

Sodium Acetate Hand Warmers

Introduction

In this activity sodium acetate hand warmers are used to introduce students to supersaturated solutions, crystallization, and exothermic reactions.

Material

Sodium Acetate Hand Warmer

Thermometer



To Do and Notice

Snap the metal disc in the hand warmer and observe what happens. Pay attention to the temperature change, crystal growth pattern and orientation, and crystal growth rate.

Does the crystal growth have a distinct starting point?

Does the temperature fluctuate or change during the reaction?

What happens if you use a hand warmer that has been chilled in the refrigerator?

Does initial temperature change the speed or duration of the reaction? Does it change the temperature during the reaction?

What's going on?

The hand warmer contains a super saturated solution of water and sodium acetate ($\text{NaC}_2\text{H}_3\text{O}_2$). At room temperature the water in this solution contains many more molecules of sodium acetate than would normally dissolve in water at that temperature. Snapping the metal disc creates a seed crystal that starts a chain reaction causing the solution to crystallize. The crystallization process is an exothermic reaction, in other words, it give off heat.

A super saturated solution of sodium acetate is a super cooled liquid at room temperature. Sodium Acetate is normally a solid at temperatures below 130°F (54°C), but it can easily exist in its liquid state at much lower temperatures. The addition of a seed crystal starts the rapid crystallization.

Sodium acetate heat packs can be recharged by melting the crystals. To do this, heat the solution in boiling water for 10-15 minutes and allow to cool slowly.

Going Further

You can prepare your own supersaturated sodium acetate solution with 50 grams of food grade sodium acetate trihydrate and 5mL water. Gently heat and stir the mixture in a clean flask until the crystals of sodium acetate dissolve. Remove the mixture from the heat and cool slowly. If crystals form upon cooling, reheat and add 1mL of water to the solution. Again allow to cool slowly.

To activate crystal growth drop a single sodium acetate crystal into the flask and watch the solution solidify. You can also pour a small amount of the supersaturated solution into a petri dish on an overhead projector, drop a crystal in, and watch the reaction projected on the wall.

This activity is based on an activity by RAFT:

<http://www.raft.net/ideas/Zap%20Packs.pdf>

Additional resources:

Sodium acetate hand warmers can be purchased at most sporting goods stores.

<http://www.howstuffworks.com/question290.htm/printable>

<http://quest.arc.nasa.gov/space/teachers/microgravity/12rapid.html>

<http://www.stevespanglerscience.com/experiment/00000078>