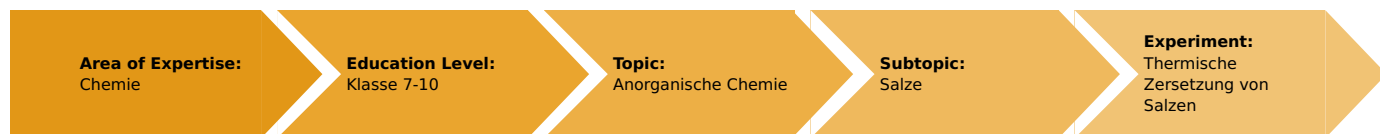


Thermal decomposition of salts (Item No.: P7159900)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

salts, reaction behaviour, thermal decomposition

Task and equipment

Information for teachers

Learning objectives

- Salts can be decomposed thermally.
- As a rule, this already happens at lower temperatures when gaseous decomposition products appear.

Notes on set-up and procedure

Preparations

It is recommended to dry the sodium chloride and the potassium chloride one day before the experiment at about 80 °C in the drying oven since otherwise the humidity contained in the salts leads to the impression that a decomposition takes place.

Remarks on the students' experiments

Make sure that the salts are heated carefully and especially in the first part of the experiment also slowly since otherwise the difference in the change in colour of the indicator paper does not become clear enough. In part 1 of the experiment heating can be stopped when both strips of indicator paper have changed their colour. In part 4 of the experiment heating should be stopped when the copper sulphate starts to turn blue. Make sure that the right-angled glass tube is taken out of the water at first.



Hazard and Precautionary statements

Ammonium chloride:

H302: Harmful if swallowed.

H319: Causes serious eye irritation.

P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do.

P338: Continue rinsing.

Copper sulphate:

- H319: Causes serious eye irritation.
H315: Causes skin irritation.
H302: Harmful if swallowed.
H410: Very toxic to aquatic life with long lasting effects.
P273: Avoid release to the environment.
P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Hazards

- Use some glycerine to make the rubber-glass-joints slippery.
- The experiments lead to the formation of irritating and toxic substances. Do not inhale these gases!
- The first part of the experiment must be carried out under the fume hood!
- Put on protective glasses!

Notes

Potassium chloride melts when the burner is strong enough (melting point 768 °C).

The decomposition of ammonia salts, carbonates and comparable salts already at lower temperatures is due to the formation of low-energy decomposition products which are stable from a thermodynamic point of view and the entropy increase caused by the change of the state of aggregation.

Remarks on the method

Depending on the level of knowledge of the students this experiment is suitable for a first consideration of the chemical equilibrium as part 1 and especially part 4 of the experiment represent the reversion of salt formation.

Waste disposal

Potassium chloride and sodium chloride can be reused for further experiments. The other salts and solutions must be put into the collecting tank for acids and alkalis.

Thermal decomposition of salts (Item No.: P7159900)

Task and equipment

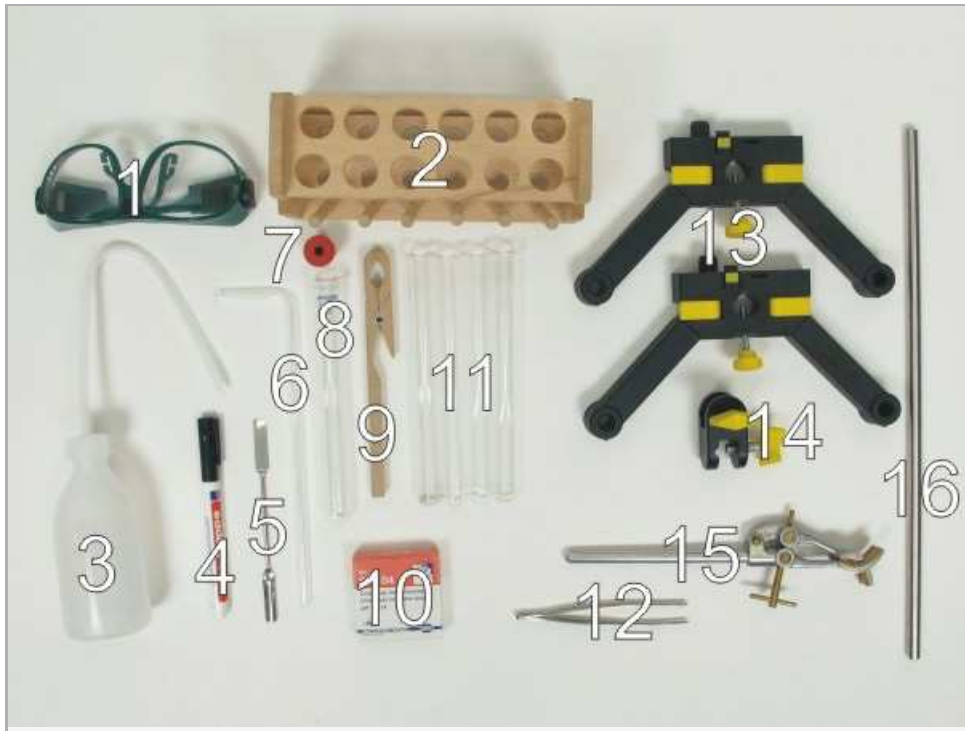
Task

How do salts react when they are heated?

Study the reaction of several salts when they are heated.



Equipment



Position No.	Material	Order No.	Quantity
1	Protecting glasses, clear glass	39316-00	1
2	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
3	Wash bottle, 250 ml, plastic	33930-00	1
4	Labor pencil, waterproof	38711-00	1
5	Spatula, powder, steel, l=150mm	47560-00	1
6	Glass tubes,right-angled, 10	36701-59	(1)
7	Rubber stopper, d = 22/17 mm, 1 hole	39255-01	1
8	Test tube,180x20 mm,DURAN, PN19	36293-00	1
9	Test tube holder, up to d 22mm	38823-00	1
10	Indicator paper, pH1-14, roll	47004-02	1
11	Test tube, 18x188 mm, 10 pcs	37658-03	(4)
12	Tweezers,straight,blunt, 160 mm	64610-02	1
13	Support base, variable	02001-00	1
14	Boss head	02043-00	1
15	Universal clamp	37715-00	1
16	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Ammonium chloride 250 g	30024-25	1
	Glycerol, 250 ml	30084-25	1
	Potassium chloride 250 g	30098-25	1
	Sodium hydrogen carbonate 500 g	30151-50	1
	Sodium chloride 250 g	30155-25	1
	Water, distilled 5 l	31246-81	1
	Calcium hydroxide solution 1000ml	31458-70	1
	Copper-II sulphate, anhydr. 250 g	31495-25	1
	Cotton wool, white 200 g	31944-10	1

Set-up and procedure

Set-up

Hazards

- Use some glycerine to make rubber-glass joints slippery.
- The experiment lead to the formation of irritating and toxic substances. Do not inhale these gases!
- The first part of the experiment must be carried out under the fume hood!
- Put on protective glasses!



Set-up

Set up the support system according to Fig. 1 -Fig. 4.

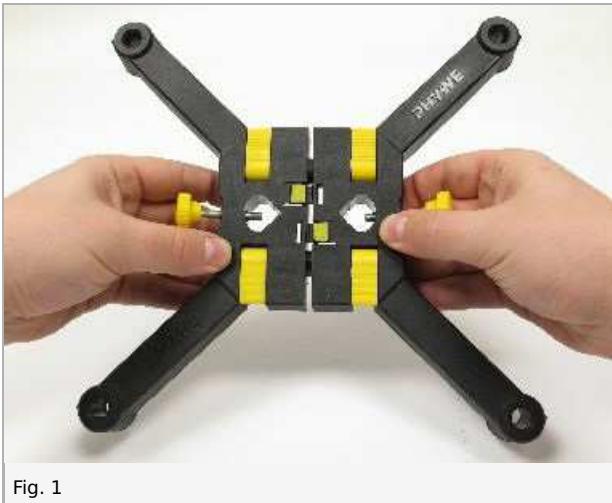


Fig. 1

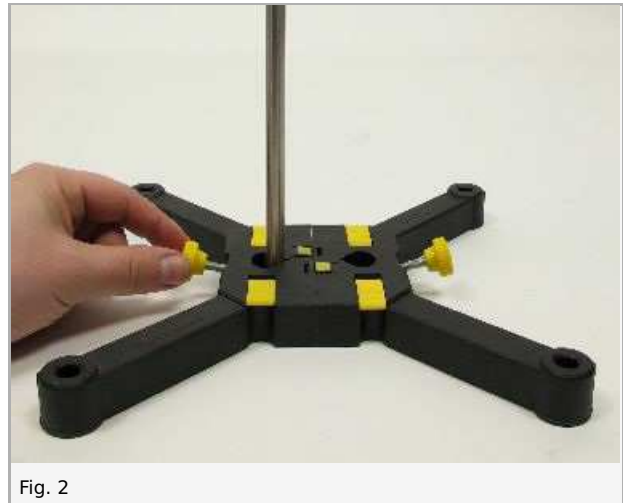


Fig. 2

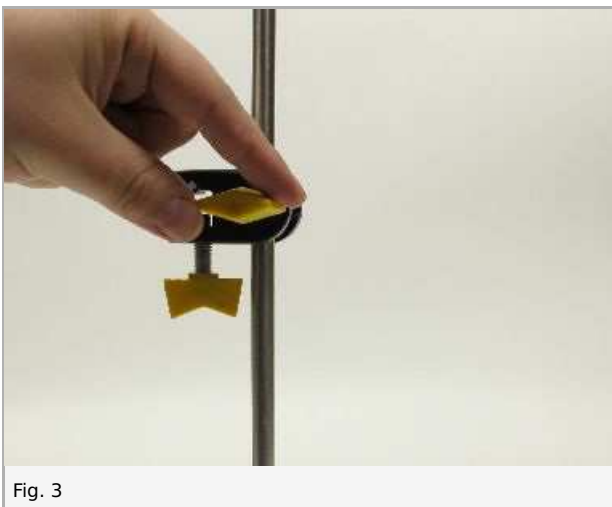


Fig. 3



Fig. 4

Number the test tubes from 1 to 5 and put them into the test tube rack whereby the Duran test tube is number 4 (Fig. 5).



Fig. 5

Procedure

Fill one spatula of ammonium chloride into test tube 1 (Fig. 6). Use the tweezers to attach a strip of universal indicator paper humidified with distilled water to the glass wall of the test tube 1 cm above the ammonium chloride (Fig. 7). Insert a cotton wool ball of about 1 cm into the upper third of the test tube (Fig. 8). Then attach a second strip of universal indicator paper to the wall of the test tube (Fig. 9).

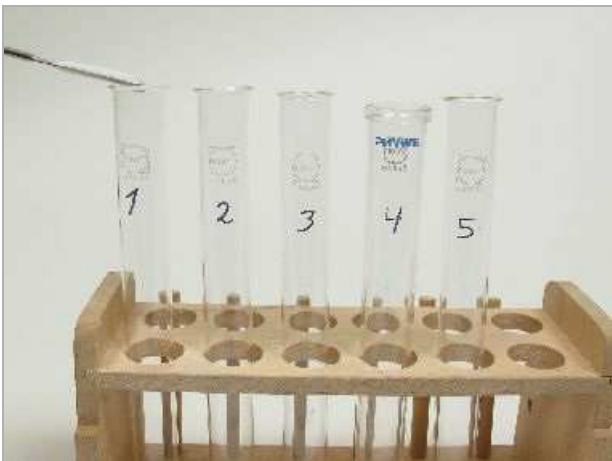


Fig. 6

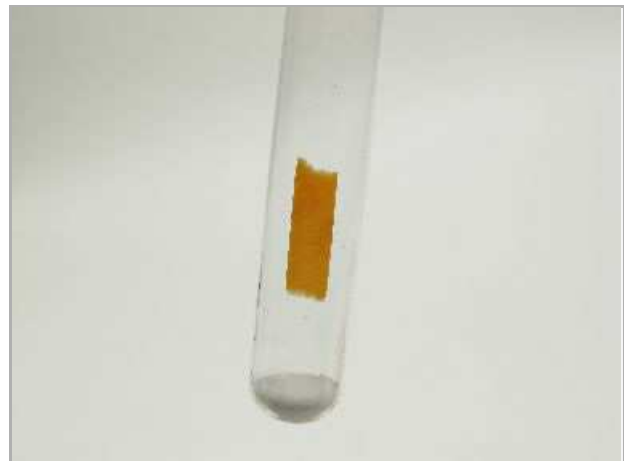


Fig. 7



Fig. 8



Fig. 9

Use the test tube holder to hold the lower part of the test tube into the burner flame. Start heating it slowly and then a little bit more vigorously (Fig. 10). Place the test tube under the fume hood. Write down your observations in the report.



Fig. 10

Fill a spatula of sodium chloride into test tube 2 and a spatula of potassium chloride into test tube 3 (Fig. 11). Heat both salts one after the other vigorously in the burner flame (Fig. 12).



Fig. 11

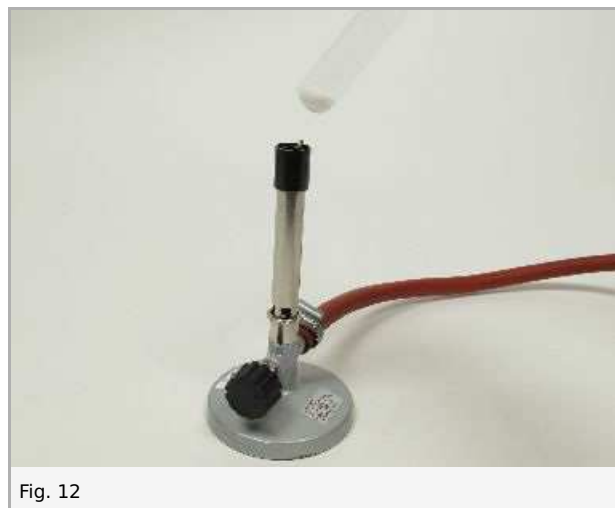


Fig. 12

Slip the short leg of the right-angled glass tube through the rubber stopper (use some glycerine to make it slippery) (Fig. 13). Fill a spoon of sodium hydrogen-carbonate into test tube 4 (Fig. 14).

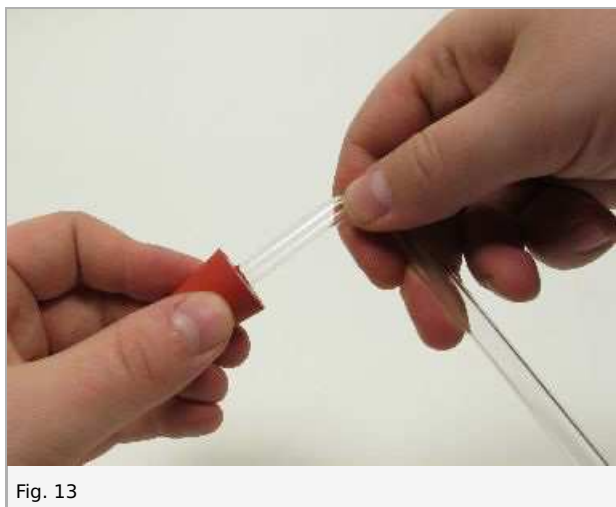


Fig. 13

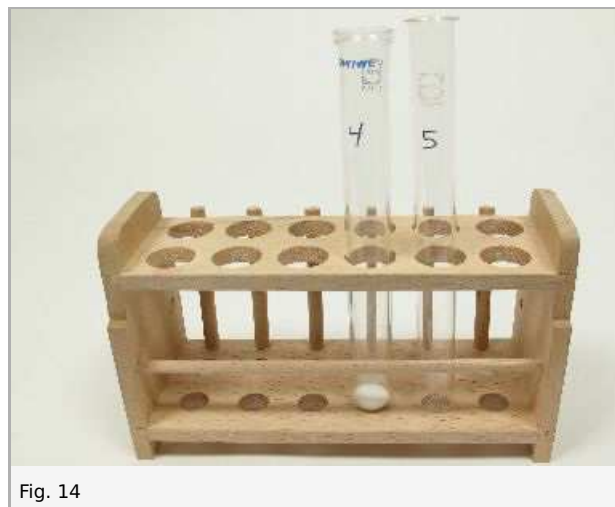


Fig. 14

Fix the test tube horizontally to the support system (Fig. 15). Fill a spatula-tipfull of anhydrous copper sulphate into the front third of the test tube (Fig. 16) and seal it by means of the rubber stopper (Fig. 17).



Fig. 15



Fig. 16

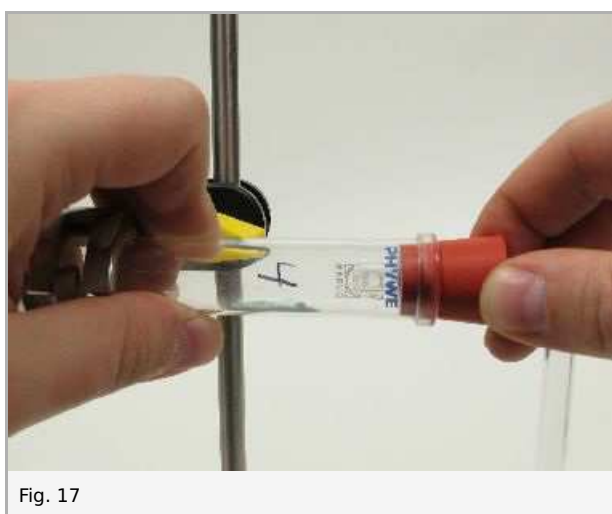


Fig. 17

Fill test tube 5 half full with lime water (Fig. 18) and place it under the right-angled glass tube so that the long leg is dipped into the solution (Fig. 19). First heat the sodium hydrogen-carbonate slowly and then more vigorously for about 3 minutes (Fig. 20). Remove the glass tube from the lime water before stopping to heat.

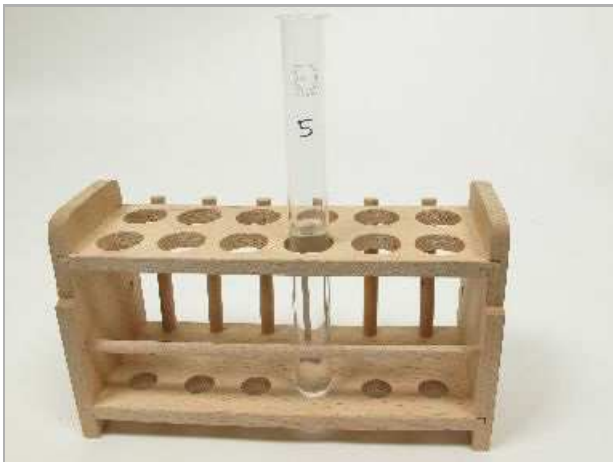


Fig. 18



Fig. 19

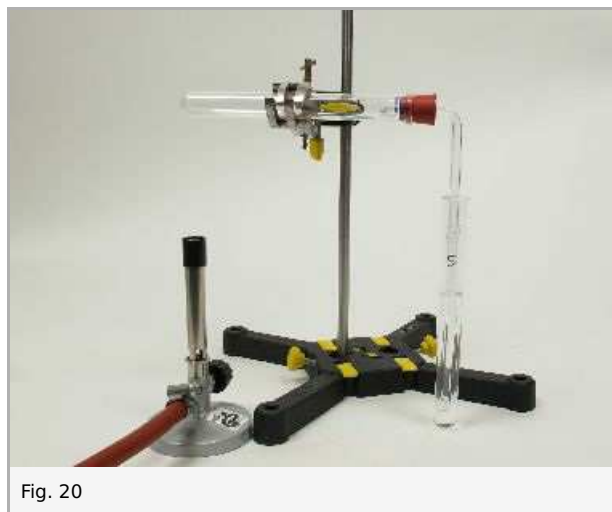


Fig. 20

Waste disposal

Put the content off all test tubes into the collecting tank for acids and alkalis.

Report: Thermal decomposition of salts

Result - Observations

Write down your observations on test tube 1 to 5.

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Evaluation - Question 1

Draw the conclusions from your observations.

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Evaluation - Question 2

Answer the initial question stated in the title of this experiment and try to find a reason for the difference in behaviour that could be observed in part 2 and 3 of the experiment. What common grounds are there in part 1 and 4 of the experiment?

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Evaluation - Question 3

State the reaction equations for part 1 and 4 of the experiment.

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Evaluation - Question 4

From a chemical point of view, the salt of harthorn contained in baking powder actually is ammonium carbonate. Describe the effect of baking powder and state the corresponding reaction equation.

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