

3: Analysis of a Commercial Antacid (Experiment)

Introduction

In this experiment, you will use the standard acid and standard base that you prepared earlier to analyze the neutralization capacity of a commercial antacid.

Safety Precautions:

Be especially careful when using acid or base solutions as they can cause severe burns. All waste solutions may be disposed of by rinsing them down the drain.

Procedure

1. Obtain an unknown antacid sample from the front counter. Using a mortar and pestle, grind the sample to a fine powder. To efficiently do this experiment you will first do a quick titration to get a rough idea of the neutralization capacity of your unknown. Your class will then be divided into three groups. You will be assigned to conduct three runs of accurate titrations on one of the three commercial antacid brands provided. You will share your data with the rest of the class after the experiment. Meanwhile, data on the other two antacids will be made available for you after everyone is done with their calculations.
2. Into a 300 mL beaker weigh, by difference, one sample of the unknown (weigh to ± 0.1 mg) within the mass range of 0.1600 to 0.2500 gram. Add 50 mL of your standard 0.1 M HCl solution using your 25 mL pipet. Swirl the beaker to wet the samples thoroughly with acid, and allow them to stand for about 15 minutes. Then set the hot plate to very low, around 20% heating intensity, with occasional swirling (with tongs!), for about 20 minutes. At the end of the heating period, add three drops of phenolphthalein indicator. If the contents turn pink, add another 25.00 mL aliquot of standard acid and continue heating for about 15 minutes. Antacid tablets often contain water-insoluble binders so your solution may look cloudy. This should not adversely affect your results.

Question 3.1

Write a balanced chemical equation for this reaction.

3. Remove the beaker from the heat source and cool it to room temperature using a dishpan of water, being careful not to contaminate the contents of the beaker. Just prior to titrating your sample, add about 5 drops of phenolphthalein indicator to the solution and titrate to the visual endpoint with your standard 0.1 M NaOH solution. Wash down the sides of the beaker with deionized water using your water bottle to be sure all the reactants are in the solution. The indicator will change colors from colorless to pink. This is the same as the first endpoint in the carbonate titration. For reasons of accuracy, it is important that the volume of NaOH required to be between 25 mL and 45 mL. If your volume is not within this range, you will have to adjust the mass of antacid sample for the next analyses. Using the information gained from this rough titration you are now ready to make an accurate determination.
4. Into three separate 300 mL Erlenmeyer flasks weigh, by difference, triplicate samples of the tablets of the unknown use the same weight as you used in the preliminary run (weigh to ± 0.1 mg). To each flask add 50.00 mL of your standard 0.1 M HCl solution using your calibrated 25 mL pipet. Swirl the flask to wet the samples thoroughly with acid, and allow them to stand for about 15 minutes. Then heat the flasks, with occasional swirling (tongs!), for about 20 minutes. At the end of the heating period, add three drops of phenolphthalein indicator to each flask.
5. Cool the flasks to room temperature under running tap water, being careful not to contaminate the contents. Titrate your sample, to the visual endpoint with your standard 0.1 M NaOH solution. The repeat titrations will go much faster once the endpoint is found.

Calculations

1. Report the effective mass percent of OH^- or CO_3^{2-} for the antacid you measured. For remote students, just calculate it for CO_3^{2-} . The effective mass is the mass of OH^- or CO_3^{2-} that would be in the unknown if that were the only base present. The antacid samples actually contain a variety of bases.
2. Report the average percent by mass of OH^- or CO_3^{2-} in your unknown along with a standard deviation, a 95% confidence limit, and a relative deviation. This can easily be done on a computer. or remote students, just calculate it for CO_3^{2-} .

Question 3.2

Do you have more confidence in your analysis of the KHP or of the antacid? Why?

Question 3.3

Stomach acid is about 0.12 M HCl. Does your unknown consume 47 times its own weight of 0.12 M HCl solution? Show by calculation.

Clean-up. After the experiment is completed, drain any remaining solution from the burette. Rinse each burette with deionized water. Then, fill the burette with deionized water and carefully place it in the burette rack.

Post-lab exercise. The data from your laboratory section will be collected. From this information, determine the average effective mass percent OH^- or CO_3^{2-} for each type of tablet along with the standard deviation, 95% confidence limit, and a relative deviation. Based on this data, what product would you recommend to the consumer? Explain.

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