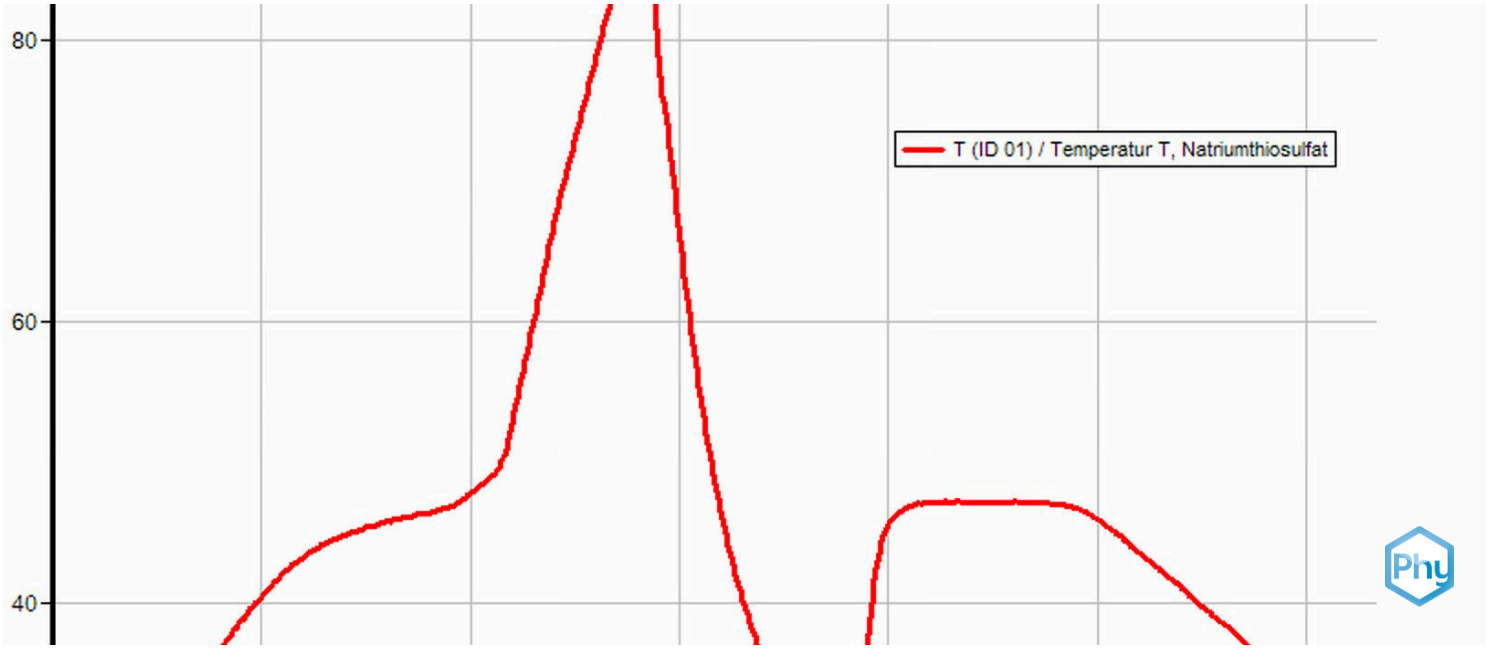
Melting and freezing of sodium thiosulphate with Cobra SMARTsense



Physics	Thermodynamics	States of matter, dissolution (kinetic particle theory)
Chemistry	General Chemistry	States of matter, dissolution (kinetic particle theory)

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	40 minutes

This content can also be found online at:

http://localhost:1337/c/5f43456473f9e40003d15e42

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Teacher information

Application

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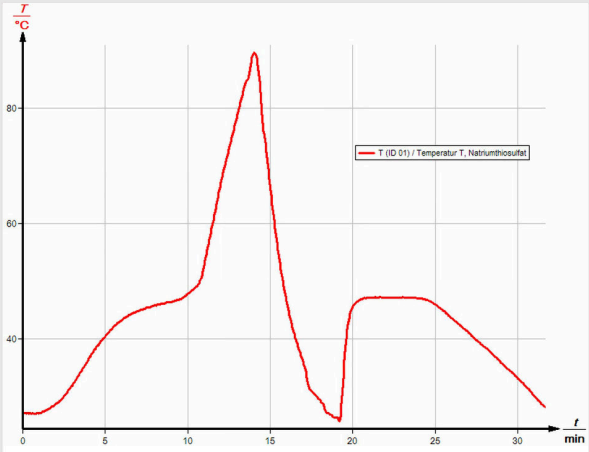

Theoretical course of the temperature curve of sodium thiosulfate

The temperature curve during melting and subsequent solidification of sodium thiosulphate is measured. It can be clearly seen that heat is required for the melting process. The temperature does not rise until all the salt has melted.

When it solidifies, this heat is released again. This can be seen particularly clearly when the melt is first supercooled and suddenly solidifies by adding a crystallization seed. During this process the temperature rises again to the melting temperature.

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Notes on construction and implementation

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- The thermometer which has melted in the test tube can be dissolved by heating and melting the sodium thiosulphate again.
- The water-soluble sodium thiosulfate can be disposed of with the waste water.
- The temperature sensor should not be moved during the measurement of the melting curve, so that a smooth curve is measured. If necessary, it should be fixed separately with another universal clamp.

Other teacher information (1/2)

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Prior knowledge

The students should know the different states of matter. The structure of matter at the molecular level should also be known in order to be able to interpret the change between, for example, solid and liquid. The law of conservation of energy should also be known, so that the students can draw the correct conclusion from the flattening of the temperature curve. The students should be familiar with safe experiments with a butane gas burner.

Scientific principle

The experiment shows the temperature change of sodium thiosulfate during the phase transition between liquid and solid or solid and liquid. The transition between states of aggregation is accompanied by a change in internal energy. Accordingly, the temperature remains the same during the phase transition, although thermal energy is still added.

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Other teacher information (2/2)

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Learning objective

The students learn that a change in temperature of a molten salt at constant pressure causes a change in the state of aggregation and that this change requires energy.

Tasks

Heat sodium thiosulfate until it melts and let it cool down again. Measure the temperature curve as a function of time with a steady heat supply or removal.

Safety instructions

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The general instructions for safe experimentation in science lessons apply to this experiment.

For H- and P-phrases please consult the safety data sheet of the respective chemical.

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Student Information

Motivation

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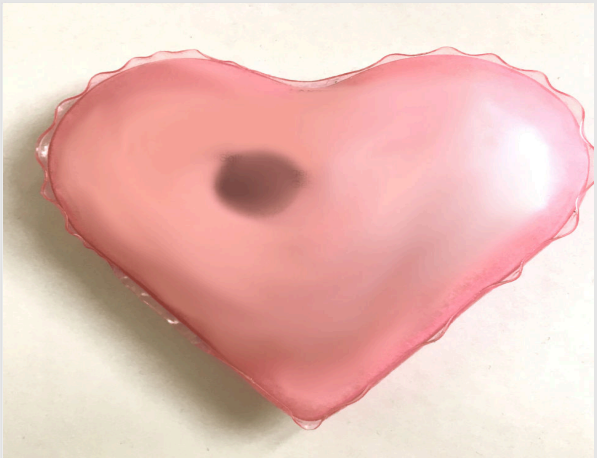

A hand warmer uses the heat of crystallization of sodium thiosulfate

Magic heat - what happens when melting and solidifying?

In winter, when it is freezing cold outside, hand warmers or heat pads are really practical. If the contents are in a liquid state, you can get a nice warm cushion to warm yourself in seconds by simply folding a metal plate. The liquid, which is sodium thiosulfate among other things, becomes solid inside. Now the question arises what exactly happens when the liquid solidifies. You will investigate this in this experiment by recording the temperature curve of sodium thiosulfate. Not only the solidification process of crystals but also the melting process will be closely examined.

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Task

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Experiment set-up

Heat sodium thiosulfate until it melts and let it cool down again. Measure the temperature curve as a function of time with a steady heat supply or removal.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense - Temperature, - 40 ... 120 °C (Bluetooth)	12903-00	1
2	Support base, variable	02001-00	1
3	Support rod, stainless steel, l = 600 mm, d = 10 mm	02037-00	1
4	Boss head	02043-00	1
5	Ring with boss head, i. d. = 10 cm	37701-01	1
6	Universal clamp	37715-01	1
7	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
8	Agitator rod	04404-10	1
9	Spoon, with spatula end, 180 mm, plastic	38833-00	1
10	Beaker, Borosilicate, low form, 250 ml	46054-00	1
11	Beaker, Borosilicate, low-form, 400 ml	46055-00	1
12	Test tube,200x30 mm	36304-01	1
13	Butane burner, Labogaz 206 type	32178-00	1
14	Butane cartridge C206, without valve, 190 g	47535-01	1
15	Sodium thiosulphate pentahydrate, 500 g	30169-50	1
16	Boiling beads, 200 g	36937-20	1
17	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Set-up

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Experiment set-up

- Set up the tripod as shown in the figure on the left.
- Fill the test tube about 3 cm high with sodium thiosulfate.
- Fix the test tube in the universal clamp and lower it into the beaker until the sodium thiosulfate is completely surrounded by water.
- Insert the temperature sensor into the test tube so that it is in contact with the sodium thiosulfate.
- Fill the 400 ml beaker with about 300 ml of cold water and keep it next to your setup.

Procedure (1/2)

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Turn on your Cobra SMARTsense temperature. Open the "measure" App . Select the temperature sensor.

Set the sampling rate to 1 Hz under Settings.

1. melting

Start the measured value recording in measureApp . It then records a temperature value every second.

Ignite the burner and place it under the 250 ml beaker.

Do not move the sensor during heating.

When the water starts boiling, you can turn the burner down so far that the water just keeps boiling.

Delete the burner when all sodium thiosulfate in the test tube has melted.

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Procedure (2/2)

2. solidification

Take the test tube together with the sensor out of the universal clamp.

Place the test tube with the sensor in the beaker with cold water.

If the temperature has fallen below 35 °C and no crystals have formed yet, then throw a crystal of sodium thiosulphate into the test tube and wait a moment.

When the temperature finally falls back towards the initial temperature ,

you can stop and save the measurement.  

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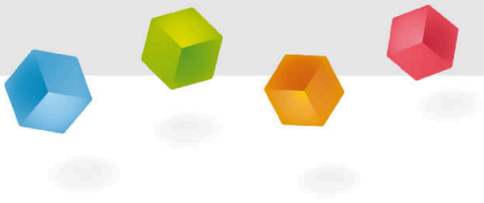

Report

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Task 1

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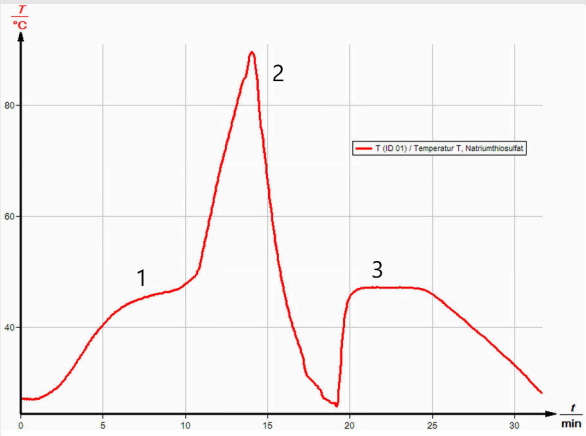

Theoretical course of the temperature curve of sodium thiosulfate

Your temperature curve should look something like the following. Which section of the temperature curve shows the phase transition between liquid and solid?

- ○ 2
- ○ 3
- ○ 1

Check

Task 2

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Insert the correct words in the text to be able to establish a general if, then relationship using the test results.

In this experiment it becomes clear that heat energy is required for the phase transition between _____. While the phase transition between _____ releases heat energy.

General can be said that when the bond between the atoms becomes _____, energy is added, and when it becomes _____, energy is released.

solid and liquid
liquid and solid
solid
less

Check

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Task 3

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Lisa wants to cook noodles with her friends, they need 8-10 minutes. They are all very hungry and can hardly wait. Lisa wants to reduce the cooking time and thinks that a higher temperature will make the noodles cook faster. She suggests to cook the noodles with the stove fully open. Because she believes that the more the water bubbles, the hotter it is. Is she right?

○ True ○ Wrong

Check

Boiling water is present in the solid and liquid states of aggregation.

Slide	Score / Total
Slide 15: Interpretation of the temperature curve	0/1
Slide 16: Phase transition	0/4
Slide 17: cook pasta	0/1

Total amount 0 / 6

Solutions Repeat

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