Experiment 3

A Little Sand and A Pinch of Salt

OUTCOMES

After completing this experiment, the student should be able to:

1. separate a soluble substance from an insoluble substance.
2. determine the mass percentages of components in a mixture.
3. describe several different physical separation techniques.

DISCUSSION

In this experiment, you will be given a mixture of sodium chloride and silicon dioxide, commonly known as . . . well, you can figure this one out. Mixtures are comprised of two or more substances that are not chemically bonded with each other and, therefore, may be separated based on their physical properties. Your job will be to separate the mixture and determine the mass percentage of each component in the mixture.

Physical separation techniques may be as simple as those used in a coffee maker. In a coffee maker, hot water is used to extract the water-soluble components in the ground coffee mixture. A filter is used to prevent the insoluble materials from passing through. On the other hand, the techniques may be as complex as those employed in large petroleum refineries, where the crude petroleum is separated into its numerous components. Much of the separation is performed through the distillation of the petroleum, where the components are separated based on different boiling points.

Common physical processes utilized in the chemistry laboratory include filtration, extraction, distillation, evaporation, decanting, and chromatography. What do each of these processes involve? Which ones will be used in this experiment? By the time the experiments in this manual are completed, you will have experienced each of these techniques, except distillation. Ask your instructor to demonstrate a distillation apparatus. There may be a large still used for making deionized water in the laboratory. Do you know where it is?

PROCEDURE

SAFETY GOGGLES MUST BE WORN WHENEVER ANYTHING IS HEATED OVER A FLAME.

1. Obtain a test tube containing 2-4 g of a mixture of salt and sand from your instructor and record its number. Measure and record the mass of a clean, dry 100 mL beaker. Pour the contents of the test tube into the beaker and weigh the beaker again. Record the mass of the mixture.

2. Add 20 mL of deionized water to the beaker and stir occasionally for several minutes. What happens to the components of the mixture when the water is added? Set up a ring stand with an iron ring and wire gauze. To the opposite side of the ring stand, attach a clamp that is holding a funnel. Fold a piece of filter paper in half. Fold the paper in half again, so that it is the shape of a 1/4-slice of pie. Measure and record the mass of the filter paper and place it in the funnel. Open one corner of the filter paper and moisten the paper to hold it in place. Measure and record the mass of an evaporating dish and watch glass that will be used as a cover together on a balance. Then position the evaporating dish under the stem of the funnel.

3. Take the beaker containing the mixture, stir it a bit more and pour its contents through the filter. Avoid spilling the liquid or allowing the level of the liquid in the funnel to be higher than the paper. Use a wash bottle to rinse any remaining salt or sand into the beaker. (Use the wash bottle sparingly since all water you add now will have to be boiled away later.) Allow the liquid to drain completely. Pour two separate 5 mL portions of deionized water through the funnel, allowing the water to pass completely through before adding the additional portions.

4. Carefully remove the filter paper from the funnel and place it onto a watch glass (different than the one you will be using as a cover) that bears your name or initials. Put the watch glass in a 110°C oven to dry. It should take about 20-30 minutes. Once the filter paper and solid has dried, remove it from the oven and allow it to cool. Do *not* place hot objects on the balance. They must be cooled to the touch. Weigh the filter paper with the solid. What is the composition of the solid? What is the mass of the solid?

5. While the filter paper is in the oven, pour the filtrate into the evaporating dish. Do not fill the evaporating dish more than 2/3-full. Place the evaporating dish on the wire gauze and heat strongly at first over a Bunsen burner. If it appears that the liquid begins to boil over or spatter, immediately remove the flame from under the dish and lower the heat. Why?

6. As the level of liquid in the dish is reduced, add any remaining filtrate. Reduce the heat as the volume gets smaller. Once all your filtrate has been added, heat until you notice any spattering or crackling sounds, at which point you should cover the evaporating dish with the watch glass to avoid loss of any solid. Avoid allowing the liquid in the dish boil and spill over. Continue heating the dish until all of the liquid has been boiled away, and the solid in the dish and the watch glass are completely dry. Carefully remove the dish from the wire gauze and allow it to cool. Weigh the evaporating dish with the watch glass cover and solid. What is the composition of the solid in the dish and what is its mass?

7. Before disposing your solids, reconfirm that your samples were thoroughly dried. You may ask your instructor if you are unsure. Also, you may want to perform all of your calculations before disposing the solids, in the event your calculations look suspicious.

Name____ Lab Section______________

PRELAB QUESTIONS

1. Listed below are terms associated of separation. Give a brief description of each and/or give an everyday example of where the technique is used. Tell whether the technique is used in this experiment. *Note: You will probably need to consult your text and/or a dictionary (online dictionary at http://www.dictionary.com).*

   a) Decanting

   b) Filtration

   c) Evaporation

   d) Extraction

   e) Distillation

   f) Chromatography

2. What is the proper chemical name for table salt? What is the primary compound found in sand? How do their solubilities compare in water?

3. Which safety precautions, if any, must be observe during this experiment?

Name______________________________________ Lab Section_____________

Partner's Name_______________________________

DATA

Mixture Number ___________

Mass of the 100 mL beaker with the mixture	
Mass of the 100 mL beaker	
Mass of the mixture	

Mass of the filter paper and solid	
Mass of the filter paper	
Mass of the solid	
Identity of the solid	

Mass of the evaporating dish, watch glass, and solid	
Mass of the evaporating dish and watch glass	
Mass of the solid	
Identity of the solid	

Name____ Lab Section_______________

Partner's Name______________________________________

POSTLAB QUESTIONS

1. The term "filtrate" was used in this procedure. Based on its usage, define the term in your own words. What substance(s) were present in the filtrate in this experiment?

2. Why shouldn't the filtrate be allowed to boil over or spatter when heated?

3. Calculate the sum of the mass of the solid collected on the filter paper and the mass of the solid collected in the evaporating dish. How does the mass of the original mixture compare to the sum of these two masses? How should they compare? Explain any variation.

4. What was the mass percentage of salt in your mixture? of sand in your mixture? Use the mass of the original mixture for the total mass of the mixture in your calculations. Show your calculations.