

**DETERMINATION OF PERCENT BY MASS OF  $\text{NaHCO}_3$  IN ALKA-SELTZER**

**Purpose:** To determine the percent by mass of  $\text{NaHCO}_3$  in Alka-Seltzer.

**Background Information:** Alka Seltzer is an over-the-counter antacid and pain relief medication that is taken by dissolving it in water before ingesting. The effervescent tablet contains aspirin (acetylsalicylic acid), citric acid, and  $\text{NaHCO}_3$ . As soon as the tablet dissolves in water, an acid-base reaction involving the sodium bicarbonate takes place. Carbon dioxide is produced from the acid-base reaction, causing bubbling. Since the carbon dioxide is released into the atmosphere, there is a loss of total mass. From this mass loss (which equals mass of  $\text{CO}_2$  produced) the amount of  $\text{NaHCO}_3$  which reacted can be calculated. According to the balanced chemical equation, one mole of  $\text{NaHCO}_3$  produces one mole of  $\text{CO}_2$ . Therefore the moles of  $\text{CO}_2$  produced = moles of  $\text{NaHCO}_3$  reacted. Using this knowledge and the molar mass of both compounds, the mass of  $\text{NaHCO}_3$  can be calculated.

**Pre-Lab Questions:** Read the whole lab procedure and then answer the following questions.

1. Which ingredient in the Alka-Seltzer would neutralize excess acid in the stomach?
2. When Alka-Seltzer is dissolved in water, which reactants must be in excess? Explain.
3. Write the balanced net ionic equation for the reaction that occurs when the Alka- Seltzer is dissolved in water.
4. How will you determine the amount of carbon-dioxide generated in the reaction?
5. What is the purpose of the vinegar in this experiment?

**Materials:**

8 Alka-Seltzer tablets	balance
250 mL beaker	graduated cylinder

**Lab Safety:** Wear goggles at all times. Never eat anything in lab. Solutions may be poured down the drain with plenty of water.

**Procedure:**

1. Add 35 mL of water to the beaker.
2. Take the total mass of the beaker and water.
3. Take the mass of an Alka-Seltzer tablet.
4. Drop the tablet into the cup and swirl to ensure the tablet completely dissolves.
5. Take the mass of the beaker and its contents once the bubbling stops.
6. Rinse the beaker then repeat the experiment using 5mL of vinegar + 30 mL water, 10 mL vinegar + 25 mL water, 15 mL vinegar + 20 mL water, 20 mL vinegar + 15 mL water, 25 mL vinegar + 10 mL water, 30 mL vinegar + 5 mL water, and 35 mL vinegar instead of 35 mL water.

**Data and Observations:**

Your data should include the following measurements as well as any observations that you made. Please ensure you use the correct number of significant figures in all measurements and calculations (the mL shown below do NOT have the correct number of digits)

Experiment #	1	2	3	4	5	6	7	8
Volume of Vinegar (mL)	0	5	10	15	20	25	30	35
Volume Water (mL)	35	30	25	20	15	10	5	0
Mass beaker + water (g)								
Mass tablet (g)								
Mass after reaction								
Mass loss (= mass CO <sub>2</sub> )								
Calculated mass NaHCO <sub>3</sub> reacted								
Calculated % by mass of NaHCO <sub>3</sub> in the tablet.								

**Calculations:** Clearly show your work for all calculations.

For each experiment:

1. Calculate the mass of CO<sub>2</sub>.
2. Calculate the moles of CO<sub>2</sub> produced, moles NaHCO<sub>3</sub>, and mass of NaHCO<sub>3</sub> that reacted.
3. Calculate the percent by mass of NaHCO<sub>3</sub> in the tablet.

**Graph:** Plot the percent by mass of NaHCO<sub>3</sub> in each tablet versus the volume of vinegar used.

**Conclusions:**

**Discussion:**

**Experimental Sources of Error:**

**Post-Lab Questions:**

1. How was the NaHCO<sub>3</sub> completely neutralized in the experiment?
2. At which point in your graph (volume vinegar used) does the NaHCO<sub>3</sub> become the limiting reactant? Explain your reasoning.
3. How would the calculated % of NaHCO<sub>3</sub> be affected if some of the CO<sub>2</sub> remained dissolved in the solution? Explain.
4. How would the calculated % of NaHCO<sub>3</sub> be affected if some of the water evaporated during the experiment? Explain.
5. Vinegar is a solution of approximately 5% acetic acid and 95% water. How would your results have been affected if you used a brand with 4.5% acetic acid in water instead?