AP Chemistry 30 Lab 2: Lifetime of a Marble Statue

Essential Skills

- Collect data to determine the rate of a reaction
- Determine how rate-determining factors affect the rate of reaction

Context

Many historic buildings and monuments are made from limestone or marble. Limestone and marble are minerals that contain large amounts of calcium carbonate, $CaCO_3$. Since the industrial revolution, air pollutants (chiefly in the form of oxides of sulfur and nitrogen) have been absorbed into the atmosphere, leading to the production of rainwater that has become significantly more acidic. This "acid rain" reacts with limestone buildings, eroding the stone and causing disfigurement and damage.

Lab Outline

- To conduct the lab, you may work in groups of three; for this lab, you may hand in one lab report for your group. All students are expected to contribute the final report.
- Please refer to the lab report guidelines and rubric to ensure you meet all requirements.
- On the first day of the lab, you will complete the pre-lab questions, design your procedure and begin work on your background information. On the second day of the lab, you will conduct your experiment and collect your data.

Pre-Lab

Please answer the questions in your lab report under pre-lab questions, on a separate piece of paper.

1. Write the full equation, including states, for the reaction between hydrochloric acid and calcium carbonate.
2. In this lab, you must use less than 1.00 g of calcium carbonate for each trial.
    a. Use stoichiometry to determine the minimum volume of 1.0 mol/L hydrochloric acid needed to full react 1.00 g of calcium carbonate.
    b. Why should you add more acid than the volume you determined in Part A?

Background Information

Explain how the rate of a reaction changes as the reaction proceeds, using a graph or diagram. Identify how the rate of a reaction can be changed, based on your understanding of collision theory. Cite all sources, including course notes.

Materials

You will use solid marble chips and hydrochloric acid. Any other materials you use must be listed in this section.

Procedure

For your procedure, you will investigate how one factor changes the rate of reaction (temperature, concentration, surface area). You must determine how you will conduct your experiment, including how you will measure your reaction rate. Remember that your procedure should be controlled, so that only one variable is changing, and you should be able to finish your lab within one class period. You should have three trials with the independent variable different in each.

Results

1. Use Excel to make a graph that shows the reaction rate for each of your three trials.
2. Very briefly indicate the trend between your trials, WITHOUT EXPLAINING.

Discussion

Explain your results. Include information from your background information to back up your findings. Identify sources of error in your data collection. Recommend improvements that you would implement if you were going to do the experiment again or do further testing; how could you get better data?

Post-Lab Questions

1. This lab is investigating how marble structures disintegrate over time. Hypothesize a strategy for preserving them from the effects of acid precipitation.
2. Why would the results from this activity vary from the actual rate of reaction between a marble structure and acid precipitation?