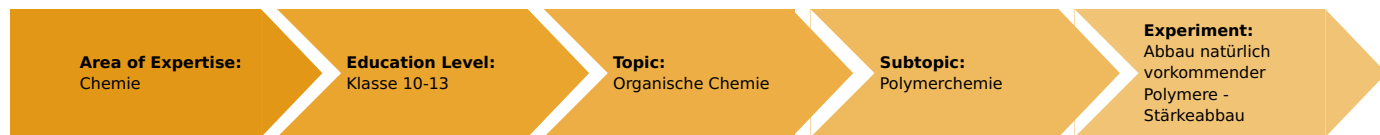


Decomposition of naturally occurring polymers - Decomposition of starch (Item No.: P7180200)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

polymers, naturally occurring polymers, starch, decomposition of starch

Task and equipment

Information for teachers

Learning objectives

- Naturally occurring polymers like cellulose or starch can be decomposed into basic components (monomers).
- Starch is a polymer which is composed of glucose molecules as monomers and can be transformed into glucose again if it is hydrolyzed.

Notes on set-up and procedure

Make available 1% starch solution to the students. Make sure that the beaker is filled so that no water overflows when the Erlenmeyer flask is placed into it.

The mixture of Fehling's solution I and II should be made only before the experiment begins.



Hazard and Precautionary statements

Sulphuric acid 95-98%:

H290:	May be corrosive to metals.
H314:	Causes severe skin burns and eye damage.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P330 + P331:	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P309 + P310:	IF exposed or if you feel unwell: Immediately call a POISON CENTER or doctor/physician.
P501:	Dispose of contents/container in accordance with applicable local, regional, national, and/or international regulations.

Fehling's solution I:

H411:	Toxic to aquatic life with long lasting effects.
P273:	Avoid release to the environment.
P391:	Collect spillage.
P303 + P361 + P353:	IF ON SKIN (or hair): Remove/Take off immediately all contaminated clothing. Rinse skin with water/shower.

Fehling's solution II:

H290:	May be corrosive to metals.
H314:	Causes severe skin burns and eye damage.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
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!

- Concentrated sulphuric acid is highly corrosive. Wear protective glasses and protective gloves!
- Iodine tincture and Fehling's solution are harmful. Do not swallow, do not bring it into contact with the skin!

Notes

Starch is a polysaccharide which is made up of 1 → 4-glycosidically linked α -glucose-molecules. The two forms of vegetable starches, amylose and amylopectin differ in their structure. Amylose is unbranched, due to the tetrahedral angles result a helical structure, in which iodine molecules are stored (blue coloration).

Amylopectin has a branched structure due to the additional 1→6 glykosidic bond, and it is coloured reddish-violet by iodine. The detection with Fehling's solution is based on the reducing effect of the aldehyde group of glucose. Since also fructose shows this reaction, the detection with the Fehling's solution is, strictly speaking, no evidence of glucose as a monomer, and certainly even less for α -glucose.

The values cited in the table are example data which can vary according to the temperature and concentration of the solutions. If the mentioned concentration and temperature is complied, the starch is after 30 minutes largely hydrolysed.

Remarks on the method

In this experiment, the work in small groups is highly recommendable, since the sample extraction and the sample analysis can be performed by different students, so that the time for realization of the experiment - which usually is scarce - is enough. In this experiment it is assumed that the detection of starch and glucose is known by the students. If necessary these detections can be preceded as a demonstration.

The complexity level of the evaluation, in particular of question 3, is based on the state of knowledge of the students. The iodine coloration can also photometrical be pursued in the last years of secondary school. The experiment is applicable also in a biochemistry course .

Waste disposal

- Filter the deposits of the Fehling's samples.
- Recycle the copper oxide or dispose of it as heavy metal waste.

Decomposition of naturally occurring polymers - Decomposition of starch (Item No.: P7180200)

Task and equipment

Task

What are the components of starch?

Decompose starch into its components by adding hydrolysis.



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	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
4	Students thermometer, -10...+110°C, l = 180 mm	38005-02	1
5	Graduated pipette, 5 ml	36598-00	1
6	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
7	Grad.cylinder,high,PP,50ml	46287-01	1
8	Glass beaker DURAN®, short, 400 ml	36014-00	1
9	Erlenmeyer flask 100 ml, narrow neck, PN 19	36418-00	1
10	Test tube, 180x18 mm,100pcs	37658-10	(12)
11	Ring with boss head, i. d. = 10 cm	37701-01	1
12	Test tube brush w. wool tip,d25mm	38762-00	1
13	Protecting glasses, clear glass	39316-00	1
14	Pipettor,bulb,3 valves, 10ml max.	47127-01	1
15	Rubber gloves, size S (7)	39325-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Fehling's solution I 250 ml	30079-25	1
	Fehling's solution II 250 ml	30080-25	1
	Iodine potassium iodide solution	30094-10	1
	Sulphuric acid, 95-98% 500 ml	30219-50	1
	Starch, soluble 100 g	30227-10	1

Set-up and procedure

Set-up

Hazards

- Wear protection gloves! Wash your hands thoroughly after the experiment!
- Wear protection glasses!



Set-up

Set up the support system with the support ring and the wire gauze according to Fig. 1 - 4.



Fig. 1



Fig. 2



Fig. 3



Fig. 4

Fill one third of the beaker with water, put it on the wire gauze (Fig. 5 - 6).



Fig. 5



Fig. 6

Heat the water up to 60 °C, adjust the burner so that the temperature remains relatively constant (Fig. 7).



Fig. 7

Procedure

Procedure

Put in the Erlenmeyer flask 50 ml of 1% starch solution (Fig. 8). Add 5 ml of concentrated sulphuric acid (Fig. 9).



Fig. 8



Fig. 9

Introduce the Erlenmeyer flask into the water bath, wait until the temperature reaches the 60 °C (Fig. 10).

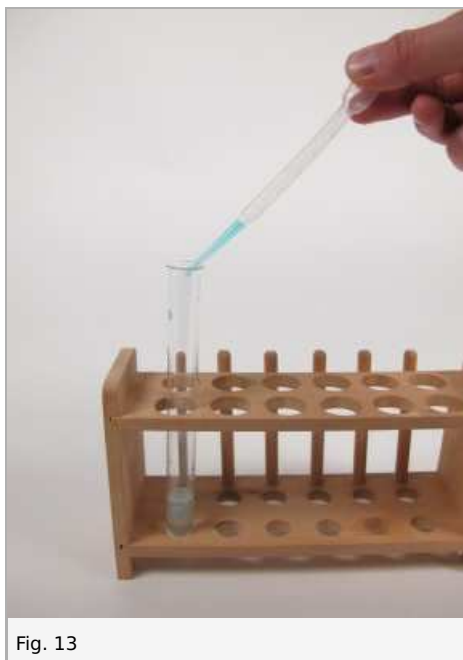


Fig. 10

From this moment on, take 2 samples of 2 ml each in intervals of 5 minutes by means of the pipette, and put each sample into a different test tube (Fig. 11 - 12).



In each case analyse a pair of each sample: sample 1 with Fehling's solution (Fig. 13), sample 2 with iodine / potassium iodine solution (Fig. 14) and write down the results of the duplicates on the table.



Waste disposal

Filter the deposits of the Fehling's samples. Recycle the copper oxide or dispose of it as heavy metal waste.

Report: Decomposition of naturally occurring polymers - Decomposition of starch

Result - Observations

Write down your observations.

- a) Test with the Fehling's solution:
- b) Test with the iodine / potassium iodide solution:

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Result - Table 1

Write down your observations in table: (0 none, + little to +++++ a lot precipitation)

Duration	Precipitation quantity in sample 1 (Fehling's solution)	Colour of sample 2 (iodine/potassium iodide solution)
5 min	1	
10 min	1	
15 min	1	
20 min	1	
25 min	1	
30 min	1	

Evaluation - Question 1

Which substance is detected by applying Fehling's solution and which other one by applying iodine / potassium iodide solution?

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Evaluation - Question 2

Draw the conclusions from your result.

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Evaluation - Question 3

Name the basic components (monomers) of which made up starch. How could one imagine the structure of the starch molecules?

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