

Separation of Sand, Salt, Iron Filings, and a Mystery Substance in a Micro-Mixture

Objectives: This experiment is designed to teach the techniques of separating mixtures, transferring solids and liquids quantitatively, filtering and washing solutes, and evaporating salt solutions to dryness.

Theory: Some mixtures of solid substances may be separated if a solvent can be found that will dissolve one solid but not the other in the mixture. A sample mixture can be massed, the solvent added to dissolve one solid, and the remaining solid collected on filter paper by filtration. The solid and filter paper can be washed free of all the solution. The mass of the solid can be determined and if the solvent is evaporated from the solute, the mass of the soluble solid can be determined. The sum of the mass of each solid should equal the total mass of the original mixture.

Procedure:

1. Mass accurately the cup with mixture, 3 separate sheets of filter paper (if their masses are different you will need to label them), a clean dry Erlenmeyer flask, and a clean dry beaker. Record these masses on your data sheet. Use the magnet (wrapped) to remove the all of the iron filings. This may take several tries. Record the total mass of the iron filings.
2. Prepare a filtering funnel with one sheet of filter paper. Properly fold the paper. You may use a few drops of water to help position the paper in the funnel. This will be used to filter a water solution of the mixture. The flask will be used to capture the filtrate. Use a ringstand and pipestem triangle to hold the funnel. Be certain the ring is cooled before use.
3. As you rotate the funnel, add the mixture into the dampened funnel. Try to cover the bottom half of the funnel with the mixture. Place the funnel in the ring and position the flask to capture the filtrate.
4. Obtain about 60 mL of hot water from the supply of hot water maintained on the hot plates. Place the graduated cylinder in the sink and add the hot water to it carefully. Transport it to your station and use it quickly before it cools. You may insulate it to keep the water hot.
5. Pour about 5 to 10 mL of the hot water into the funnel, again making sure the flask is underneath the funnel. CAUTION! Pour small amounts of the water into the funnel several times. It is more efficient to wash a system several times with small volumes of water than once with a large volume. TRY TO NOT USE OVER 40 TO 55 mL OF WATER. This will save evaporation time.
6. After complete drainage place the flask on wire gauze on the ringstand. Place the remaining filter paper on top of the flask to prevent splattering (place it on the flask when about 1/2 the liquid has been evaporated.) CAUTION! BE CAREFUL NOT TO ALLOW THE FILTER PAPER TO CATCH ON FIRE. As you remove most of the liquid, the small amounts of liquid still present may generate steam which can splatter large amounts of salt out of the dish when applying direct heat. Heat to complete dryness and stop heating immediately. The time to dry completely may be as much as 30 minutes. Let me check that the salt is dry before discontinuing the heating. There should be no sound from the dry salt. Allow the Erlenmeyer flask and salt to cool to room temperature before massing.

7. As soon as you get the filtrate heating, you must devise a method for separating the sand from the mystery substance. You must separate the two substances and remove all the water (both sand and mystery substance must be completely dry before massing). Filtration will not work because both substances are insoluble in water. Remember to mass any piece of equipment prior to its use. You may need equipment not at your station. Just ask me for needed items. Some suggestions: scrape and rinse all the wet mixture into a beaker, add tap water, stir, and decant (pour off) the water that contains the floating mystery substance. Filter out the water (again). Place the wet filter paper (opened) with the beaker containing the sand off to the side with a piece of paper with your group members' names on it. I will place it in a cabinet and allow it to dry. You will need to mass the two during the first few minutes of the next class period.

8.. Complete all calculations and answer the questions assigned at the end of the sample data sheet. A full lab write-up will be completed.

SAMPLE DATA SHEET

Name: Station Number:

Group members:

Sample Number:

Mass of cup & mixture:

Mass of **RECOVERED IRON FILINGS:**

Mass of flask:

Mass of beaker:

Mass of empty sample cup:

Filter paper masses:

Mass of **RECOVERED SAND:**

Mass of **RECOVERED SALT:**

Mass of **RECOVERED MYSTERY SUBSTANCE:**

CALCULATIONS:

1) % total mixture recovered:

total mass of sand, salt, Fe filings, mystery sub. recovered / mass of total original mixture x 100 =

2) % recovery of individual components:

sand recovered / actual mass of sand x 100 =

salt recovered / actual mass of salt x 100 =

Fe filings recovered / actual mass of Fe x 100 =

mystery substance recovered / actual mass of mystery substance x 100 =

Lab Questions:

1. Define filtrate, solution, solvent, solute. Tell which substances in this lab acted as each of these.
2. Describe the appearance of the filtrate during the evaporation phase. Try to explain what you saw.
3. What effect would using far too much water to dissolve the salt have on the results?
4. What new procedure would you follow if you discovered that the filter paper had torn and some bits of sand and paper were in the evaporating dish along with the filtrate?
5. Describe the possible cause(s) for a sand recovery greater than 100 % and a related salt recovery of less than 100 %.
6. What might be the explanation for a salt recovery greater than 100 % with a sand recovery at or very near 100 %?
7. Which acts to dissolve the salt more completely; one large rinse of water or several small rinses of water, and why? Discuss the effects of hot versus cold rinse water.
8. Describe other errors or poor technique that might result in incorrect results.
9. If you were to redo this experiment, how would you change the procedure?
10. List some properties of the mystery substance. Can you use those along with the Internet to identify it? What other test might you perform to help identify the substance?