Lab: Specific Heats of Metals

Safety Precautions

Always wear safety goggles and a lab apron to protect your eyes and clothing. If you get a chemical in your eyes, immediately flush the chemical out at the eyewash station while calling to your teacher. Know the location of the emergency lab shower and the eyewash station and the procedure for using them.

Do not touch any chemicals. If you get a chemical on your skin or clothing, wash the chemical off at the sink while calling to your teacher. Make sure you carefully read the labels and follow the precautions on all containers of chemicals that you use. If there are no precautions stated on the label, ask your teacher what precautions you should follow. Do not taste any chemicals or items used in the laboratory. Never return leftovers to their original containers; take only small amounts to avoid wasting supplies.

Call your teacher in the event of a spill. Spills should be cleaned up promptly, according to your teacher’s directions.

Open flame alert. Exercise extreme caution with open flames. Be sure to tie back long hair and secure loose clothing. Students wearing acrylic nails should not perform this lab activity.

Thermal Safety. Hot plates or other sources of heat will be used. Assume all glassware is hot even if it looks cool. Use appropriate tongs or heat resistant gloves.

Never put broken glass in a regular waste container. Broken glass should be disposed of properly according to your teacher’s instructions.

Introduction

On a sunny day, the water in a swimming pool may warm up a degree or two while the concrete around the pool may become too hot to walk on in your bare feet. This may seem strange because both the concrete and the water are being heated by the same source—the sun. This evidence suggests it takes more heat to raise the temperature of some substances than others. This, in fact, is true: The amount of heat that is required to raise the temperature of 1 g of a substance by 1°C is the called the specific heat capacity, or simply the specific heat, of that substance. Water, for example, has a specific heat of 1.0 cal/(g • °C). This value is high in comparison with the specific heats for other materials, such as concrete. In this investigation, you will use a simple calorimeter and your knowledge of the specific heat of water to determine the specific heat of lead.

Procedure

1. Heat 250 mL of water in a 400-mL beaker until it is boiling gently.

2. While the water is heating, use an electronic balance to determine and record the exact mass of the metal sample to the beaker.

3. CAREFULLY transfer the metal sample to the boiling water bath using tongs OR string if your block has a hook. BE CAREFUL NOT TO DROP THE METAL SAMPLE TO AVOID CRACKING THE BEAKER. Leave the metal sample in the boiling water bath for at least 10 minutes.

4. While the metal is heating, measure 100 mL of water in a graduated cylinder. Pour the water into a plastic-foam cup and place the cup in a 250-mL beaker for support, as shown in the figure below.
5. Using a thermometer or temperature probe, measure and record the temperature of the water in the plastic-foam cup and of the water in the boiling bath.

6. Remove the metal sample using tongs (or the string) and quickly place it into the water-filled, plastic-foam cup and immediately cover with a foam plate cover. Place a thermometer or temperature probe and a glass stirring rod into the cup. Use the stirring rod to gently stir the lead shot. Do not stir with the thermometer. Note the temperature frequently and record the maximum temperature reached.

7. Pour the water off and return the metal sample to your teacher.

8. Repeat the same procedure to determine the specific heat of the remaining metal samples.

Cleanup and Disposal

Clean all apparatus and your lab station. Return equipment to its proper place. Dispose of all chemicals and waste as directed by your teacher. Wash your hands thoroughly after all work is finished and before you leave the lab.