Determination of Mass Percent NaCl Using a Standard Curve

In this experiment you will prepare 5 known solutions of varying sodium chloride concentration and obtain one solution whose concentration of sodium chloride is unknown. You will determine the density of these six solutions as well as the density of D.I. water. You will then plot the density of the 5 known solutions and that of D.I. water versus the mass percent of sodium chloride with a spreadsheet, finding the equation of the best-fit straight line. You will use the equation to find the mass percent of sodium chloride in your unknown.

EQUIPMENT

You will need a total of five 30 or 50 mL beakers, it doesn't matter which. You will also need two 10.00 mL pipets and your unknown. You will also need two weigh boats. Make sure to record your unknown number in your data table.

CHEMICALS

You will need about 15 grams of sodium chloride.

PROCEDURE

Solution Preparation

Label your beakers as beaker 1, 2, 3, 4, & 5. Measure the mass of beakers 1-5 and record their masses to 3 places past the decimal. Place beaker 1 on the balance and tare the balance. Add approximately 1 gram of solid NaCl and record the mass of NaCl to 3 places past the decimal. Repeat this process for beakers 2, 3, 4, & 5 weighing approximately 2 grams of NaCl into beaker 2, approximately 3 grams into beaker 3, approximately 4 grams into beaker 4, and approximately 5 grams into beaker 5. Using a graduated cylinder add approximately 20 mL of D.I. water to all five beakers. Swirl beakers 1-5 to dissolve the solid NaCl. Make sure all of the NaCl dissolves. Measure the masses of beakers 1-5 with the resulting solutions in them, recording their masses to 3 places past the decimal.

Density Determination

Place a plastic weigh boat on the balance and tare the balance. Using a 10.00 mL volumetric pipet, transfer 10.00 mL of D.I. water into the plastic weigh boat and record the mass of the 10.00 mL of water. Drying the weigh boat thoroughly, repeat

this process with the solutions in beakers 1-5. Before each measurement rinse your pipet with a little of the solution that you will be measuring. Make sure to go in order of lowest to highest concentration.

MAKE SURE TO GO IN ORDER OF LOWEST TO HIGHEST CONCENTRATION!

Place your second weigh boat (the one you have not used yet) on the balance and tare the balance. Using a new, clean, pipet transfer 10.00 mL of your unknown into the tared weigh boat. Place the weigh boat with the 10.00 mL of unknown in it back on the balance and record the mass of the 10.00 mL of your unknown in your data table.

Calculations

Calculate the density of each of the solutions, including the D.I. water. Make sure to be careful with significant figures. Since density is mass divided by volume, and you know the mass and volume of each solution, the calculation is straight forward:

$$\text{Density}_{\text{solution}} = \frac{\text{Mass of Solution}}{10.00\ \text{mL}}$$

The volume was always 10.00 ml (4 significant figures) because you used the volumetric pipet.

Calculate the mass percent of NaCl in each solution.

$$\text{Mass \% NaCl} = \frac{\text{Mass of NaCl}}{\text{Mass of Solution}} \times 100\%$$

Note that for D.I. water, the mass of NaCl is zero, so the mass% NaCl is zero.

Using a spreadsheet, plot the densities on the y-axis and the mass percent on the x-axis. Include D.I. water. Get the best-fit straight line and the equation in slope-intercept form. Include a title (dependent vs. independent variable, in this case density vs. mass % NaCl). Make sure you label each axis, including units. Here is a link to a short video on how to do this with LibreOffice Calc: Best-fit with Calc.

Determine the mass % NaCl in your unknown by substituting your density you found for your unknown as the y-value in the quation of your best–fit straight line from your graph. Solve the equation of the best-fit straight line for the x-value (the mass % NaCl).

Copy your graph, along with the equation of your best-fit straight line, into your lab report.

Waste Disposal/Safety

Every aqueous reagent used in this experiment can go down the drain. Any waste solid sodium chloride should go in the garbage can.

Conclusion

In your conclusion include:

- **Your unknown number**
- The mass % NaCl in your unknown.
- Discuss at least one possible source of error. Make sure to not merely list the source of error, but to also explain specifically what effect that error would have on your result, and why it would have that effect.