

SCI10-CR4

Investigate the rates of chemical reactions, including factors that affect the rate.

Indicators for this outcome:

- (b) Predict how factors such as temperature of the reactant(s), concentration of the reactant(s), surface area of the reactant(s) and the presence or absence of catalysts or inhibitors might affect the rate of a chemical reaction.
- (e) Compile and organize data, using appropriate formats and data treatments to facilitate interpretation of data related to rates of chemical reactions.
- (f) Interpret patterns and trends in data and infer or calculate linear and nonlinear relationships among variables related to chemical reaction rates.
- (i) Value the processes for drawing conclusions in science.
- (k) Work co-operatively with team members to develop and carry out a plan and troubleshoot problems as they arise when investigating rates of reactions.

Introduction

Alka-Seltzer is a common medicine that is used in North America to treat upset stomachs and headaches. It has 3 ingredients:

- Acetylsalicylic acid (Aspirin)
- Citric acid (acid with the anion $\text{C}_6\text{H}_5\text{O}_7^{3-}$)
- Sodium bicarbonate

When the tablet (pill) is put in water, the **citric acid** reacts with the **sodium bicarbonate**. This creates sodium citrate, carbon dioxide, and water. The Acetylsalicylic acid then mixes and relieves pain and upset stomachs.

Purpose

In this lab, effect of temperature, surface area and concentration on the rate of a chemical reaction will be investigated.

Materials

- Alka-Seltzer tablets
- Film canister with lid
- Graduated cylinder
- Stopwatch
- Scoopula
- Hot Plate
- Paper towel
- Water

Hypothesis

Create a hypothesis for each of the following effects on the reaction rate:

1. How will **hot water** affect the rate of the reaction?
2. How will **cold water** affect the rate of reaction?
3. How will **crushing** the tablet affect the rate of reaction?
4. How will using a **larger sized tablet** (greater concentration) affect the rate of reaction?

Procedure

Part 1: Establishing a **control** (This is what you will compare the rest of your results against):

1. Place 20.0mL of room temperature water in your film canister.
2. Break an Alka-Seltzer tablet into two (2) pieces.
3. Place one half in the film canister with water and QUICKLY put the lid on.
4. Using a stopwatch, time how many seconds it takes from the time the tablet was dropped in the water to when the cap pops off
5. Record your time in your data table
6. Clean up the mess

Part 2: Testing the effect of **temperature** on the rate of a chemical reaction:

7. Test the effect of cold temperature by REPEATING STEPS 1-6 with cold water (use ice to cool your water)
8. Test the effect of hot temperature by REPEATING STEPS 1-6 with hot water (use the hot plate to get warm water)

Part 3: Testing the effect of **surface area** on the rate of a chemical reaction:

9. Obtain half of an Alka-Seltzer tablet and crush it into a fine powder
10. REPEAT STEPS 1-6 with the crushed half tablet

Part 4: Testing the effect of **concentration** on the rate of a chemical reaction:

11. Obtain a full Alka-Seltzer tablet
12. REPEAT STEPS 1-6 with a full sized tablet

Data Table

Trial	Time	Class Average
Room temp. water, $\frac{1}{2}$ tablet		
Cold water, $\frac{1}{2}$ tablet		
Hot water, $\frac{1}{2}$ tablet		
Room temp. water, $\frac{1}{2}$ crushed tablet		
Room temp. water, 1 full tablet		

Analysis Questions

1. Name 2 physical changes you witnessed in this lab.
2. Explain how you know the Alka-Seltzer in water is a chemical change.
3. When Alka-Seltzer dissolves in water, the following reaction occurs:

The citric acid and sodium bicarbonate in the Alka-Seltzer tablet react to produce water, carbon dioxide gas and sodium citrate.

Write a WORD EQUATION and a BALANCED EQUATION for the reaction.

4. What combination of all the factors in this lab would create the FASTEST reaction?
5. What combination of all the factors in this lab would create the SLOWEST reaction?
6. List 2 constants in this experiment.

Conclusion

Summarize (in a paragraph, containing at least six sentences) what you learned about the rates of chemical reactions in this lab experience?