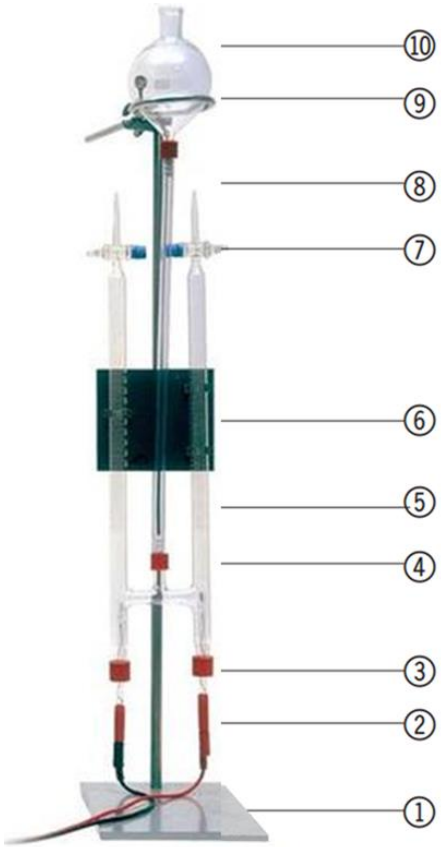
Hofmann Water-Decomposition Apparatus 1002899

Instruction sheet

11/22 HJB



① Base-plate with stand rod
② Platinum electrodes
③ GL-18 screw fitting
④ GL-14 screw fitting
⑤ Gas collection tubes
⑥ Securing plate
⑦ Ground stopcock
⑧ Plastic hose
⑨ Stand ring
⑩ Leveling bulb

1. Safety instructions

- Since the conductivity of distilled water is too low, electrolysis is carried out using dilute sulfuric acid (c =1 mol/l approx.).
- Carefully add the sulfuric acid to the water while stirring. Never do this the other way round!
- Wear protective goggles when mixing the solution and when releasing the gases.
- Students should always be informed of the dangers of the chemicals needed for the experiment.
- Caution. Any acid that escapes can cause irreparable stains and holes in clothing.
- Be careful when taking the glass tubing off its securing plate.
- Do not subject the glass components of the water decomposition apparatus to mechanical stress.
- Hydrogen and oxygen form an explosive mixture. Never re-combine the gases in a test tube.

2. Description

Hofmann's voltameter is used for the electrolysis of water (converting electrical energy into chemical energy), quantitative determination of the resulting gases and confirmation of Faraday's laws.

The water-decomposition apparatus consists of an H-shaped section of glass tubing attached to a securing plate fixed to a stand rod that rests on a base-plate. The glass section involves two gas collection tubes each with a measuring scale. At the top of each tube there is a ground stopcock.

Two platinum electrodes are secured at the lower ends via GL-18 screw fittings. The electrodes are connected to a low voltage DC power supply unit. A flexible plastic hose leads to a leveling bulb for equalizing the pressure in the collection tubes.

3. Scope of delivery

1 Glass section with gas collection tubes
1 Base-plate with stand rod and securing plate
1 Pair of platinum electrodes with 4-mm sockets
1 Leveling bulb with plastic hose
1 Stand ring to hold the leveling bulb
1 Universal sleeve

Additionally required equipment:

1 DC Power Supply 0 - 20 V, 0 - 5 A
1003312: @230V
or
1003311: @115V
1 1003368: Mechanical Stopwatch
1 1023780: Digital Pocket Thermometer
1 1002804: K-Type NiCr-Ni Immersion Sensor
1 1010232: Barometer
Distilled water
Sulphuric acid (c = 1 mol/l approx.)

4. Technical data - dimensions

Water-decomposition apparatus:

Height:	800 mm approx.
Width:	150 mm
Base-plate:	250 mm x 160 mm
Rod:	750 mm x 12 mm Ø
Securing plate:	120 mm x 110 mm

Gas collection tubes::

Height:	510 mm
Width:	150 mm
Tube diameter:	19 mm
Scale:	50 ml each with 0.2 ml divisions

Leveling bulb:

Volume:	250 ml

5. Example experiments

5.1 Investigation of the conductivity an composition of water

- Pour distilled water into the leveling bulb with both stopcocks open. Fill the gas collection tubes completely by altering the height of the leveling bulb.
- Close the glass stopcocks. The water level in the leveling bulb should be higher than that in the collection tubes.
- Check the apparatus for leaks and tighten connections where necessary.
- Turn on the power supply and observe the electrodes.

There is no perceptible reaction at the electrodes.

- Turn the power supply off again.
- Add a few drops of dilute sulfuric acid (c = 1 mol/l approx.).
- After waiting for about 5 minutes, switch on the power supply again.

Gas bubbles should rise from both electrodes.

- When the gas collection tube at the negative pole (cathode) is half filled with gas, turn off the power supply.
- To achieve a precise reading of the gas volumes, lower the leveling bulb until the water in the bulb is level with that in the tube to be measured.

- Release the gases through the stopcocks and collect them in upturned test tubes.
- Demonstrate the presence of hydrogen by the pop test and the presence of oxygen using a glowing splint.

Result:

- Electrolysis does not take place when distilled water is used on its own.
- Addition of dilute sulfuric acid has a catalytic effect so that the distilled water is electrolyzed into its two components, hydrogen and oxygen.
- The volume of hydrogen gas formed at the cathode is twice the volume of the oxygen gas formed at the anode.

5.2 Determining the Faraday constant

- Pour distilled water with diluted sulphuric acid into the leveling bulb with both stopcocks open. Fill the gas collection tubes completely by altering the height of the leveling bulb.
- Close the glass stopcocks. The water level in the leveling bulb should be higher than that in the collection tubes.
- Check the apparatus for leaks and tighten where necessary.
- Turn on the power supply and set the voltage so that approximately 1 A of current flows. Check to see that gas is being emitted into both tubes.
- Turn the power supply off again, open the stopcocks and release the gas.
- Close the glass stopcocks. Turn on the power supply and the stopwatch at the same time.
- When the glass collection tube at the negative pole (cathode) is nearly full, turn off the power supply and the stopwatch together and record the time.
- Determine the volumes of gas. The hydrostatic pressure should be equalized in order to do this.
- Measure the air pressure and room temperature.

For a known current I (A), time t (s), air pressure p (Nm^{-2}), temperature T (K), volumes of gas VH_2, VO_2 (m^3) and universal gas constant R (8,3 J mol^{-1} K^{-1}) the Faraday constant F is given by:

$$F = \frac{I \cdot t \cdot R \cdot T}{2 \cdot p \cdot V} \approx 10^5 C / mol$$