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Factors Affecting Solubility

Student Laboratory Kit

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Introduction:

Why is it that some soluble solids take so much longer to dissolve than others? What factors affect the rate of dissolving? Understanding solutions is important when studying chemistry since solutions are used to perform so many chemical reactions. In this laboratory activity, you will test several factors and observe how each factor affects the rate of a solute dissolving in a solvent.

Chemical Concepts:

- Solutions
- Solubility
- Rate of Dissolving

Materials:

Chemicals

Ice, several cubes

Sodium chloride, rock salt, 2 crystals

Sodium chloride, salt crystals, 2 g

Water, distilled or deionized, 150 mL

Equipment

Balance

Beakers, 100-mL or other small size, 3

Hot plate or Bunsen burner

Mortar and pestle

Stopper, Size #0

Test tubes, 16 × 125 mm, 3

Test tube rack

Thermometer

Weighing boat

Safety Precautions:

Wear chemical splash goggles.

Procedure:

Part A: Preparation

1. Fill a small beaker half-full with water. Warm on a hot plate to about 80 °C.
2. Fill a second small beaker half-full with water. Add several ice cubes and allow the ice-water to cool to about 5 °C.
3. Fill a third small beaker half-full with water. Let this water sit on the lab bench and come to room temperature.
4. These beakers of water will be used in Part C. Proceed with Part B while they are coming to the desired temperatures.

Part B: Effect of Stirring on the Rate of Dissolving

5. Place two test tubes in a test tube rack. Label the tubes 1 and 2. Place about 0.2 g of salt crystals in each test tube. The amount added is not as important as adding equal amounts to each tube.
6. Add enough water to fill each test tube about two-thirds full. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added.
7. Stopper test tube 2 and invert it. If all of the salt does not dissolve, invert it again. Continue inverting until all of the salt is dissolved. Count the number of inversions required. One inversion consists of turning the stoppered test tube upside down, then bringing it back right-side-up.
8. Compare the rate of dissolving between the two tubes. Record your observations in Data Table 1.
9. Rinse the contents of both test tubes down the drain. Rinse and dry each test tube.

Part C: Effect of Temperature on the Rate of Dissolving

10. Place three test tubes in a test tube rack. Label the tubes 1, 2, and 3. Add about 0.2 g of salt crystals to each tube. The amount added is not as important as adding equal amounts to each tube.
11. Measure the temperature of the water in the beakers from Steps 1, 2, and 3 with a thermometer. Once they have reached the desired temperatures, record the temperatures in Data Table 2 and proceed with Step 12.
12. Fill the first test tube about two-thirds full with the cold ice-water. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added. Stopper the tube and invert it to dissolve all of the salt. Count the number of inversions required. Record your observations and the number of inversions required in Data Table 2.
13. Fill the second test tube about two-thirds full with room temperature water. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added. Stopper the tube and invert it to dissolve all of the salt. Count the number of inversions required. Record your observations and the number of inversions required in Data Table 2.
14. Fill the third test tube about two-thirds full with the hot water sample. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added. Stopper the tube and invert it to dissolve all of the salt. Count the number of inversions required. Record your observations and the number of inversions required in Data Table 2.
15. Rinse the contents of each test tube down the drain. Rinse and dry each test tube.

Part D: Effect of Surface Area on the Rate of Dissolving

16. Place three test tubes in a test tube rack. Label the tubes 1, 2, and 3.
17. Obtain two rock salt crystals that are approximately the same mass. Weigh them on a balance. Place one of the rock salt crystals into the first test tube.
18. Grind the second rock salt crystal with a mortar and pestle until it is a fine powder. Transfer the powdered salt to the third test tube.
19. Add the same mass of salt crystals to the second test tube.
20. Fill the first test tube containing the rock salt crystal about two-thirds full with water. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added. Stopper the tube and invert it to dissolve all of the salt. If the number of inversions required to dissolve the crystal is greater than 25, stop and record ">25" for the number of inversions in Data Table 3.

21. Fill the second test tube containing the salt crystals about two-thirds full with water. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added. Stopper the tube and invert it to dissolve all of the salt. Count the number of inversions required. Record your observations and the number of inversions required in Data Table 3.

22. Fill the third test tube containing the powdered salt about two-thirds full with water. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added. Stopper the tube and invert it to dissolve all of the salt. Count the number of inversions required. Record your observations and the number of inversions required in Data Table 3.

23. Rinse the contents of each test tube down the drain. Rinse and dry each test tube.

Part E: Effect of Already Dissolved Solute on the Rate of Dissolving

24. Place two test tubes in a test tube rack. Label the tubes 1 and 2.

25. Place about 0.2 g of salt crystals in test tube 1. Fill this tube about two-thirds full with water. Pour the water carefully down the side of the tube so that little mixing occurs as the water is added. Stopper the tube and invert it to dissolve all of the salt. Count the number of inversions required. Record your observations and the number of inversions required in Data Table 4.

26. Add 0.4 g of salt crystals to test tube 2. Fill this tube about two-thirds full with water and invert (without counting) until all of the salt is dissolved.

27. Now add about 0.2 g of additional salt crystals to test tube 2. Stopper test tube 2 and invert until all of the salt is dissolved. Count the number of inversions required. Records your observations and the number of inversions required in Data Table 4.

28. Rinse the contents of each test tube down the drain. Rinse and dry each tube.

Name: _____

Data Tables

Data Table 1: Effect of Stirring on the Rate of Dissolving

	Observations	Number of Inversions Required
Uninverted Solution		Test tube not inverted.
Inverted Solution		

Data Table 2: Effect of Temperature on the Rate of Dissolving

	Temperature (°C)	Observations	Number of Inversions Required
Cold Solution			
Room Temperature Solution			
Warm Solution			

Data Table 3: Effect of Surface Area on the Rate of Dissolving

	Observations	Number of Inversions Required
Rock Salt		
Salt Crystals		
Powdered Salt		

Data Table 4: Effect of Already Dissolved Solute on the Rate of Dissolving

	Observations	Number of Inversions Required
Solution Containing *No* Already Dissolved Solute		
Solution Containing Already Dissolved Solute		

Name: _____

Questions:

1. What is the effect of inverting the test tube on the rate of dissolving? Explain.

2. What is the effect of temperature on the rate of dissolving? Explain.

3. What is the effect of surface area on the rate of dissolving? Explain.

4. What is the effect of already dissolved solute on the rate of dissolving? Explain.

5. Why is solvation a surface phenomenon?

6. Give three examples of solutions you encounter on an everyday basis. List the solute and solvent for both examples.