



ESDY 13.4.2014 "Crystals"

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Hot Ice

You need:

- 1 liter clear vinegar (weak acetic acid)
- 4 tablespoons baking soda (sodium bicarbonate)

Proceedings:

In a saucepan or large beaker, add baking soda to the vinegar, a little at a time and stirring between additions.

The baking soda and vinegar react to form sodium acetate and carbon dioxide gas. If you don't add the baking soda slowly, you'll get a baking soda and vinegar volcano, which would overflow your container.

You've made the sodium acetate, but it is too dilute to be very useful, so you need to remove most of the water.

Boil the solution to concentrate the sodium acetate.

You could just remove the solution from heat once you have 100-150 ml of solution remaining, but the easiest way to get good results is to simply boil the solution until a crystal skin or film starts to form on the surface. This usually takes about an hour on the stove over medium heat.



If you use lower heat you are less likely to get yellow or brown liquid, but it will take longer. Once you remove the sodium acetate solution from heat, immediately cover it to prevent any further evaporation.

You should not have any crystals in your solution. If you do have crystals, stir a very small amount of vinegar into the solution, just sufficient to dissolve the crystals.

Place the covered container of sodium acetate solution in the refrigerator to chill.

When the solution is cooled, you can initiate crystallization by adding a small crystal of sodium acetate or possibly even by touching the surface of the sodium acetate solution with a spoon or finger.

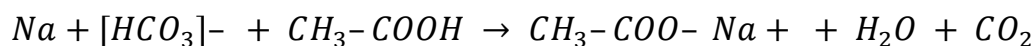


You can also drop a crystal into the container of cooled sodium acetate solution. The sodium acetate will crystallize within seconds, working outward from where you added the crystal. The crystal acts as a nucleation site or seed for rapid crystal growth.

You can re-melt sodium acetate and re-use it for demonstrations.

Why does it happen?

Here is the reaction between the baking soda and vinegar to produce the sodium acetate:



The sodium acetate in the solution in the refrigerator is an example of a supercooled liquid. That is, the sodium acetate exists in liquid form below its usual melting point.

The kinetic energy given with your finger or the nucleation by the little crystal “teaches” to the liquid molecules how to put themselves to solidificate.

As you would expect, sodium acetate is a safe chemical for use in demonstrations. It is used as a food additive to enhance flavor and is the active chemical in many hot packs. The heat generated by the crystallization of a refrigerated sodium acetate solution should not present a burn hazard.