Experiment Five

Quantitative Separation of a Mixture

Procedure

For this experiment you will be given a mixture of sand and salt of an indeterminate composition. Your task is to determine the percent composition of each of the components in the mixture. Ask your instructor for your unknown sample and make sure to write down the unknown number. Take a dry 100 mL or 150 mL beaker, weigh it on the centigram balance and record the mass. Take your unknown sample, which was pre-weighed for you, and should have a mass of about 4 g. Reweigh your beaker (use the centigram balance again) with the mixture sample and record the observed mass. Use the same balance with which you weighed your empty beaker. Determine the mass of your unknown sample by subtraction. Do not forget to consider significant figures when you recording your results.
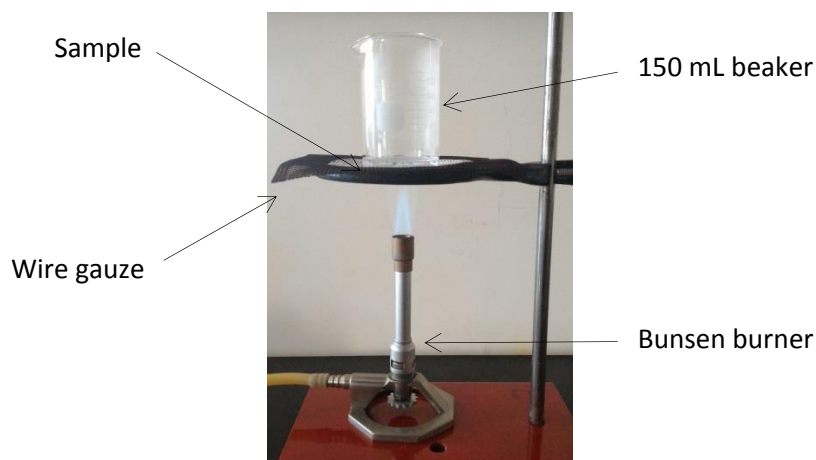

Figure 1. Heating your mixture with a Bunsen burner.

Add 10 mL of pure water to your sample and gently swirl your beaker in order to facilitate that one of the components of your mixture dissolves. Which component do you think is dissolved by the addition of water, the salt or the sand? Take your mixture in the beaker and warm it using a Bunsen burner for about 5 minutes in a setup similar to Figure 1. Make sure to heat it gently so your sample won't boil and a spill out. While your mixture is being warmed, obtain a piece of filter paper and fold it in to fourths. This is the same procedure that was employed in the Physical and Chemical Changes experiment. It is displayed in Figure 2 in case you forgot how to fold it
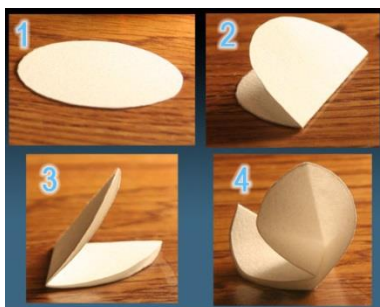
Figure 2. How to fold a filter paper circle in fourths.

Weigh the folded filter paper using the balance that you have used previously and put it in a glass funnel that is supported on your ring stand. Write the mass observed in your notebook. Use a small iron ring or a big iron ring with a clay triangle, and place a beaker under the funnel. The filter paper should not extend above the edge of the funnel. Your set up should look similar to that shown in Figure 3. Once your mixture has become warm stir it gently using your glass rod to make sure that all the salt in the mixture has dissolved.

The sand in the warm mixture will be separated by a technique known as gravity filtration. Gently pour the warm mixture into the filter. Do not completely fill the funnel. It must never overflow. Add the liquid to the filter paper at a rate that keeps the mixture level about 1 cm from the top of the paper. When
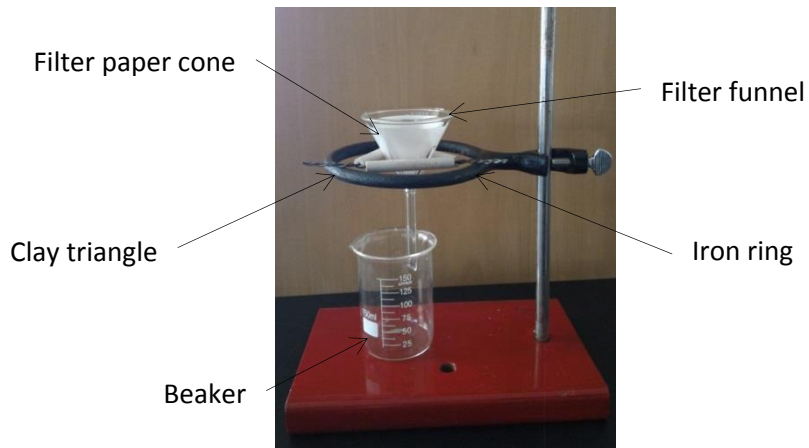

Figure 3. Gravity filtration set up.

the liquid is poured from the beaker, it may adhere to the glass and run down the outside wall. This may be avoided by holding a stirring rod against the lip of the beaker as shown in Figure 4. The liquid will run down the rod and rod off into the funnel without running down the outside of the beaker. If any solid remains in the beaker, use your wash bottle and use pure water to gently rinse the sand from the beaker into the funnel as in Figure 5. Try to use a minimal amount of water. Two to three gentle bottle squirts should be able to accomplish the task.

Figure 4. Proper technique for pouring a mixture using a beaker.

Figure 5. How to remove the solid sample using a wash bottle.

Once all the filtrate is in the beaker, wash the sand in the filter paper with two portions of 5 mL of pure water. This allows you to remove any traces of salt that the sand might still have into the beaker that contains your filtrate. With extra care remove the filter paper from the funnel and place it on a watch glass. Open it gently and spread over the watch glass. Place the watch glass with the filter paper and sand under a heat lamp, or in an oven. If you use a heat lamp, your sample should dry in about 15 minutes. If you use an oven at 110 °C you will need about 30 minutes to dry your sample. When your filter paper and sand are completely dry, remove from the heat lamp or oven, let it cool down for about 5 minutes and weigh the filter paper with the sand. Record the mass observed in your notebook. The mass of sand recovered from your mixture is obtained by subtracting the mass of the filter paper from the mass of the dry filter paper with the sand sample. Record the value you calculated.

While your sand sample is drying, weigh a dry evaporating dish and record the observed value. Pour half of your filtrate on the evaporating dish. The salt contained in the filtrate will be recovered by pouring the filtrate into the evaporating dish and evaporating it over a LOW flame nearly to dryness. Figure 6 shows the correct set up for evaporation. Start the evaporating process by pouring half of your filtrate into the evaporating dish that you weighed, and place it on the wire gauze over a moderate
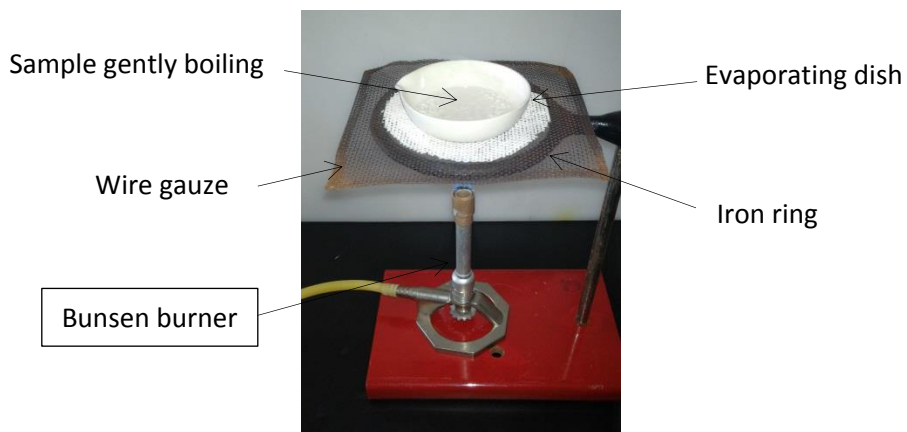

Sample gently boiling

Evaporating dish

Wire gauze

Iron ring

Bunsen burner

Figure 6. Evaporation setup.

flame. Avoid making your filtrate boil to avoid it from spattering Once you see that you have evaporated most of the filtrate add the second half of your filtrate and continue to evaporate the liquid to dryness. Remove the flame as the liquid begins to spatter. Pay close attention at the point that most of the water has evaporated from the sample. This is the point at which most of the spattering will take place. Once all the water has evaporated, turn off the Bunsen burner, and let the evaporating dish cool down. Weigh the evaporating dish with the salt sample once it has cooled down and record the mass. The mass of salt recover is obtained by subtracting the mass of the evaporating dish from the mass of the evaporating dish with salt. Calculate the percentage of salt and sand recovered using the following formula:

$$Percent\ of\ sample\ recovered = \left(\frac{Mass\ of\ sand + mass\ of\ salt\ recovered}{Mass\ of\ original\ sample}\right) x\ 100\%$$

$$Percent\ of\ sand\ recovered = \left(\frac{Mass\ of\ sand\ recovered}{Mass\ of\ original\ sample}\right) x\ 100\%$$

$$Percent\ of\ salt\ recovered = \left(\frac{Mass\ of\ salt\ recovered}{Mass\ of\ original\ sample}\right) x\ 100\%$$