Prodution of methanol "wood spirit"

Chemistry > Organic chemistry > Organic compounds containing oxygen

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

This content can also be found online at:

http://localhost:1337/c/638b5e6eabe2e70003a7e562

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Teacher information

Application

The experimental setup

In chemistry, the term alcohols covers not only the drinkable alcohol found in beer or wine, but an entire group of substances. Alcohols are organic chemical compounds that have hydroxyl groups on one or more different aliphatic carbon atoms. Methanol is often produced industrially from coal or natural gas.

In this experiment, methanol is distilled from wood. The methanol is essentially formed from the methoxy groups of the lignin.

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Other teacher information (1/5)

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Prior knowledge

The students should already know the group of alcohols and the principle of distillation. Furthermore, the students should already be familiar with the safe handling of chemicals, as well as butane or Bunsen burners.

Principle

Methanol is produced from wood by means of dry distillation. Since almost no air gets into the wood during this process, it does not burn but forms hydrogen, carbon monoxide and ethene, among other things, which is collected as a liquid phase. Methanol can be produced from this through multiple distillation.

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Other teacher information (2/5)

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Learning objective

The students should learn that the dry distillation of wood also produces methanol, among other things, which is a flammable alcohol with a low boiling point.

Tasks

Make methanol from wood.

Other teacher information (3/5)

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Notes on preparation

Particularly suitable for dry distillation are larger dried sawdust or wood shavings, but also other dry pieces of wood. Of course, it is possible to work with a Bunsen burner instead of a butane burner.

Notes on the student experiment

Make sure that the apparatus is tension-free and leak-proof. If there are not enough exhaust places available, the escaping gases must be constantly burnt off with a wood chip. If permanent combustion of the gases is ensured, the odour nuisance and danger from escaping methanol is almost completely eliminated.

Add the distillates of several groups together if the quantities produced are not sufficient for the examination.

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Other teacher information (4/5)

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Notes on set-up and procedure

Methodological remarks

It is not immediately clear from the experiment that an alcohol (methanol) has been produced. This fact must be worked out in a corresponding class discussion. A substance profile of methanol could already be prepared here (not part of these instructions), if the homologous series and the structural formula of the alcohols have already been worked out. Substance profiles of methanol and ethanol are included in the evaluation in experiment "Iodoform test" (P7172000).

The methanol that is produced is essentially formed from the methoxy groups of the lignin. Besides methanol (approx. 2%), the aqueous phase contains mainly acetic acid (approx. 6%) and acetone (approx. 0.2%). The escaping and combustible gas consists of methane, hydrogen and small amounts of non-condensed methanol.

Other teacher information (5/5)

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Notes on set-up and procedure

Disposal

- The Duran test tube can either be reused for similar experiments or, after mechanical cleaning, freed from organic decomposition products by prolonged annealing.
- The test tubes should not be cleaned by the students because the decomposition products contain carcinogenic substances.

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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 refer to the safety data sheet of the respective chemical.

Dangers

- The experiment produces strong-smelling and harmful substances. Carry out the test under the fume cupboard!
- Put on protective goggles!
- Making rubber-glass compounds slippery with glycerine

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Student information

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Motivation

Industrial production of methanol

While in colloquial usage the word alcohol is associated with drinks such as beer, wine or cocktails, in chemistry it is a term for an entire group of substances. The best-known representative of this group is ethanol, but methanol is also very important. On the one hand, methanol serves as a starting material for the synthesis of chemicals such as formaldehyde or acetic acid, on the other hand, methanol is used as a fuel for combustion engines or as an energy supplier for fuel cells.

In this experiment, methanol is produced from wood.

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Equipment

Position	Material	Item No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Boss head	02043-00	2
4	Spoon, special steel	33398-00	1
5	Watch glass, dia.60 mm	34570-00	1
6	Beaker, Borosilicate, low form, 250 ml	46054-00	1
7	Test tube,180x20 mm, PN19	MAU-17080101	1
8	Glass tube,right-angled w.tip	MAU-10030704	1
9	Glass tubes,right-angled	MAU-10030701	1
10	Test tube, 180x18 mm,100pcs	37658-10	1
11	Test tube,180x20 mm,side arm,PN19	MAU-17080301	1
12	Test tube brush w. wool tip,d20mm	38762-00	1
13	Universal clamp	37715-01	2
14	Rubber stopper, d = 22/17 mm, 1 hole	39255-01	2
15	Rubber tubing, i.d. 6 mm	39282-00	1
16	Protecting glasses, clear glass	39316-00	1
17	Pipette with rubber bulb	64701-00	1
18	Glycerol, 250 ml	30084-25	1
19	Sodium chloride 1000 g	30155-70	1
20	Iron wool 200 g	31999-20	1
21	Butane burner with cartridge, 220 g	32180-00	1
22	Wood splints, package of 100	39126-10	1

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Additional equipment

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Additionally required
Ice
Sawdust, dry

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Set-up (1/5)

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Figure 1

1. Assemble the stand according to Fig. 1 with two sleeves and universal clamps.

2. Attach the two universal clamps to the stand rod, offset in height and at right angles to each other.

Set-up (2/5)

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Figure 2

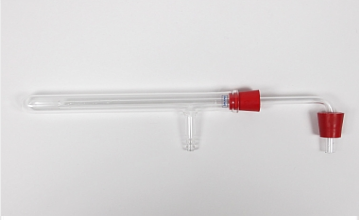

Figure 3

In the following, make all rubber-glass joints slippery with glycerine, do not use force. Danger of injury!

3. Insert the short leg of the large angle tube into the stopper suitable for the Duran test tube (Fig. 2).

4. Close the test tube with the neck with the appropriate stopper, insert the long leg of the angled tube so that it ends about 3 cm above the bottom (Fig. 3).

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Set-up (3/5)

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Figure 4

6. Fill the Duran glass two-thirds full with sawdust, clamp it horizontally in the upper clamp on the stand (Fig. 4.).

7. Connect both test tubes with each other via the angle tube, then clamp the test tube with lateral attachment vertically in the second clamp (Fig. 5).

8. Make sure that both test tubes are connected to each other without tension, but that they are well closed.

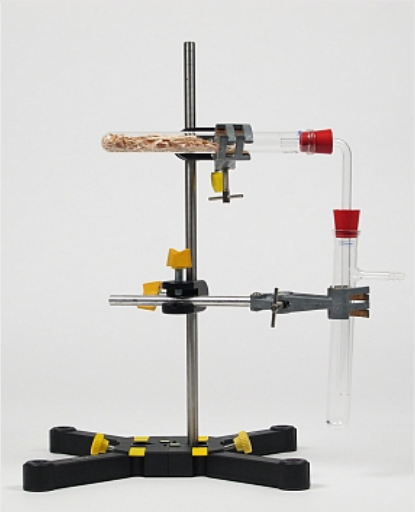

Figure 5

Set-up (4/5)

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Figure 6

8.Fill the beaker about halfway with ice, put several spoonfuls of sodium chloride on top (Fig. 6) and stir the mixture.

9. Place the beaker underneath the test tube with the preparation spout used as a template, move the apparatus so that the test tube is half immersed in the cold mixture (Fig. 7).

Figure 7

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Set-up (5/5)

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Figure 8

10. Use a piece of hose to connect the nozzle (Fig. 8), which is fitted with a non-return device made of iron wool, to the attachment nozzle in such a way that the opening of the nozzle points upwards (Fig. 9).

Figure 9

Procedure (1/2)

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Figure 10

1. Heat the Duran test tube over its entire length, then heat the wood vigorously in the front part.

2. Gradually move the heating point to the end of the test tube.

3. Remove the gas escaping from the nozzle and carry out the oxyhydrogen test (Fig. 10).

4. Ignite the gas at the nozzle after negative progression.

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Procedure (2/2)

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Figure 11

5. Stop heating the wood as soon as no more distillate is formed in the template.

6. Let the template cool and then remove the beaker.

7. Take the light phase of the distillate with the pipette (Fig. 11), put it on a watch glass and try to ignite it with a wood chip.

Disposal

Place the test tubes in the test tube rack for cleaning. Do not clean them yourself!

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Report

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Task 1

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Write down your observations.

Task 2

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Are short-chain alcohols such as methanol soluble in water under normal conditions?

No, organic compounds are always hydrophobic. The best-known example of this is oils, which form an independent layer on contact with water instead of mixing.

No, short-chain alcohols are gaseous under normal conditions and gas cannot be dissolved in water.

Yes, because of the strong dipole due to the OH group, short-chain alcohols can even dissolve in water at any ratio. With long-chain alcohols, the non-polar carbon chain dominates and these alcohols become increasingly insoluble.

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Task 3

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Methanol is a highly flammable alcohol.

○ True ○ False

Check

Methanol is colourless under normal conditions.

○ True ○ False

Check

Task 4

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Drag the words into the correct boxes!

The substance group of _____ differs from other substance groups in that in alcohols the carbon atom with the bond to the _____ furthermore only forms bonds with hydrogen and carbon atoms.

alcohols

hydroxy group

Check

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