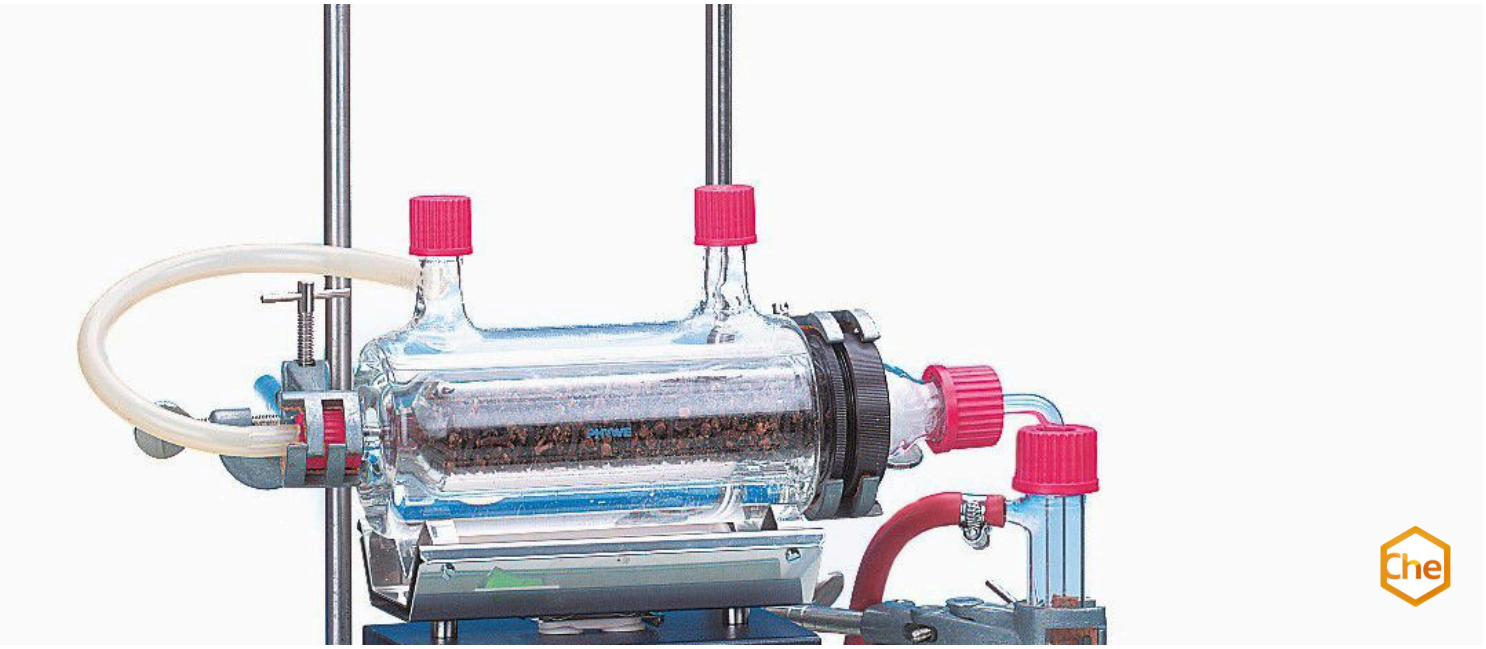
Steam distillation



The students learn the distillation with steam by using a model experiment.

Chemistry	Organic chemistry	Distillation & Purification
Chemistry	Physical chemistry	Phaseequilibrium

Difficulty level	Group size	Preparation time	Execution time
hard	2	10 minutes	30 minutes

This content can also be found online at:

http://localhost:1337/c/602131e3e609ea0003bbba3d

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General information

Application

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Experimental setup

An elegant and simple apparatus for carrying out water vapour distillations is used in the distillation with steam.

Steam distillation uses steam to "extract" the oils out of the plant parts. The distillate (oil) with the cooled water vapor is collected outside the distillation apparatus. The distillate usually floats on top (organic compound (lower density than water) and can easily be skimmed off).

In this experiment, the students extract ethereal oils from parts of plants e g. orange peel and cloves using steam distillation.

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Other information (1/2)

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Prior knowledge

The students should already be familiar with the steam distillation in theory.

Scientific principle

The vapour is generated in the outer chamber and then passes through the inner chamber. Due to the structural arrangement, the inner chamber is heated directly by the vapour generated in the outer chamber.

Other information (2/2)

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Learning objective

The students learn the distillation with steam by using a model experiment.

Tasks

The students extract ethereal oils from parts of plants e g. orange peel and cloves using steam distillation.

For this purpose, water vapor is blown into a closed glass jacket system with crushed plant material. The water vapor "extracts" the essential oil out of the plant.

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Safety instructions

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- When handling chemicals, you should wear suitable protective gloves, safety goggles, and suitable clothing.
- For the H- and P-phrases please refer to the corresponding safety data sheets.
- The general instructions for safe experimentation in science education apply to this experiment.

Theory

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An elegant and simple apparatus for carrying out water vapour distillations: the advantage of this arrangement is that it eliminates the need for a separate vapour generator, making it possible to operate with a single heat source (other set-ups require two). The vapour is generated in the outer chamber and then passes through the inner chamber.

Due to the structural arrangement, the inner chamber is heated directly by the vapour generated in the outer chamber. This also eliminates the possibility of overheating the substances being extracted.

Parts of plants suitable for the extraction of essential oils include orange peel and cloves, for example.

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Equipment

Position	Material	Item No.	Quantity
1	Support base DEMO	02007-55	1
2	Support rod, stainless steel, 500 mm	02032-00	2
3	Right angle boss-head clamp	37697-00	3
4	Universal clamp	37715-01	3
5	Lab jack, 160 x 130 mm	02074-00	1
6	Glass jacket	02615-00	1
7	Distilling insert for glass jacket.	02615-06	1
8	Cooling jacket, GL 25/8	MAU-27225000	1
9	Beaker, Borosilicate, tall form, 250 ml	46027-00	1
10	Glass tubes,right-angled, 10	36701-59	1
11	Silicone tubing i.d. 7mm, 1 m	39296-00	2
12	Hose clip, diam. 8-16 mm, 1 pc.	40996-02	4
13	Heating apparatus for glass jacket system	32246-93	1
14	Power regulator	32288-93	1
15	Boiling beads, 200 g	36937-20	1
16	Cotton wool, white 200 g	31944-10	1
17	Lab protecting glasses with UV filter	39315-00	1
18	Graduated beaker with handle, 1000 ml, plastic (PP)	36640-00	1
19	Funnel, glass, top dia. 50 mm	34457-00	1
20	Base plate for support base DEMO	02007-01	1

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Setup and procedure

Setup (1/2)

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Experimental setup

Setup the stand as shown in the picture on the left side.

Take the support base and two rods.

Position the two rods in the base as shown in the picture.

But the base plate on top of the support base.

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Setup (2/2)

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Position the distillation insert in the glass jacket, and fix the jacket so high on the holding rods that there is plenty of room for the vertical positioning of the condenser and glass beaker.

Pack the substance which is to be steam distilled (e.g. orange peel) between two pieces of cotton wool and place it in the insert.

Fill about 300 ml of water (or of a mixture of water and ethanol) into the glass jacket and close both of the screw cap adapters with GL 18 closing caps. If you prefer, you can position a thermometer in one of these to observe the boiling point.

Experimental setup

Procedure

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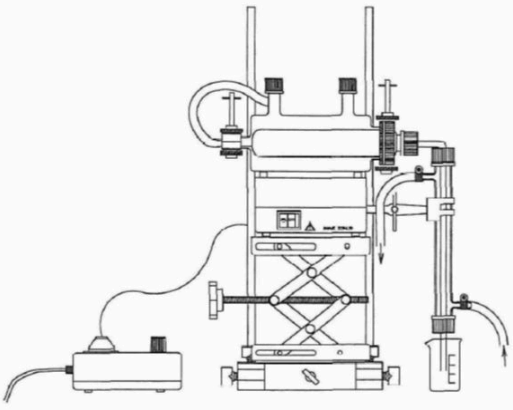
Connect the adapter hose nipple to the nozzle of the distillation insert projecting from the glass jacket by means of silicone tubing

Start the heating and the cooling.



Experimental setup

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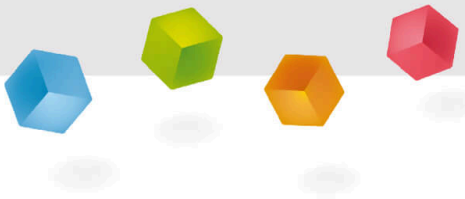

Evaluation

Evaluation (1/4)

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Result

The steam which is generated in the heated glass jacket is led into the distillation insert through the silicone rubber tubing. As this insert is also heated by the boiling water (or alcohol-water mixture), only a small amount of steam condenses, and this quickly re-vaporizes. Steam volatile components (the so-called ethereal oils) are carried over with the steam into the condenser and collected in the beaker.

Note

The construction of the glass jacket system for steam distillation allows ethereal oils to be produced simply, with only a single source of heat. Normal apparatus (retorts) require two sources of heat, to generate steam and for the gentle warming of the piece of a plant which is to be extracted.

The power regulator is used for the temperature control because of safety and energy-saving reasons.

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Evaluation (2/4)

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Mark the correct statements.

- [ ] The vapour in the steam distillation is generated in the outer chamber and then passes through the inner chamber.
- [ ] The structural arrangement eliminates the possibility of overheating the substances being extracted.
- [ ] Due to the structural arrangement, the inner chamber of the steam distillation is heated directly by the vapour generated in the outer chamber

Überprüfen

Evaluation (3/4)

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What makes the glass jacket system for steam distillation different from normal retorts?

- ○ None of the answers is correct, because the glass jacket system for steam distillation is the same as the normal apparatus (retort).
- ○ Normal apparatus (retorts) require two sources of heat, to generate steam and for the gentle warming of the piece of a plant which is to be extracted, the glass jacket system for steam distillation only one.
- ○ Normal apparatus (retorts) can only be used to produce liquor and schnaps.

Überprüfen

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Evaluation (4/4)

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Summary of the experiment

The _____ which is generated in the heated glass jacket is led into the _____ insert through the silicone rubber tubing. As this insert is also heated by the _____ (or alcohol-water mixture), only a small amount of steam _____, and this quickly re-vaporizes. Steam _____ (the so-called ethereal oils) are carried over with the steam into the condenser and collected in the beaker.

- condenses
- volatile components
- boiling water
- steam
- distillation

Überprüfen

Folie	Punktzahl / Summe
Folie 14: Principal of steam distillation	0/3
Folie 15: Glass jacket system	0/1
Folie 16: Summary of the experiment	0/5

Gesamtsumme 0 / 9

Lösungen Wiederholen

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