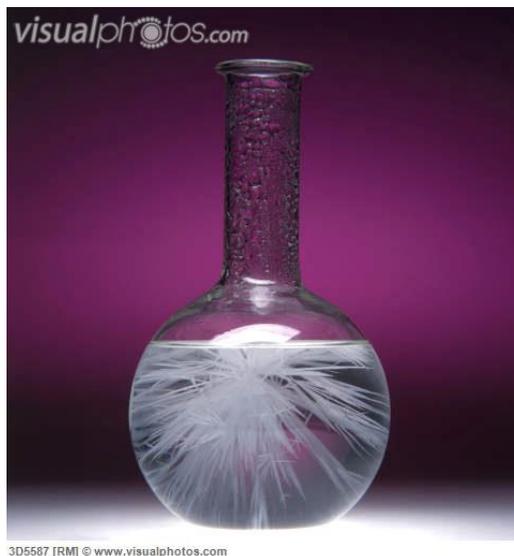


# Supersaturated Solutions

## Discussion

The solubility of a pure substance in a particular solvent is the quantity of that substance that will dissolve in a given amount of the solvent. Solubility varies with the temperature of the solvent. Thus, solubility must be expressed as quantity of the solute per quantity of the solvent at a specific temperature. For most ionic solids in water, solubility varies directly with temperature. That is, the higher the temperature of the solvent (water), the more solute that will dissolve in it.



In this experiment, you will look at a very special case of solubility, the creation of a supersaturated solution of sodium acetate trihydrate  $\text{Na}_2\text{C}_2\text{H}_3\text{O}_2 \cdot 3\text{H}_2\text{O}$ . At room temperature, sodium acetate is very soluble in water, however, the amount of sodium acetate that can be dissolved is limited by the temperature. It is possible to dissolve a tremendous amount of sodium acetate in a small amount of water at higher temperatures. Once the sodium acetate is dissolved at a high temperature, the solution can be cooled. One would think that as the temperature drops and the solubility decreases, the excess solute should fall out of solution (precipitate). However, sodium acetate will not precipitate if it is cooled

undisturbed. Essentially, the solution is holding more solute than it should be able to, the solution is now **SUPERSATURATED!** If a tiny seed crystal is added to the solution once it has cooled, the excess solute in the solution will fall out immediately, quite a dramatic process.

## Equipment

Bunsen burner or hot plate

Test tube rack

Test tube

Ring stand

Wire gauze

2 x 400 ml beaker

Utility clamp

Rubber stopper

Ice

Sodium acetate trihydrate (do not ingest or touch the chemical)



## Procedure

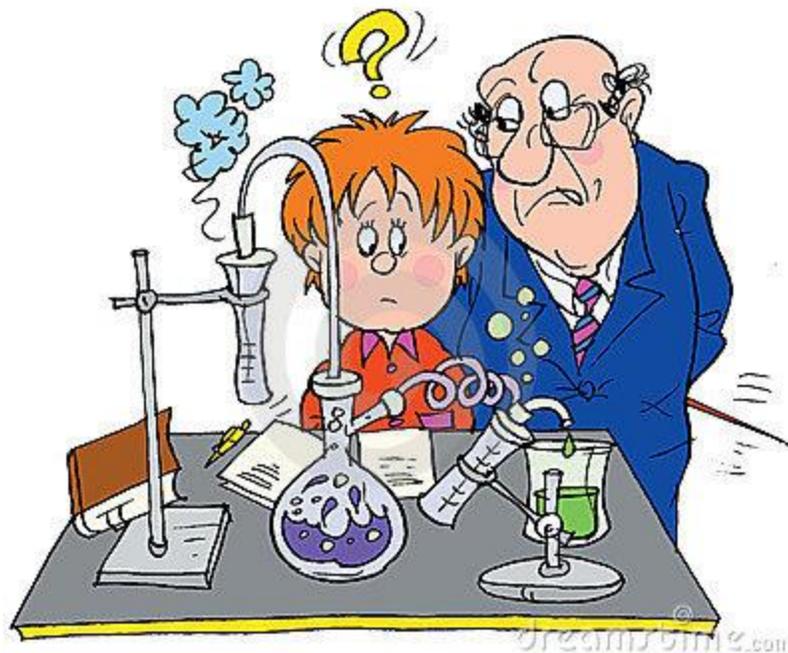
1. Weigh out 15.0 grams of sodium acetate on a piece of weighing paper.
2. Pour 3.0 ml of distilled water into the test tube.
3. Add the sodium acetate a little at a time until no more will dissolve at room temperature. About 4 grams is required to produce a saturated solution. Shake the test tube with a rubber stopper on top to speed up the solution process. Note any change in temperature as the dissolving process occurs. Do not use a thermometer, it will remove some of the water, and the 3 ml of water is rather critical. To note the temperature change, touch the bottom of the test tube with your inner wrist from time to time.
4. Using a test tube clamp, immerse the test tube in a hot water bath.
5. Continue to add the sodium acetate until all 15.0 grams has been added.
6. Keep the test tube in the hot water bath until all of the sodium acetate has dissolved.
7. While heating the hot water bath, set up a ice water bath in another beaker.
8. Once all of the sodium acetate has dissolved, remove the test tube from the hot water bath and let it cool undisturbed until cool. This will take 10-15 minutes. **BE CAREFUL NOT TO DISTURB THIS SOLUTION.**
9. Carefully examine the test tube after it has cooled. The solution should be clear with no solid visible. Feel its temperature on your inner wrist. Note this temperature in your data and observations.

10. Drop a tiny piece of the sodium acetate into the supersaturated solution and observe what happens. Touch the bottom of the test tube to your inner wrist every 15 seconds until all action has stopped and note any change in temperature.

11. Reheat the test tube in hot bath for 5 minutes or until all solids disappear. Cool the test tube in ice bath for about 5 minutes **BE CAREFUL NOT TO DISTURB THIS SOLUTION.**

12. While the test tube is cooling, get a clean petri dish and place a tiny crystal in the middle of the plate.

13. Take the cooled test tube out of the ice bath and very slowly pour onto the crystal on the petri dish. What do you think will happen?



## Questions and Calculations

1. How could such a large amount of solute be dissolved in such a small amount of water?

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2. The dissolving process (raised, lowered) the temperature? \_\_\_\_\_

3. The dissolving process was (endothermic, exothermic)? \_\_\_\_\_

4. The crystallization process (raised, lowered) the temperature? \_\_\_\_\_

5. The crystallization process was (endothermic, exothermic)? \_\_\_\_\_

6. As the temperature increased the solubility of the solute (increased, decreased)?

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7. Do all solutes show the same temperature-solubility relationship as sodium acetate?

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8. Explain how you knew during the lab when you had:

a. An unsaturated solution

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b. A saturated solution

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c. A supersaturated solution

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9. Which of the 3 solutions was the least stable?

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Why?

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10. What is a hydrate? (Use your book).

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11. How did you like this lab?

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