Experiment 23 - Concentration of a Sodium Chloride Solution

The concentration of a solution is determined from the amount of solute present in a given amount of solution. Various concentration units are commonly used; among them are molarity, mass/mass percent, and mass/volume percent.

Molarity is defined as the number of moles of solute per liter of solution.

To determine the molarity of a solution, divide the number of moles of solute by the number of liters of solution.

$$\text{molarity (M)} = \frac{\text{moles of solute}}{\text{liters of solution}}$$

Mass/mass percent is defined as the mass of solute (in grams) per gram of solution.

$$\text{mass/mass percent (m/m\%)} = \frac{\text{grams of solute}}{\text{grams of solution}} \times 100$$

To determine the mass/mass percent of a solution, divide the number of grams of the solute by the total number of grams of the solution and then multiply by 100.

Mass/volume percent is defined as the mass of solute (in grams) per milliliter of solution.

$$\text{mass/volume percent (m/v\%)} = \frac{\text{grams of solute}}{\text{milliliters of solution}} \times 100$$

To calculate the mass/volume percent, divide the mass of the solute by the number of milliliters of solution and then multiply by 100.

In this experiment, you will carefully measure the mass and volume of a quantity of aqueous sodium chloride solution and then evaporate it to dryness. You will weigh the dry sodium chloride that remains, and then calculate the concentration of the original sodium chloride solution in units of molarity, mass/mass percent, and mass/volume percent.

Safety Precautions:

- Wear your safety goggles.

Waste Disposal:

- The waste in this experiment is harmless and can be washed down the sink.

Procedure

1. Weigh a clean, dry evaporating dish. Record the mass.
2. Using a 10-mL graduated cylinder or a 10-mL pipet, measure out a 10.0 mL sample of the NaCl solution provided. Record the volume to the nearest 0.1 mL. (If you wish to use a pipet, ask your instructor to demonstrate the proper technique.)
3. Weigh the evaporating dish and the NaCl solution. Record the mass.
4. Fill a 400-mL beaker about one-half full of water. Heat it on a hotplate or with a Bunsen burner (if you use a Bunsen burner, use a ring stand, an iron ring, and a piece of wire gauze to support the beaker). Place the evaporating dish on top of the beaker. Heat the water in the beaker to boiling. If the water level in the beaker

drops to one-fourth full, add more water to the beaker. (Keep replenishing the water in the beaker as needed so it doesn't go dry.) The point here is to evaporate the water from the NaCl solution in the evaporating dish. Keep heating it until the contents of the evaporating dish appear to be dry.

5. When the NaCl appears to be dry, carefully remove the evaporating dish, dry the bottom, and warm the dish directly over the burner on the wire gauze (without using the water bath). **Note:** If the NaCl is too wet at this stage, it will splatter. Since it is important not to lose any NaCl, if it starts splattering, the sample is still too wet and you must keep heating it over the water bath for until it is dry. When heating the sample over the direct flame, heat it gently with a **low** flame at first to dry the salt completely. Gradually turn up the flame to make sure the salt is totally dry. Cool the evaporating dish and dried NaCl for 10 minutes. Weigh the evaporating dish and the dry NaCl. Record the mass.

Calculations

1. Calculate the mass of the NaCl after drying.
2. Calculate the mass of the solution before evaporation.
3. Calculate the mass/mass percent concentration.
4. Calculate the mass/volume percent concentration.
5. Calculate the moles of NaCl present in the sample.
6. Convert the volume of the solution to liters.
7. Calculate the molarity of the NaCl solution.

Questions

1. What are some possible sources of error in this experiment?
2. 15.0 mL of a NaCl solution that has a mass of 15.78 g is placed in an evaporating dish and evaporated to dryness. The residue has a mass of 3.26 g. Calculate the following concentrations for the NaCl solution:
   a. mass/mass percent
   b. mass/volume percent
   c. molarity