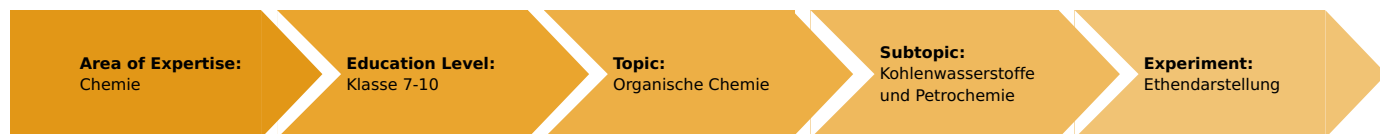


The characterization of ethylene (Item No.: P7171000)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

organic compounds, ethylene, material property of ethylene

Task and equipment

Information for teachers

Learning objectives

- Ethylene can be prepared by the reduction of ethanol with aluminium oxide.
- Ethylene is an "unsaturated" and therefore relatively reactive hydrocarbon, which belongs to the group of olefins.

Notes on setup and procedure

Preparation:

Prior to the experiment, the aluminium oxide has to be dried. This can be done by heating it until it glows, or alternatively it can be dried overnight at 200 °C in a drying oven.

Prepare fresh potassium permanganate solution made alkaline with soda (add 5% potassium permanganate solution to 10% sodium carbonate solution until it has a light violet colour).

Remarks on the students experiments:

It is generally sufficient to heat the aluminium oxide in order to evaporate the ethanol. If necessary, the ethanol should be carefully and only briefly warmed. Use the test tube which was filled second to test the combustibility of ethylene.



Hazard and precautionary statements

Ethanol:

H225: Highly flammable liquid and vapour.

P210: Keep away from heat/sparks/open flames/hot surfaces - No smoking.

Potassium
permanganate:

- H272: May intensify fire; oxidizer.
H302: Harmful if swallowed.
H410: Very toxic to aquatic life with long lasting effects.
P210: Keep away from heat/sparks/open flames/hot surfaces – No smoking.
P273: Avoid release to the environment.
P501: Dispose of contents/ containers to be collected by a licensed contractor in accordance with national and local regulations.

Sodium
carbonate:

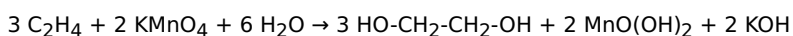
- H319: Causes serious eye irritation.
P260: Do not breathe dust.
P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.
P501: Dispose of contents/ containers to be collected by a licensed contractor in accordance with national and local regulations.

Hazards

- Explosive gases are evolved during the experiment. Air the room well after the experiment!
- Wear protective glasses!
- Ethanol is very inflammable. Extinguish all open flames when handling the storage bottle.
- To make glass/rubber connections, wet the glass with glycerol so it can be easily inserted!

Notes

Ethanol can be catalytically dehydrated to ethylene. Apart from aluminium oxide, anhydrous aluminium sulphate or aluminium asbestos are also suitable. Potassium permanganate acts as an oxidizing agent in the presence of double bonds. The characteristic colour change from violet to brown results from the formation of manganese hydroxide:



Remarks on the method

The homologous series of the alkenes can be developed just as it was done for the alkanes. The similarities can be demonstrated by means of solubilities, combustibilities, reactivities etc. (e.g. compared to hexene).

Waste disposal

- Put aluminium oxide in the heavy metals waste container.
- Put the potassium permanganate solution in the acid and alkali waste container.

The characterization of ethylene (Item No.: P7171000)

Task and equipment

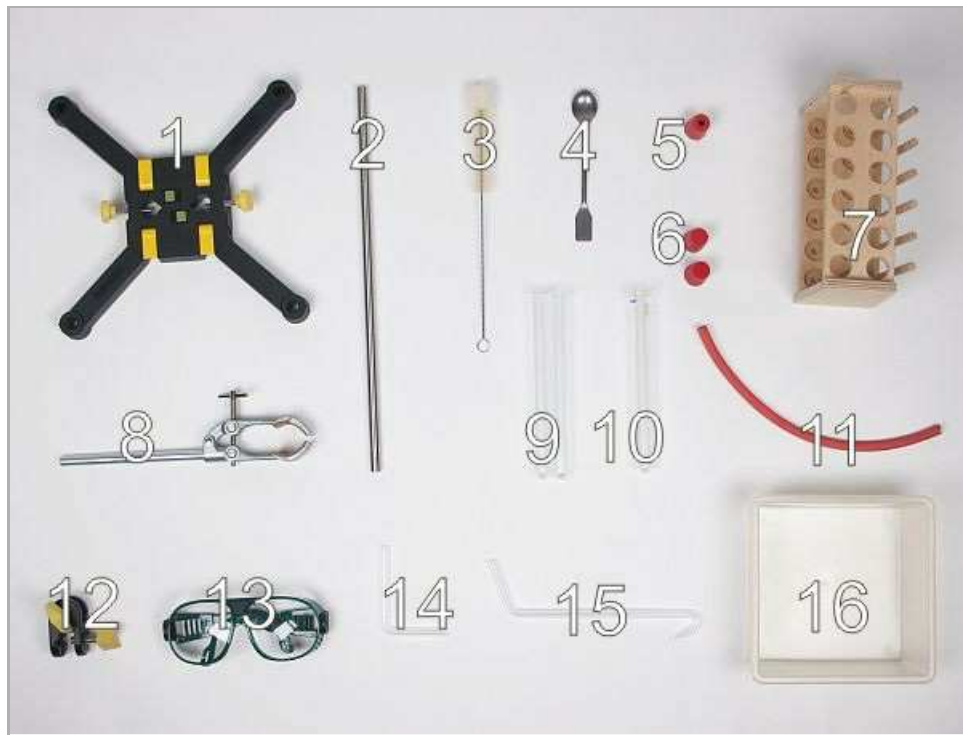
Task

What is meant by the term "unsaturated" hydrocarbons?

Prepare ethylene and examine some of its properties.



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	Rubber stopper, d = 22/17 mm, 1 hole	39255-01	1
6	Rubber stopper, d=22/17 mm, without hole	39255-00	2
7	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
8	Universal clamp	37715-00	1
9	Test tube, 180x18 mm,100pcs	37658-10	(2)
10	Test tube,180x20 mm,DURAN, PN19	36293-00	1
11	Rubber tubing, i.d. 6 mm	39282-00	1
12	Boss head	02043-00	1
13	Protecting glasses, clear glass	39316-00	1
14	Glass tube,right-angled, 10 pcs.	36701-52	1
15	Glass tubes,straight with tip, 10	36701-63	1
16	Dish, plastic, 150x150x65 mm	33928-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Ethanol extra pure ab.95% 1000 ml	30008-70	1
	Aluminium oxide 250 g	30020-25	1
	Glycerol, 250 ml	30084-25	1
	Potassium permanganate, chem. pur., 250 g	30108-25	1
	Sodium carbonate, anhyd. 1000 g	30154-70	1
	Water, distilled 5 l	31246-81	1
	Standard sand,fine 2500 g	31825-79	1

Set-up and procedure

Set-up

Hazards

- Explosive gases are evolved during the experiment. Air the room well after the experiment!
- Wear protective glasses!
- Ethanol is very inflammable. Extinguish all open flames when handling the storage bottle.
- To make glass/rubber connections, wet the glass with glycerol so it can be easily inserted!



Setup

Set up the stand as in Fig. 1 to 3.



Fig. 1



Fig. 2



Fig. 3

Fill the Duran test tube up to a height of about 3 cm with standard sand, and pour ethanol onto the sand so that it is completely steeped in ethanol but no liquid stands above the sand (Fig. 4). Fix the Duran test tube on the stand at a very slight angle and put three spoonfuls of aluminium oxide in the middle of it (Fig. 5).

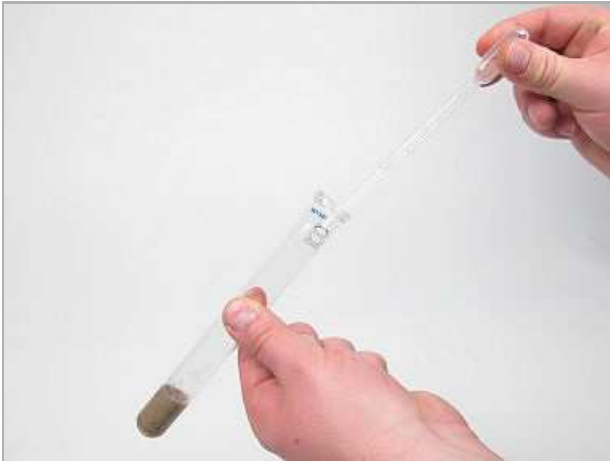


Fig. 4



Fig. 5

Connect the right-angled glass tube to the untipped end of the straight glass tube (gas tube) with a piece of rubber tubing. Ease the free end of the right-angled glass tube through the hole of the rubber stopper (wet the glass with glycerol!) using a gentle screwing motion (Fig. 6+7). Fit the stopper on the Duran test tube.



Fig. 6



Fig. 7

Fill the dish two thirds full with tap water. Fill the two test tubes with water, close them with your thumb and position them upside down in the dish (Fig. 8+9).



Fig. 8



Fig. 9

Procedure

First heat the front part of the Duran test tube, then heat the aluminium oxide until it glows red.

Put the gas tube in the plastic dish with water. After about 30 seconds, lead the gas which is evolved successively into the two water-filled, inverted test tubes until they are both filled with gas (Fig. 10).



Close the test tubes underwater with the stoppers, place them in the test tube rack and move this as far away from the Bunsen burner flame as possible (Fig. 11). Extinguish the Bunsen burner and at the same time remove the gas tube from the dish. Remove the apparatus from the working area.



Put a few drops of potassium permanganate solution in one of the test tubes (only slightly lift the stopper) and close it again immediately (Fig. 12). Shake the tube vigorously (Fig. 13).



Fig. 12



Fig. 13

Reignite the Bunsen burner. Hold the second test tube upside down, remove the stopper and hold the mouth of the tube at the flame of the Bunsen burner (Fig. 14).



Fig. 14

Waste disposal

- Put aluminium oxide in the heavy metals waste container.
- Put the potassium permanganate solution in the acid and alkali waste container.

Report: The characterization of ethylene

Result - Observations

Note the observations you make.

- a) On heating the Duran test tube.
- b) On the addition of potassium permanganate.
- c) On burning of the collected gas.

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Evaluation - Question 1

Draw conclusions from your observations and answer thereby the question in the header.

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Evaluation - Question 2

Formulate the equation for the reaction which took place.

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Evaluation - Question 3

Which type of bond must be present, when the formed substance has the molecular formula given in the reaction equation?

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Evaluation - Question 4

Enter the observed properties of ethylene into the general data sheet, look up missing entries in your text book to fill it in completely.

Name of the substance:	Ethylene	1
	C_2H_4	1
	colourless	1
	gaseous	1
	-169.2 °C	1
	-103.7 °C	1
	combustible, explosive in certain mixtures with air, burns with a sooty flame, reacts with potassium permanganate solution causing it to turn brown	1
	produced by cracking higher alkanes; formed by dehydrating ethanol	1
	production of plastics (polyethylene)	1