



Acid Rain

Problem

What is the normal range of pH for rainwater? Can soil neutralize the rainwater?

Introduction

At 25°C a pH of 7.00 indicates a solution is neutral. Very few substances are neutral (pure water is, but pure water is not found in nature). Rainwater is naturally acidic due to dissolved carbon dioxide from the air.

In this lab you will determine a range of pH values of rainwater in your area. You will also determine the effect of soil on the acidity of rainwater.

Prelaboratory Assignment

- ✓ Read the entire experiment before you begin.
- ✓ Answer the Prelaboratory Question.
 1. Provide calculations for all dilutions to be made in this lab.

Materials

Apparatus

Safety goggles
Lab apron
Buret
Buret clamp
Ring stand
250 mL beaker
500 mL beaker
Filter paper
Collecting bottle
Funnels (2)

Reagents

Rainwater
Soil
Calcium carbonate
NaOH (0.100 M)
Phenolphthalein

Safety



1. Safety goggles and a lab apron must be worn at all times in the laboratory.
2. If you come in contact with any solution, wash the contacted area thoroughly.

Procedure

Part 1 Determining the pH of Rainwater

1. Obtain a sample of rainwater by placing a funnel in the mouth of a collecting bottle and placing the bottle and funnel outside while it is raining.
2. Make 200 mL of $1.00 \times 10^{-3} M$ NaOH from the 0.100 M NaOH provided by your teacher.

3. Titrate 15-20 mL of rainwater with $1.00 \times 10^{-3} M$ NaOH. Use phenolphthalein indicator. Titrations were introduced in Chapter 15. Record the volume of NaOH.
4. If the titration requires less than about 5 mL of the $1.00 \times 10^{-3} M$ NaOH, dilute the NaOH solution so the titration of 15-20 mL rainwater will require about 20 mL of aqueous NaOH (you will need to calculate the exact concentration of the NaOH).
5. Titrate the new sample with the new NaOH and record the volume of NaOH.

Part 2 Determining the Effect of Soil

1. Obtain a soil sample from home or outside your school. Collect about 200 mL of soil in a 500 mL beaker.
2. Place the soil in a funnel fitted with filter paper.
3. Pour the rainwater through the soil and collect it into a 250 mL beaker
4. Collect the rainwater that has been poured through soil (filter again if there is still soil in the sample).
5. Titrate 15-20 mL of rainwater with NaOH of the same concentration used in part I (either step 3, or step 5 if you need to perform step 5). Use phenolphthalein indicator. Record the volume of NaOH.

Part 3 Increasing Soil Capacity

1. Crush and powder 5 grams of calcium carbonate. Mix with the same amount of soil as in Part II. (mix until homogeneous)
2. Place the soil in a filter.
3. Pour the rainwater through the soil and collect in a 250 mL beaker.
4. Collect the rainwater that has been poured through the soil (filter again if there is still soil in the sample).
5. Titrate 15-20 mL of this rainwater with NaOH of the same concentration in Part I (either step 3, or step 5 if you need to perform step 5). Use phenolphthalein indicator. Record the volume of NaOH.

Cleaning Up



1. Empty the buret and rinse thoroughly. Clamp it back in the buret clamp upside down to drain.
2. Dispose of all chemicals as instructed by your teacher.
3. Wash your hands thoroughly before leaving the laboratory.

Analysis and Conclusions

Complete the **Analysis and Conclusions** section for this experiment either on your Report Sheet or in your lab report as directed by your teacher.

Part 1

1. What is the number of moles of NaOH used in the titration?
2. What is the number of moles of acid in your rainwater sample?
3. Determine the concentration of H^+ in your rainwater sample.
4. Calculate the pH of your rainwater sample
5. Collect class data.

Parts 2 and 3

6. Determine the pH of rainwater after it flows through untreated soil.
7. Determine the pH of rainwater after it flows through soil mixed with calcium carbonate.
8. What is the normal range of pH for rainwater? Use class data.
9. Does the untreated soil neutralize the rainwater?
10. Does soil mixed with calcium carbonate neutralize the rainwater?
11. Which soil (untreated or mixed with calcium carbonate) neutralized the rainwater better?

Something Extra

1. Does boiling affect the pH of rainwater? Boil and cool rainwater and test it. Explain your results.
2. Does potting soil have an effect on the pH of rainwater? Test it and compare your results to the soil you gathered.