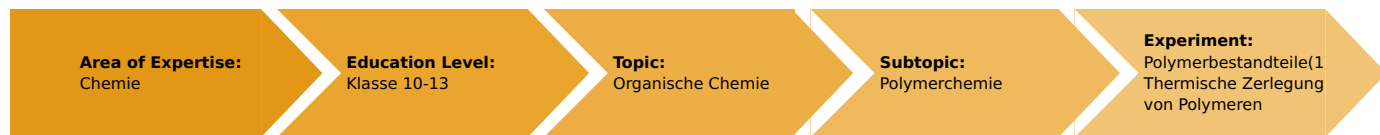


Constituents of polymers (1) - Thermal decomposition - Oxidation of polymers (Item No.: P7180000)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

polymers, thermal decomposition, oxidation

Task and equipment

Information for teachers

Learning objectives

- Polymers decompose on heating.
- The oxidation products are essentially carbon dioxide and water.

Notes on set-up and procedure

Baryta-water (barium hydroxide solution) can be used instead of limewater. It also reacts with small quantities of evolved carbon dioxide.

PE or PP should be used as plastic material, as here the pollution caused by the decomposition products is relatively small.



Hazard and Precautionary statements

Copper(II)-oxide:

- H302: Harmful if swallowed.
 H410: Very toxic to aquatic life with long lasting effects.
 P260: Do not breathe dust/fume/gas/mist/vapours/spray.
 P273: Avoid release to the environment.
 P501: Dispose of contents/container in accordance with applicable local, regional, national, and/or international regulations.

Remarks on the students' experiments

Make sure that the upper third of the test tube is not heated up, because otherwise water condensation will not take place. Point

out to the students that it is absolutely necessary to remove the test tube containing the limewater before the heating process ends, because, otherwise the solution goes back through the right-angled tube.

Hazards

- Limewater is corrosive.
- Wear protective glasses!
- Unpleasantly smelling gases which are harmful to health are evolved on heating! Carry out the experiment in a fume cupboard whenever possible!

Notes

Only the main components of polymers have been determined in this experiment. Other substances which are frequently present in large quantities can be determined by means of suitable detection methods. The Hepar-test can be carried out with casein, for example.

Remarks on the method

This experiment is suitable for work-sharing in groups, as then the number of substances which can be tested can be increased and the generalization gains in validity. The natural polymer classes given above can possibly be included. It is assumed that the detection methods are known by the students. If necessary, they can previously be demonstrated.

Waste disposal

- Put the limewater into the collecting tank for acids and alkalis.
- Purify copper/copper(II) oxide residues or treat them as heavy-metal waste.
- Remove mechanically remaining decomposition products from the Duran-glasses or by annealing them.

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Task and equipment

Task

What elements mostly make up natural polymers and synthetic materials (plastics)?

Examine polymers for important components.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Test tube brush w. wool tip,d25mm	38762-00	1
4	Spoon, special steel	33398-00	1
5	Glass tube,right-angled, 10 pcs.	36701-52	(3)
6	Test tube, 180x18 mm,100pcs	37658-10	(3)
7	Boss head	02043-00	1
8	Protecting glasses, clear glass	39316-00	1
9	Test tube,180x20 mm,DURAN, PN19	36293-00	3
10	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
11	Universal clamp	37715-00	1
12	Rubber stopper, d = 22/17 mm, 1 hole	39255-01	3
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Sample set for study of plastics, 60 pcs. of each species	31730-00	1
	Glycerol, 250 ml	30084-25	1
	Copper-II oxide,powder 100 g	30125-10	1
	D(+)-glucose 1-hydr. 250 g	30237-25	1
	Casein, alkali-soluble 100 g	31188-10	1
	Calcium hydroxide solution 1000ml	31458-70	1

Set-up and procedure

Set-up

Hazards

- Unpleasantly smelling gases which are harmful to health are evolved on heating!
- Carry out the experiment in a fume cupboard whenever possible!
- Wear protective glasses!
- Limewater is corrosive.



Set-up

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



Fig. 1



Fig. 2



Fig. 3



Fig. 4

Carefully rotate the right-angled tube to ease its short arm through the rubber stopper (To make glass-rubber-connections, wet the glass with glycerol so that it slides easily!) (Fig. 5), so that the result corresponds to Fig. 6.



Fig. 5



Fig. 6

Fix diagonally a Duran-test tube (heat resistant) in the clamp so that its lower part can be heated (Fig. 7).



Fig. 7

Half-fill three test tubes with limewater and place them next to each other in the test tube rack (Fig. 8).



Fig. 8

Procedure

Procedure

Put a spatula of glucose into the Duran-test tube (Fig. 9), and 3 spatulas of copper(II)-oxide (Fig. 10). Fit the rubber stopper on the Duran-test tube (Fig. 11).



Fig. 9



Fig. 10



Fig. 11

Heat first the copper(II)-oxide, then the glucose. During the heating, immerse the right-angled test tube into the test tube containing the limewater (Fig. 12).



Fig. 12

Stop heating as soon as the first traces of copper can be seen, but before doing so, remove the right-angled tube from the test tube containing limewater. Repeat the procedure using this time casein and afterwards some pieces of plastic material.

Report: Constituents of polymers (1) - Thermal decomposition - Oxidation of polymers

Result - Observations 1

Write down your observations in general form.

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Result - Table 1

Write down your observations in Table 1.

Substance	Changes	Changes in the test tube	Limewater
Glucose	1	0	0
Casein	0	0	0
Plastic	0	0	0

Evaluation - Question 1

Draw the conclusions from your observations.

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Evaluation - Question 2

Which elements always contain most plastics and natural polymers?

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Evaluation - Question 3

Wich further elements could be contained in...?

a) Natural polymers:

b) Plastics:

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