The Chemical Properties of Marble

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Topic

Chemical properties of calcium carbonate

Time

45 minutes

Safety

Adult supervision is required. Please click on the safety icon to view the safety precautions. Do not use concentrated hydrochloric acid.

Materials

marble or limestone
glass tubing
powdered marble (calcium carbonate)
rubber tubing
bromothymol blue (indicator for carbon dioxide)
dilute hydrochloric acid or vinegar
one-hole stopper
phenolphthalein (indicator for a base)
eyedropper
two 50-mL beakers
spatula
Erlenmeyer flask
piece of white paper

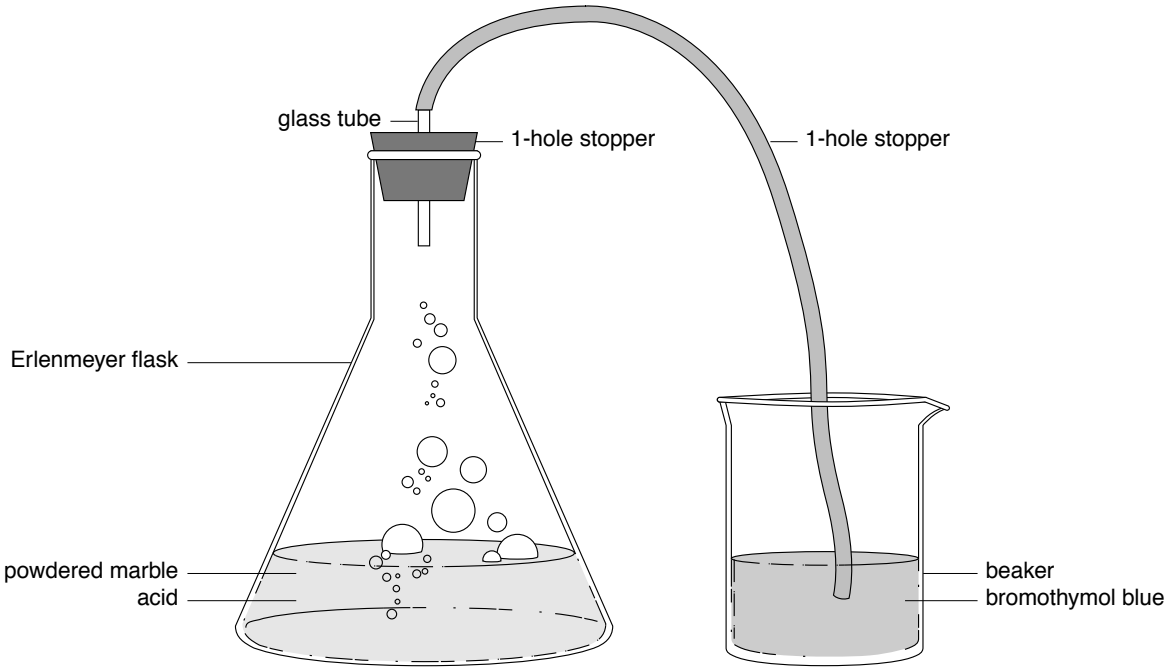
Procedure

Part A

1. Using an eyedropper, place several drops of dilute hydrochloric acid or vinegar on a piece of marble or limestone.
2. Record results.

Part B

1. Study the illustration to see how to set up this test. Connect the stopper, glass tube, and rubber tubing so that they are ready for placement. Pour the bromothymol blue into a beaker.
2. Place two or three spatulas of powdered marble (calcium carbonate) in an Erlenmeyer flask.
3. Add 50 mL weak (1.0 *N*) hydrochloric acid or vinegar.
4. Immediately cap the flask with the stopper, to which you have attached rubber tubing.
5. Place the other end of the rubber tubing into the beaker of bromothymol blue. Place a piece of paper beneath the beaker.
6. Observe the bromothymol blue, and record your observations.



PART C

1. Mix a spatula of powdered marble and 50 mL water in a 250-mL beaker.
2. Add several drops of phenolphthalein to 50 mL water in a separate beaker. Then add this solution to the calcium carbonate solution in the 250-mL beaker. Observe.
3. Add 5 to 10 drops weak hydrochloric acid or vinegar to the solution.
4. Observe. Record your observations.
5. What happens when acid is added to marble or limestone?
6. What gas is given off when acid is added to powdered marble (calcium carbonate)?
7. What happened when you added phenolphthalein to the calcium carbonate solution? Is calcium carbonate acidic, basic, or neutral?
8. What effect would you predict that acid rain might have on marble statues, buildings, and grave markers?

What's Going On

A gas is produced when an acid is added to marble or limestone. Carbon dioxide is produced when an acid is added to calcium carbonate. The calcium carbonate solution turns pink when phenolphthalein is added, indicating basicity. When hydrochloric acid is added, the solution reacts by fuming clear (yellowish). This shows that calcium carbonate is a base and that it neutralizes an acid. Since an acid chemically reacts with marble (calcium carbonate), acid rain is causing marble statues, buildings, and grave markers to dissolve rapidly.

Connections

For centuries, artists and architects have used marble (calcium carbonate) to create buildings and statues, many of which are now seriously affected by chemical pollution. In this exercise, you studied the chemical properties of marble and saw why it is damaged by pollution.

Safety Precautions

READ AND COPY BEFORE STARTING ANY EXPERIMENT

Experimental science can be dangerous. Events can happen very quickly while you are performing an experiment. Things can spill, break, even catch fire. Basic safety procedures help prevent serious accidents. Be sure to follow additional safety precautions and adult supervision requirements for each experiment. If you are working in a lab or in the field, do not work alone.

This book assumes that you will read the safety precautions that follow, as well as those at the start of each experiment you perform, and that you will *remember* them. These precautions will not always be repeated in the instructions for the procedures. It is up to you to use good judgment and pay attention when performing potentially dangerous procedures. Just because the book does not always say "be careful with hot liquids" or "don't cut yourself with the knife" does not mean that you should be careless when simmering water or stripping an electrical wire. It *does* mean that when you see a special note to be careful, it is extremely important that you pay attention to it. If you ever have a question about whether a procedure or material is dangerous, stop to find out for sure that it is safe before continuing the experiment. To avoid accidents, always pay close attention to your work, take your time, and practice the general safety procedures listed below.

PREPARE

- Clear all surfaces before beginning work.
- Read through the whole experiment before you start.
- Identify hazardous procedures and anticipate dangers.

PROTECT YOURSELF

- Follow all directions step by step; do only one procedure at a time.
- Locate exits, fire blanket and extinguisher, master gas and electricity shut-offs, eyewash, and first-aid kit.
- Make sure that there is adequate ventilation.
- Do not horseplay.
- Wear an apron and goggles.
- Do not wear contact lenses, open shoes, and loose clothing; do not wear your hair loose.
- Keep floor and work space neat, clean, and dry.
- Clean up spills immediately.
- Never eat, drink, or smoke in the laboratory or near the work space.
- Do not taste any substances tested unless expressly permitted to do so by a science teacher in charge.

USE EQUIPMENT WITH CARE

- Set up apparatus far from the edge of the desk.
- Use knives and other sharp or pointed instruments with caution; always cut away from yourself and others.
- Pull plugs, not cords, when inserting and removing electrical plugs.
- Don't use your mouth to pipette; use a suction bulb.
- Clean glassware before and after use.
- Check glassware for scratches, cracks, and sharp edges.
- Clean up broken glassware immediately.

- Do not use reflected sunlight to illuminate your microscope.
- Do not touch metal conductors.
- Use only low-voltage and low-current materials.
- Be careful when using stepstools, chairs, and ladders.

USING CHEMICALS

- Never taste or inhale chemicals.
- Label all bottles and apparatus containing chemicals.
- Read all labels carefully.
- Avoid chemical contact with skin and eyes (wear goggles, apron, and gloves).
- Do not touch chemical solutions.
- Wash hands before and after using solutions.
- Wipe up spills thoroughly.

HEATING INSTRUCTIONS

- Use goggles, apron, and gloves when boiling liquids.
- Keep your face away from test tubes and beakers.
- Never leave heating apparatus unattended.
- Use safety tongs and heat-resistant mittens.
- Turn off hot plates, bunsen burners, and gas when you are done.
- Keep flammable substances away from heat.
- Have a fire extinguisher on hand.

WORKING WITH MICROORGANISMS

- Assume that all microorganisms are infectious; handle them with care.
- Sterilize all equipment being used to handle microorganisms.

GOING ON FIELD TRIPS

- Do not go on a field trip by yourself.
- Tell a responsible adult where you are going, and maintain that route.
- Know the area and its potential hazards, such as poisonous plants, deep water, and rapids.
- Dress for terrain and weather conditions (prepare for exposure to sun as well as to cold).
- Bring along a first-aid kit.
- Do not drink water or eat plants found in the wild.
- Use the buddy system; do not experiment outdoors alone.

FINISHING UP

- Thoroughly clean your work area and glassware.
- Be careful not to return chemicals or contaminated reagents to the wrong containers.
- Don't dispose of materials in the sink unless instructed to do so.
- Wash your hands thoroughly.
- Clean up all residue, and containerize it for proper disposal.
- Dispose of all chemicals according to local, state, and federal laws.

BE SAFETY-CONSCIOUS AT ALL TIMES