top half of a 500-mL soda bottle to use as a funnel.

   b. Fold a paper towel in half, and then fold it in half again. Separate the layers to make a funnel-shaped filter.

   c. Stack 3 paper napkins together and shape them into a shallow bowl. Tuck these into the paper funnel and push the entire membrane construction into the funnel, forming a bowl to hold the filtrate.

8. Open the AGR02 Water Treatment.spklab file.

   - If the lab file is not available create an experiment file to display the pH, conductivity, and turbidity readings in a table or digits displays.

9. Connect to the turbidity, pH, and conductivity sensors to your device.

10. Calibrate the pH and turbidity sensors using the directions that came with the equipment or go to https://www.youtube.com/pascoscientific to view calibration methods.

11. Examine the beaker labeled “untreated” and record its odor, color and general appearance in Table 2.

12. Place the pH and conductivity sensors in the wastewater labeled “Untreated” and allow the readings to stabilize and then record the values in Table 2. Remove the sensors from the sample and thoroughly clean them with distilled water.

13. Determine the turbidity of the wastewater and record the turbidity in Table 2.

    NOTE: turbidity sampling procedure in the product manual or see the demonstration, https://www.youtube.com/watch?v=BAyY0UrJrLI

14. Test the effect of filtration on the untreated wastewater sample.

    a. Arrange the filter you created earlier over a 50-mL beaker

    b. Pour 10 mL of the wastewater from the beaker labeled “Untreated” into the filter, inside the paper napkin "bowl".

    c. Filter the wastewater until you have 15 to 20 mL of filtrate in the 50-mL beaker.

15. Repeat the observations and measurements in steps 11-13 and record them in Table 2. for the filtered water.

16. Discard the paper towels and napkins from the filter and clean the bottle so that another filter can be made. Clean the beaker, test tube and sensors by thoroughly rinsing them with distilled water.

17. Make another filter as described in step 7 and then;

    a. Measure and add 1 gram of activated charcoal to 100mL of water and stir.

    b. Pour this slurry into the filter.

    c. After that slurry has drained, slowly pour another 100mL of water into the filter.

    d. The paper filter should be coated with a layer of activated charcoal. If the water is not clear add 100ml of water.

18. Arrange the activated charcoal filter over a 50mL beaker.

    a. Pour 10 mL of wastewater into the beaker labeled “Activated Charcoal” into the filter paper napkin bowl.

    b. Filter the waste water until you have 30mL of filtrate in the 50mL beaker.

    c. Pour the wastewater from the “Activated Charcoal” beaker into the filter in 10 mL portions stop at 20mL.

19. Repeat the observations and measurements in steps 11-13 and record them in Table 2. for the filtered with activated charcoal water.

20. What effects did adding activated charcoal to membrane filtration have on the results of the filtration?

21. Test the effect of agglutination by returning to the beaker labeled “Agglutination” that you have been stirring over the last 30 minutes. Repeat the observations and measurements in steps 11-13 and record them in Table 2. for the Agglutination.

22. Make another paper membrane filter as described in step 7, then filter the “Agglutination” sample and Repeat the observations and measurements in steps 11-13 and record them in Table 2. for the Filtered Agglutination.

30. Test the effect of sedimentation by returning to the beaker labeled “Sedimentation” that has sat undisturbed for approximately 30 minutes.

31. Use a pipette to transfer a 30-mL sample from the top of the beaker into the test tube, being careful not to disturb the sediment. Repeat the observations and measurements in steps 11-13 and record them in Table 2. for the Sedimentation.

Optional STEM Inquiry

Design a filter that will treat the wastewater using two or more of the techniques that you have tested and collect data to compare them with other filters your classmates have assembled. Record the data in table 2.

Data Summary

Table 2: Water treatment process results

Water treatment	pH	Conductivity (µS/cm)	Turbidity (NTU)	Odor	Appearance
Untreated "wastewater"					
Filtration					
Activated charcoal filtration					
Agglutination					
Agglutination followed by filtration					
Sedimentation					
My Designed Treatment System					

Analysis

Compare the data obtained from your designed water treatment system with the data collected in Part One by filling in “My Designed Treatment System” data and the "Best Individual Test System" in Table 4. Share the data with your classmates. Use Table 4.

Table 4: Designed water treatment system results

Water Treatment Data Summary	pH	Conductivity (µS/cm)	Turbidity (NTU)	Odor	Appearance
My Designed Treatment System					
Best Individual Test System (Optional)					
Best Designed System in the Class (Optional)					

Questions

1. What was the effect of filtration using a simple paper filter?
2. What was the effect of treatment with the activated charcoal filter?
3. What was the effect of treatment with an agglutinating agent? What was the effect of agglutination followed by filtration?
4. What was the effect of treatment with sedimentation?
5. Which treatment method worked best for odors?
6. Which treatment method worked best for lowering turbidity? Which was least effective?
7. What was the effect of treatment on pH?
8. Compare the results obtained with your custom-designed filtration process to those from the individual filter media. Be sure to make comparisons regarding the rate of filtration. (Why might this be important?)
9. Based on your results and those of your classmates, which combination of treatment processes produced the best results? Explain, using your data to support.
10. Suppose you had to design a system to treat for human consumption a large amount of the type of wastewater used in this activity. What treatment methods would you include? Explain.?