

Materials

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|---|----------|---|
| Frame for complete experiments | 45500.00 | 1 |
| Rear cover for complete experiment panel | 45501.00 | 1 |
| Panel for complete experimental set-ups | 45510.00 | 1 |
| Clamping holder, $d = 18-25$ mm | 45520.00 | 1 |
| Holder for glass jacket | 45524.00 | 1 |
| Apparatus carrier with fixing magnets | 45525.00 | 2 |
| Spring plugs, 50 pieces | 45530.00 | 1 |
| Fixing band, univ. 100 pcs, 2 only | 45535.00 | 1 |
| G-clamp | 02014.00 | 2 |
| Glass jacket | 02615.00 | 1 |
| Insert with extension tube for glass jacket | 02615.06 | 1 |
| Cooling jacket | 34880.01 | 1 |
| Glass tube, right-angled, $l = 230 + 55$ mm | 36701.59 | 1 |
| Beaker, DURAN, short form, 400 ml | 36014.00 | 1 |
| Silicone tubing, $d = 7$ mm | 39296.00 | 1 |
| Rubber tubing, $d = 6$ mm | 39282.00 | 4 |
| Quick-connect hose coupling, $d = 8$ mm | 47521.00 | 2 |
| Hose clip made of stainless steel, $d = 8-16$ mm | 40996.01 | 6 |
| Hose clip made of stainless steel, $d = 12-20$ mm | 40995.00 | 1 |
| Graduated jug, 500 ml | 36640.00 | 1 |
| Funnel, glass, $d = 50$ mm | 34457.00 | 1 |
| Heating apparatus | 32246.93 | 1 |
| Tweezers, $l = 200$ mm, straight, blunt, st. steel | 40955.00 | 1 |
| Boiling stones, 200 g | 36937.20 | 1 |
| Cotton wool, white, 100 g | 31944.10 | 1 |
| Parts of plants, seeds, fruit, peel etc. | | |

Safety measures

Take care! The heating apparatus and the glass jacket get very hot in this experiment. It is obligatory to secure the glass jacket with the spring plugs supplied.

Set-up

Position the clamping holders on the panel for complete experiments as shown in Fig. 2.

Connect the tubing for cold water to the cooling jacket. Mount two quick-connect hose couplings in this arrangement in order to have the possibility of quick disconnection from the water tap (Fig. 1). Use hose clips to secure all connections against slippage. Fix the tubings to the frame with fixing band.

Place the substance that is to be subjected to steam distillation (e.g. orange peel or cloves) in the insert with extension tube, between two cotton wool plugs. Position the insert in the glass jacket so that there are no leaks (refer to the operating instructions supplied with the glass jacket), and fix the glass jacket in its holder on the panel (Fig. 1). Use a funnel to pour about 300 ml of water into the glass jacket and add a few boiling stones. Close the upper two sockets with GL 18 closing caps. Alternatively, insert thermometers in them to be able to measure the boiling point. Subsequent to this, use a short length of tubing to connect the glass nipple on the left socket to the insert extension tube that projects out of the glass jacket.

Insert a right-angled glass tube (230 + 55 mm) in the cooling jacket, ease the short leg of the tube into the connect-

Fig. 1



ing cap of the insert and secure it there by fitting a screw-cap on.

Position the electrical heating apparatus on the apparatus carrier under the glass jacket, so that it almost touches the glass jacket (Fig. 1). Before doing so, however, remove the Velcro band, so that this is not damaged by the heat from the heating apparatus.

Procedure

Allow cold water to flow through the cooler and switch on the heating.

Observations

After some time, the water in the glass jacket begins to boil. Steam flows through the insert and is condensed in the cooler. A slightly turbid, two-phase liquid (emulsion) collects slowly in the beaker.

Continuation

When the water in the glass jacket has almost all evaporated, switch off the heater to stop the distillation.

Allow the liquid collected in the beaker to stand for some time, so that the substances extracted from the plant part can settle. It is sometimes helpful to place the beaker in a refrigerator overnight or to saturate it with common salt, so that the emulsion is broken and the organic phase can separate from the aqueous phase. The organic phase swims on the water surface and be easily removed, e.g. with a Pasteur pipette.

Results

Many high boiling liquids that are not miscible, or are hardly miscible, with water can be distilled at a temperature as low as about 100°C, when they are heated together with water, or when hot steam flows across them during distillation. This technique is still used nowadays to win ethereal oils and essences.

Notes

Orange peel and cloves are both very suitable for winning ethereal oils, whereby cloves give by far the biggest yield of them.

Fig. 2

