

Production of gases with a dropping funnel

Aims of the experiment

- To learn a method for producing gases.
- To understand properties of gases.
- To understand a reaction.
- To observe the various aggregate states of substances.

Principles

In solids, the particles contained in them have a very high attraction to one another. However, in gases it is the exact opposite. The particles rarely hit one another. The particles contained in a gas move freely at large distances from one another. This is also the reason why gases do not have a solid structure. They use the entire space made available to them and are limited only by the walls of a storage container, for example.

Gases are produced through chemical reactions. In the process, the starting materials can be liquid, gaseous or solid. For example, in a known gas synthesis method, the Haber-Bosch ammonia synthesis method, two gaseous educts, nitrogen and hydrogen, react with each other.

In this experiment, oxygen (O₂) is produced using a gas generator and a dropping funnel. The advantage of this apparatus

is that the dropping funnel regulates the production of gas. Faster dropping causes more gas to be generated, and slower dropping causes the reaction to come to a standstill faster. The apparatus required here is very simple since only an Erlenmeyer flask with a drain line and a dropping funnel is required.

To produce oxygen, in this experiment manganese(IV) oxide (manganese dioxide) as a solid and hydrogen peroxide as a reaction solution are to react with one another. To do so, the manganese dioxide is placed in the flask and hydrogen peroxide is slowly added in drops. Manganese dioxide catalyses the decomposition of hydrogen peroxide according to the following reaction equation:

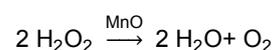


Fig. 1: Set-up of the experiment.

After the reaction, the synthesised gases are scrubbed by washing with concentrated sulphuric acid. The purpose of this procedure is to remove water vapour from the gas. In general, scrubbing gases removes contaminants. Depending on the scrubbing liquid, other contaminants can also be removed. For example, water is used to remove solid particles or alkaline solutions are used to remove traces of acid.

Risk assessment

During the experiment, make sure to wear protective equipment. Gas can form suddenly when adding drops.

Manganese(IV) oxide (manganese dioxide)	
  Signal word: Hazard	<p>Hazard statements</p> <p>H272 May intensify fire; oxidiser agent. H302+332 Hazardous to health if swallowed or inhaled.</p> <p>Safety statements</p> <p>P221 Avoid mixing with flammable substances under all circumstances. P261 Avoid breathing dust/fume/gas/mist/vapour/aerosol. P264 Wash hands thoroughly after use. P280 Wear eye protection. +Depending on the risk, also consider wearing face protection P301+312 IF SWALLOWED: Call a POISON CENTRE or doctor/physician if feeling unwell.</p>
Hydrogen peroxide, 30 %	
  Signal word: Hazard	<p>Hazard statements</p> <p>H302 Harmful if swallowed. H318 Causes serious eye damage.</p> <p>Safety statements</p> <p>P301+312 IF SWALLOWED: Call a POISON CENTRE or a physician if feeling unwell. P305+P351+P338 IN CASE OF CONTACT WITH EYES: Rinse carefully with water for several minutes. Remove contact lenses if present and easy to do so. Continue to rinse. P310 Immediately call a POISON CENTER or doctor/physician.</p>
Sulphuric acid, 95-98 %	
 Signal word: Hazard	<p>Hazard statements</p> <p>H290 Can corrode metals H314 Causes severe skin burns and severe eye damage.</p> <p>Safety statements</p> <p>P280 Wear protective gloves/protective clothing/eye protection/face protection. P305+P351+P338 IF IN EYES:</p>

	<p>Rinse carefully with water for several minutes. Remove contact lenses if present and easy to do so. Continue rinsing.</p> <p>P309 IF exposed or you feel unwell: P310 Immediately call a POISON CENTER or doctor/physician. P301+P330+P331 IF SWALLOWED: Rinse mouth. Do NOT induce vomiting.</p>
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Equipment and chemicals

1	Maey gas generator	665 647
1	Glass dropping funnel, 75 ml, 2 NS 29/32.....	665 649
1	Metal experiment tray.....	666 6221
1	Angle strip	666 623
3	Leybold multiclamp.....	301 01
3	Stand rod 50 cm, 10 mm diam.	301 27
4	Bosshead S.....	301 09
4	Universal clamp 0...80 mm.....	666 555
1	PVC tube 7 mm diam., 1 m	604 501
2	Gas scrubber bottles - bottom	664 800
2	Glass tube insert	664 805
1	Gas syringe, 100 ml with 3-way stopcock	665 914
1	Set of 10 test tubes, 16 x 160 mm.....	664 043
1	Wooden turnings, 100 pieces.....	672 2520
1	Spatula	
1	Manganese(IV) oxide, 100 g	673 2200
1	Hydrogen peroxide, 30 %, 250 ml.....	6753500
Additional recommendation for scrubbing the gas		
1	Sulphuric acid, 95-98 %, 500 ml.....	674 7860

Set-up and preparation of the experiment

Set-up of the apparatus

1. The Maey gas generator consists of an Erlenmeyer flask with a ground glass joint. The dropping funnel with gas equaliser is connected to the ground glass joint and fastened with a joint clamp. A stopper is placed onto the dropping funnel.

Note: The stopper prevents generated gas from escaping through the pressure equaliser of the dropping funnel. However, it should be noted that the generated gas also collects in the dropping funnel.

2. Screw the angle strip onto the experiment pan. Fasten three Leybold multiclamps to the angle strip, with the three stand rods inserted into the clamps.

3. Fasten the gas generator to the first stand rod. Fix it to both the Erlenmeyer flask and to the dropping funnel using a universal clamp.

4. Make sure the gas scrubber bottles are fastened to the other two stand rods with bosshead and the universal clamp so that the openings with the straight handles point to one another.

5. Connect the gas generator to the first gas scrubber bottle by way of the gas outlet cock using a piece of tube.

6. Likewise, connect the gas scrubber bottles together using a piece of tube.

7. Attach a piece of tube that is connected to a gas syringe to the rear gas scrubber bottle in order to capture generated gas and use it for further reactions.

Preparation of the experiment

1. O₂ gas is generated in this experiment. To dry the generated gas, fill sulphuric acid as a desiccant into the second gas scrubber bottle downstream of the gas generator.

Note: The first gas scrubber bottle is only used as a safety wash bottle between the gas generator and the desiccant.

2. Add some of the solid to the Erlenmeyer flask, in this case manganese dioxide.
3. Fill the dropping funnel with the reaction liquid. In this experiment, this is hydrogen peroxide.

Performing the experiment

1. Carefully open the cock of the dropping funnel.

Caution: the reaction proceeds very vigorously! If too much gas is generated, the stopper in the dropping funnel can come off. Also, make sure that the gas withdrawal cock at the Erlenmeyer flask is open.

2. The generated gas can now be collected through the connected gas syringe.
3. To stop the reaction, close the cock on the dropping funnel. The reaction will then only proceed until the reaction solution dripped in has been completely used up and then comes to a stop.

Observation

As soon as the hydrogen peroxide from the dropping funnel hits the manganese dioxide, a violent reaction occurs which generates gas.

Evaluation

To check the identity of the gases present, carry out the glowing splint test.

To do so, bring a wooden turning to a glowing state using a flint lighter. Then, pass a bit of the gas from the syringe over the glowing wooden stick.

If the stick glows strongly, this is evidence that the generated gas is oxygen.

Result

In this test, oxygen is produced using the Maey gas generator.

A gas is generated by dripping hydrogen peroxide onto the manganese dioxide. The identity of this gas is checked through the glow potential test.

If the wooden stick glows when the gas passes over it, the gas is pure oxygen.

Other gases can be generated using this apparatus. Some examples can be found in Table 1. In the process, the respective risks and safety data sheets must be considered.

Alternatively, gases can also be generated using a Kipp's apparatus (see experiment C1.4.2.1).

Cleaning and disposal

Add manganese dioxide to hydrogen peroxide and allow to react under the fume cupboard.

Suspend manganese dioxide in water and dispose in the container for inorganic salt solutions with heavy metals.

Generated gas	Reaction partner in the Erlenmeyer flask	Reaction liquid in the dropping funnel	Desiccant for the gas	Remarks
O ₂	MnO ₂ or dry yeast	H ₂ O ₂ (approx. 10 %)	e.g. H ₂ SO ₄	-
NH ₃	NaOH (solid)	NH ₃ (conc.)	e.g. NaOH (solid)	poisonous, work in the fume cupboard!
Cl ₂	KMnO ₄ (solid)	HCl (conc.)	e.g. CaCl ₂ (solid)	poisonous, work in the fume cupboard!
HCl	NaCl (solid)	H ₂ SO ₄ (conc.)	e.g. CaCl ₂ (solid)	corrosive, work in the fume cupboard!
SO ₂	NaHSO ₃ (approx. 50 %)	H ₂ SO ₄ (conc.)	e.g. H ₂ SO ₄	poisonous, work in the fume cupboard!
NO ₂	Cu or Sn	HNO ₃ (conc.)	e.g. H ₂ SO ₄	poisonous, work in the fume cupboard!
CO	H ₂ SO ₄ (conc. heated)	Formic acid	e.g. H ₂ SO ₄	poisonous, work in the fume cupboard!
C ₂ H ₂	CaC ₂ (pieces)	H ₂ O	e.g. CaCl ₂ (solid)	Detonating gas test!
CH ₄	Al ₄ C ₃ (pieces)	H ₂ O	e.g. CaCl ₂ (solid)	Detonating gas test!

Tab. 1: Gases producible using a dropping funnel.