Experiment 5 – Physical and Chemical Changes

Matter is an important term in physical science, including chemistry. It is defined as anything that has mass and occupies space. Cars, people, grains of rice, water, and air are matter – they have mass and they occupy space. Time, on the other hand, has neither mass nor volume, so it is not composed of matter. A sample of matter can be categorized as either a **pure substance** or a **mixture** of different substances. Pure substances can be further classified as either **elements** or **compounds**.

A **physical** change or process is usually one that involves a change of state. Melting and dissolving are examples of physical changes. In a physical change, the substance retains its identity – no chemical reactions are involved. In contrast, a **chemical** change is one in which substances change into different substances (with different formulas). Examples of chemical changes are iron rusting or gasoline burning.

Mixtures can be separated into pure substances using physical methods. Compounds can be broken down into elements using chemical reactions. In this experiment we will observe chemical and physical changes of elements, compounds, and mixtures. In this experiment, it is important to make careful observations of chemical and physical properties and changes. Observation and thorough examination of processes are fundamental to our basic knowledge of chemistry.

Safety Precautions:

- Wear your safety goggles.

Waste Disposal:

- The waste from Part 1 will be handled by your instructor.
- The waste from Parts 2 and 3 is harmless. Waste charcoal and sodium chloride can be placed in the regular garbage cans. Waste salt water can be poured down the sink.

Procedure

Part 1 – Elements and Compounds (Instructor demonstration)

1. Sodium is an element. Observe sodium as some of its properties are demonstrated by you lab instructor. (Under no circumstances should you handle sodium yourself!)
2. List as many properties of sodium as you can. Which of these are physical properties? Which are chemical properties?
3. The following procedure will be demonstrated by your lab instructor. First observe the elements iron and sulfur. Describe their appearance (physical state, color, and so on.) How does each one behave toward a magnet? Are these properties physical or chemical?
4. The instructor will add some iron to the sulfur and then test the effect of the magnet on it. Does it seem that iron and sulfur have formed a compound or only a mixture?
5. Next, iron and sulfur will be heated together. Describe the appearance of the solid after heating. How does it behave toward a magnet? Does a compound seem to have formed? Does a chemical change seem to have taken place, or only a physical change?

Part 2 – Separation of a Mixture

6. Using a spatula, pick up some salt and transfer it to a test tube. Add some water to the tube to fill it about 1/3 of the way. Shake the tube side-to-side to mix it. Does the salt dissolve in the water?
7. Repeat step 6, using charcoal instead of salt. Does the charcoal dissolve in the water?
8. Get a piece of weighing paper and put 2 or 3 spatula tipfuls of (dry) salt and about the same amount of charcoal on the paper. Mix them together with the spatula.
9. Get an empty 100-mL or 150-mL beaker and tare it on one of the digital balances. (Put the beaker on the balance and then press the button so that the balance reads 0.00 g when the beaker is on the balance.) Transfer the salt/charcoal mixture to the beaker and record the mass of the mixture.
10. Fill the beaker about halfway with deionized water and stir the contents with a stirring rod. Describe what happens.
11. Get your evaporating dish from your lab locker. Make an identifying mark on it (so you can tell it apart from other students' evaporating dishes), and weigh it on one of the digital balances.
12. Weigh a piece of filter paper, and then filter the mixture from step 10 using a funnel lined with your filter paper. Your laboratory instructor will demonstrate this procedure. Collect the filtrate (the liquid that passes through the filter paper) in your weighed evaporating dish. When the filtration is complete, rinse out the beaker with water from a wash bottle, and add the rinsings to the funnel.
13. When all of the liquid has drained through to the evaporating dish, heat the evaporating dish on a hot plate to evaporate the water.
14. Set the filter paper aside to dry or put it in the drying oven (ask your instructor which method he/she prefers). When the filter paper is completely dry, cool it and weigh it and its contents. Subtract to get the mass of just the contents of the filter paper.
15. When all of the water has evaporated from the evaporating dish (and when the residue looks dry), cool it and weigh it. Subtract to calculate the mass of salt recovered.
16. Calculate the mass percent of charcoal in the original mixture of salt and charcoal.
17. Calculate the percentage recovery of the salt after the separation process.

Part 3 – Melting and Dissolving

Different substances melt at different temperatures, some at lower and others at a very high temperature. Salt can be melted, but an extremely high temperature is required. Wax has a lower melting point and can be easily changed to liquid by ordinary heating in the lab.

18. Obtain a 400-mL beaker and fill it about 1/3 full of tap water. Place a watch glass on top of the beaker. On the watch glass, as far apart as possible, place some wax shavings and some salt.
19. Set up a ring stand with an iron ring and a piece of wire gauze over a Bunsen burner. Set the beaker on the wire gauze and start heating the water with the Burner until a change occurs in at least one of the solids on the watch glass. Describe any change occurring to the solids. Does either material melt? Explain.
20. Add a small amount of salt to some water in a beaker. Stir until you cannot see the salt anymore. Has the salt melted or has it dissolved?

Questions

1. Briefly describe a method by which you could separate the components of a mixture of sand and sugar from each other. Describe how you could determine what percent of the total mass of the mixture is sand.
2. Many people say that sugar "melts" when you stir it into tea. What is the correct way to describe what happens to the sugar?
3. Which of the following are physical changes? Are any of them chemical changes? Explain.
   a. Dissolving a solid in a liquid to form a solution
   b. Separation of two or more substances by filtration
   c. Evaporation of a liquid
   d. Melting a substance
   e. The reaction of sodium with water