

How Strong is Your Cleaner?

Introduction

When some solid cleaning powders are put in water, they dissolve and form bases that can neutralize acids. The stronger the base, the better it reacts to dirt and oil while cleaning. As you have already seen, when phenolphthalein indicator is added to a base, it turns pink. When an acid is added to a base, they neutralize each other, making phenolphthalein turn colorless again.



In this lab, you will compare the strength of several brands of cleaners using titration. You will dissolve a solid cleaner in water and then neutralize it using vinegar, which is a dilute solution of acetic acid. Phenolphthalein is pink in basic solution ($\text{pH} > 8.2$) and colorless in acidic solution ($\text{pH} < 8.2$), so when we have added just enough acid to the cleaner, it will turn colorless and stay that way, and we will know that we have neutralized the cleaner completely.

Materials

acetic acid, 5% (vinegar) [CH_3COOH]
distilled water
phenolphthalein indicator
sodium bicarbonate (baking soda) [NaHCO_3]

sodium borate (borax) [$\text{Na}_2[\text{B}_4\text{O}_5(\text{OH})_4] \cdot 8\text{H}_2\text{O}$]
sodium carbonate (washing soda) [Na_2CO_3]
trisodium phosphate (TSP) [Na_3PO_4]

Equipment

beakers (2), 250- or 400-mL
buret
buret clamp
electronic balance

Erlenmeyer flasks (2), 125- or 250-mL
graduated cylinder, 100-mL
ring stand
stirring rod

Safety Considerations

- Trisodium phosphate is moderately toxic; you must wear goggles for the entire lab.
- Sometimes chemicals from previous labs still remain in glassware and on other lab equipment; wash all lab equipment before and after performing this lab.
- Wash your hands thoroughly after completing this lab.

Procedure

1. Set up a buret using a ring stand and buret clamp.
2. Fill the buret with vinegar to the "0 mL" mark. If you overfill the buret, you may open the nozzle and pour the excess into your waste beaker.
3. Obtain 5.0 g of solid cleaner. Record the brand of cleaner in the Data Table.
4. Pour the solid cleaner into a beaker and add 95 mL of distilled water. This will prepare a 5% solution of the cleaner you chose.
5. Add 4-5 drops of phenolphthalein indicator to the cleaner solution and mix thoroughly. Note the color of the indicator in the mixture.
6. Pour 50.0 mL of your cleaning solution into each of your two flasks.
7. Using the buret, slowly add vinegar to the Erlenmeyer flask and swirl gently until a complete color change occurs and remains for 10-15 seconds. This is the end-point; record the volume of vinegar used in the Data Table under "Trial #1".
8. Repeat the titration using the other flask of cleaning solution. Record the volume of vinegar used in the Data Table under "Trial #2".

9. Rinse all flasks and beakers thoroughly in the sink.
10. Repeat steps #2-9 until you have tested all four kinds of cleaners.

Clean-up

1. Dispose of any leftover solutions in the sink; dry, extra cleaning powder should be placed in the trash.
2. Clean all used lab equipment with soap, water and a test tube brush.
3. Return all equipment to its proper location.
4. Wipe down your lab area and wash your hands before leaving the lab.

Data Table

Cleaner	Volume of vinegar used Trial #1	Volume of vinegar used Trial #2

Questions

1. Which brand of cleaner required the **most** vinegar in order to be neutralized? Which brand of cleaner required the **least** vinegar?

2. Did you notice any difference between the results of Trials #1 and #2? Why or why not?

3. How do you think this lab is related to the Making Soap lab? (*think about what bases do to fats like grease and oil!*)

4. List one way you could change this lab and describe how your results might be different.
