Chemistry

Scarsdale High School

Solubility Curve

Objective:
Create a solubility vs temperature curve for magnesium sulfate heptahydrate.
Use the curve to predict how many grams of magnesium sulfate will dissolve at a specified temperature.

Task:
Perform the attached lab.

Materials:
1. See lab procedure

Lab Report:

PRESENTATION COUNTS

Lab reports must be fully integrated and in the proper order. All components of the lab must be in one digital file and submitted via Google Classroom

1. Introduction
2. Results and Observations
    a. Data table of collected information
    b. Mass vs Temperature Curve (LoggerPro)
    c. Equation of the best fit curve of the data plotted
    d. Based upon the curve, predict how many grams of solute will dissolve at the specified temperatures
3. Conclusion
4. References

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Introduction

When the proportion of solute to solvent reaches the point that no more of the solute can be dissolved into solution, it is said to be saturated. Some salts, such as NaCl, KCl and NH_4Cl are very soluble in water. For example, about 36 g of NaCl will dissolve in 100 g of water at room temperature (20º C). Other salts are far less soluble; silver chloride, AgCl, reaches saturation when only about 2×10^{-4} g is dissolved per 100 g of water.

Solubility is usually measured and reported in one of two ways. One is the mass of solute that will dissolve in 100 grams of water (or other solvent); this is the method we will use. The other method, known as the molar solubility, is the number of moles of the salt that dissolves in one liter of solution.

Some solutes, including potassium nitrate, have a tendency to remain in solution even after being cooled to well below the saturation point. This phenomenon is known as supersaturation.

In this experiment you will explore the effect that a change in temperature has on the solubility of a typical ionic salt. You will study the solubility of magnesium sulfate, $MgSO_4$, in water by adding the salt to a fixed amount of water at different temperatures. From this data, a solubility curve will be created.

Materials:

Small test tube
Test tube clamp
250 mL Beaker
Hot plate
LabQuest and temperature probe
Solid $MgSO_4*7H_2O$
DI Water
Tap water

Procedure

1. Fill the 250 mL beaker with 200 mL of tap water
2. Set this beaker on the hot plate
3. Do NOT turn on the hot plate
4. Plug in the LabQuest and temperature probe
5. Insert the probe in the 250 mL beaker of water
6. Thoroughly wash and clean the small test tube
7. Measure 10.00 ± 0.05 grams of DI water in the small test tube

   a. Record this value to 2 decimal places
8. Mount the test tube to the lab stand so that the water in the test tube is submersed in the water bath
9. Wait 5 minutes so that the water temperatures are the same
10. Measure and record the water temperature in the beaker – NOT the water in the test tube
11. In a separate 50-mL beaker, measure 10.00 ± 1.00 grams of $MgSO_4$ (s)
12. Carefully add $MgSO_4$ (s) to the test tube UNTIL no more will dissolve
13. Determine how many grams of $MgSO_4$ (s) were added to the test tube
14. Turn on the hotplate and raise the water bath temperature 10 ± 2º C
15. Record the temperature
16. Carefully add $MgSO_4$ (s) to the test tub UNTIL no more will dissolve
17. Determine how many grams of $MgSO_4$ (s) were added to the test tube
18. Repeat this process for 5 more temperatures
19. Plot the collected data using LoggerPro
    a. Mass (g) of $MgSO_4$ (s) vs Temperature (ºC)
    b. Find the equation for the best fit curve of your data
20. Clean up your work station and put away all supplies and materials

Analysis

1. Based upon you plotted data, determine the mass of $MgSO_4$ (s) that will dissolve at the following temperatures
    a. Ten degrees (10 ºC) below the lowest measured data point
    b. The temperature between measurement 3 and 4
    c. Fifty degrees (50 ºC) above the highest measured data point
2. Compare these three data points to the actual solubility data for $MgSO_4$ (s)
    a. What is the percent error for each prediction?