

EXPERIMENT 4: SEPARATION OF A MIXTURE.

Introduction: This experiment separates a mixture using the physical property of solubility. You will learn decantation and filtration, and will use a Bunsen burner to evaporate a liquid. You will use the Law of Conservation of Mass to check your accuracy. Mixtures are combinations of substances in which the components keep their individual characteristics, can be mixed in variable proportions and can be separated by simple physical means. Contrast this with the composition of compounds that are inseparable by physical changes. Some of a mixture's components have physical properties like melting point, boiling point, or solubility that allow us to selectively remove one component from the mixture. Then the percentage of each component in the original mixture can be calculated.

Example: A student has a mixture of $\text{NaCl}(s)$ and $\text{I}_2(s)$ weighing 2.75 grams. She heats the mixture, which turns the solid iodine into a purple gas. The salt remains as a solid. After cooling the salt, it weighs 1.59 g. To find the mass of iodine in the original sample, the student assumes that the difference in mass of the mixture and the salt is the mass of the iodine originally present.

$$\text{Thus: } (2.75 \text{ g mixture} - 1.59 \text{ g salt}) = 1.16 \text{ g iodine}$$

The percent of iodine in the mixture:

$$(1.16 \text{ g iodine} / 2.75 \text{ g mixture}) \times 100 = 42.2\% \text{ iodine in this mixture.}$$

To find the percent of salt in the mixture:

$$(1.59 \text{ g salt} / 2.75 \text{ g mixture}) \times 100 = 57.8\% \text{ salt in the mixture,}$$

Materials

Chemicals: A mixture of sand and salt Deionized water/wash bottle Boiling chip	Equipment: Bunsen burner Ceramic evaporating dish, stirring rod, wire gauze Plastic funnel fitted with filter paper, iron ring, spatula 400-mL beaker, watch glass, beaker tongs (black rubber-tipped)
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Procedure: 1) Weigh a clean dry evaporating dish to the nearest 0.01 gram. Record the code # of the sand/salt mix you are using. Weigh a 3 g mixture sample in the evaporating dish. All weighings should be to two decimal places. **WORK INDIVIDUALLY**

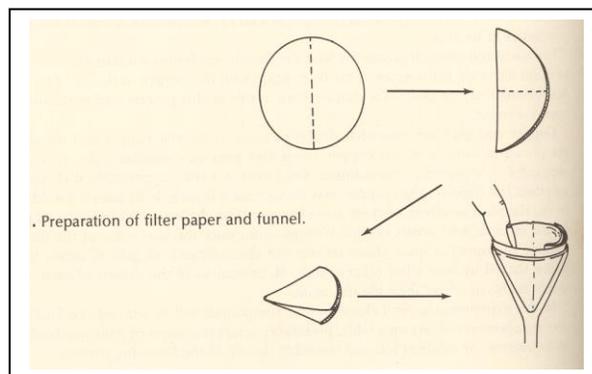
2) Add about 20 mL of deionized water to the mixture in the evaporating dish and stir with the stirring rod.

3) Set up your funnel in a clay triangle on an iron ring over the beaker and fit a piece of #1 or #4 grade filter paper in the funnel. Wet the paper with some deionized water to make it stick to the funnel.

4) Decant the liquid from the evaporating dish into the filter and funnel (leaving the sand in the evaporating dish) and collect the "filtrate" (the liquid that passed through the filter) in the beaker. Add 20 mL of water to the evaporating dish, decant & filter. Repeat twice more with additional 20 mL portions of water.

5) Using your wash bottle – rinse the filter paper thoroughly with about 20 more mL of water. Then, set aside the evaporating dish. (CAREFUL! Don't spill out the sand that remains in the dish)

6) Lift out the filter paper, open it up and rinse any sand granules that might have been trapped on the paper back into the evaporating dish. Use a little deionized water from your wash bottle to transfer any sand you find. Let the sand granules settle again in the evaporating dish, and then decant as much water, without spilling any sand, as you can. Dry the dish with the damp sand by placing it over the beaker as shown. Place the beaker with the salt solution on wire gauze mounted on an iron ring over a Bunsen burner or hot plate



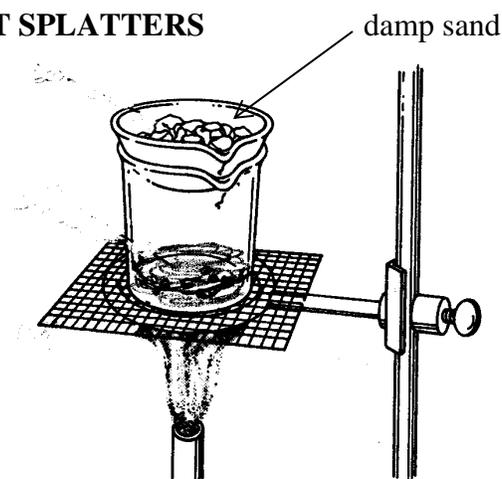
- 7) Add a boiling chip to the liquid in the beaker. Your instructor should check your set-up before you light the burner. If you are using a hot plate, use a high but not the highest setting

GOGGLES ARE MANDATORY – HOT SALT SPLATTERS

- 8) Gently heat the salt water (medium flame). Steam will escape from the beaker but the solution should not spit or spatter.

- 9) When you have boiled out most of the water (with less than 50 mL remaining in the beaker turn off the burner or hot plate.

- 10) At this point the sand in the dish will be dry. Check the bottom of the dish to see if any salt crystals have formed. Scrape any crystals back into the beaker from the dish using a spatula. Set the dish aside to cool on a piece of paper towel. Weigh the dish when cool.



- 11) Using a marker – write your initials on the dish and place it in a hot oven for 10 minutes. Using your beaker tongs, carefully remove the dish, let cool and weigh a second time. Pour the sand into an empty vial. Label it with your name and the # grams of sand recovered. If the first and second weighings don't agree to within 0.05 g, do another heating in the oven, cool and weigh again.
- 12) Lift the beaker off the ringstand (if it is still hot – use beaker tongs or a rubber beaker holder) and place it on a clean piece of paper towel if it is cool, or on a fiber pad or wire screen to cool if it is still hot. Let the beaker cool completely
- 13) Use the clean evaporating dish – there should be no sand left in it. Carefully decant the remaining Salt water into the evaporating dish. Use a stirring rod to direct the stream of salt water into the dish. Rinse your beaker with about 5 mL of wash water from the wash bottle and empty this from the beaker into the dish.
- 14). Pour about 150 mL of deionized water into the beaker and place it on the ring stand, as above. Place the dish with salt water on top of the beaker and heat the beaker as before. You are now steaming off the water from the salt water. This will take some time. You may have to refill the beaker with additional water (keep your wash bottle handy). Continue until you think the salt is dry.
- 15) Weigh the dish with the dried salt after cooling. Place the dish in the hot oven for at least 15 minutes to dry completely. Cool and weigh. If the first and second weighings don't agree to within 0.05 g, heat the sample again in the oven, cool and weigh again. Scrape the salt into another vial, and label it with your name and the grams recovered.

Never weigh an item while it is hot or even warm; it should be close to room temperature. Your instructor will collect both the sand and the salt from each student.

**EXPERIMENT 4: REPORT
SEPARATION OF A MIXTURE**

Name _____

Section _____ DATE _____

Data Table:

Mixture unknown code number (see bottle) _____

Mass of evaporating dish _____

Mass of dish with mixture sample _____

Mass of dish with dried sand

_____	_____	_____
first heating / cooling	2 nd heating / cooling	3 rd heating/cooling if required

Mass of dish with dried salt

_____	_____	_____
first heating / cooling	2 nd heating / cooling	3 rd heating/cooling if required

Calculations: Show your work for each of the following calculations * :

Mass of your sample of mixture

(Show set-up of calculation here)

*

Mass of salt in the mixture sample

*

Mass of sand in the mixture sample

*

Percentage of salt in the mixture

*

Percentage of sand in the mixture

*

Total percent recovery

*

QUEST

IONS

1. Many students do not recover 100% of the original mixture. Describe at least two possible problems that could cause less than 100% recovery of the mixture.
2. A student received a mixture that actually contained 50.0% salt and 50.0% sand. At the end of the experiment, this student calculated that his sample was composed of 45.2% salt and 54.8% sand. What might he have done (or not done correctly) during the experiment to cause this error in his results?
3. A student obtains the following data:

Mass of evaporating dish	25.87 g
Mass of dish with mixture sample	28.12 g
Mass of beaker	146.36 g
Mass of beaker with dried salt	147.10 g
Mass of evaporating dish with dried sand	???

However, this student spills her sand sample out of the evaporating dish before weighing it. If the student believes in the Law of Conservation of Mass, what should have been the weight of the evaporating dish with the sand in it? Show your work.

4. A student receives a sample of a mixture with three components, solid iodine that is removed first from the mixture by evaporation, solid salt that is dissolved to separate it from the third component, and solid sand. The salt and sand are dried and weighed but the iodine escapes as a gas and is not recovered. The student starts with 4.25 g of mixture and recovers 1.16 g of salt and 2.40 g of sand. What is the percent of each component in the original mixture? Show your work. (Attach a separate sheet of paper, if necessary.)