Electrolysis (Item No.: P1397100)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 14-16
Topic: Electricity
Subtopic: Current and its effect
Experiment: Electrolysis

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Principle and equipment

Principle

The passage of current through an aqueous solution of sodium sulphate is to be used as an example to determine what is principally meant by the term electrolysis.

Safety Precautions



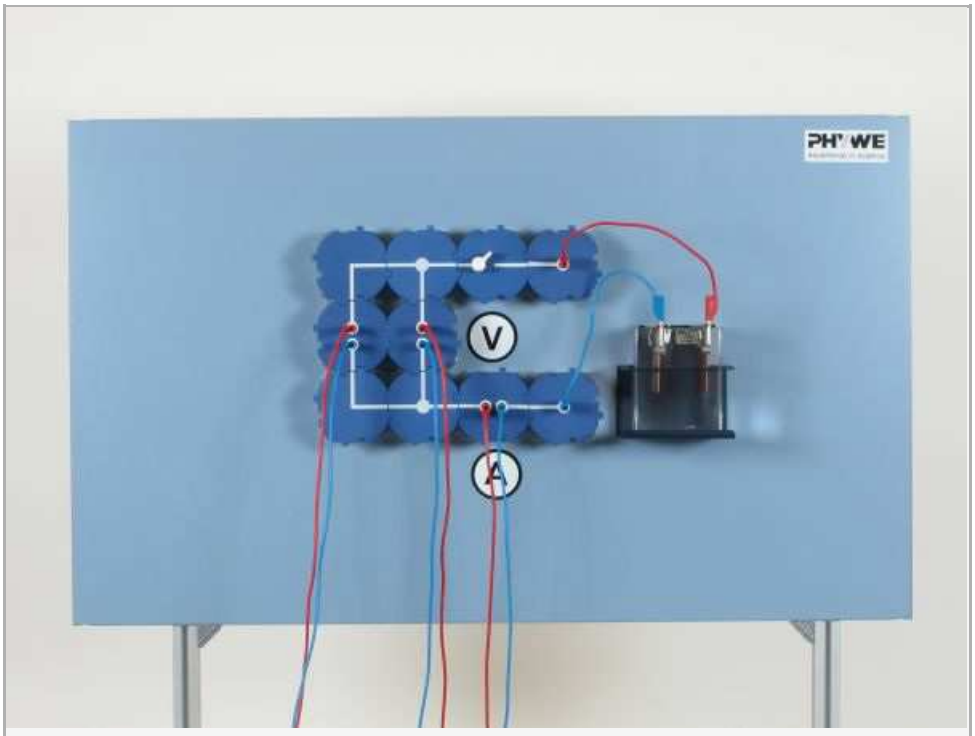

Wear eye protection and gloves!

R: 22-36/38-50/53

S: 22-60-61

Copper 11 sulphate is hazardous to health. Do not swallow it! Irritates eyes and skin. Do not inhale dusts.

Waste disposal: Pour solutions containing heavy metal ions or salts into an appropriately labelled container and subject them to proper disposal.



Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
1	Multimeter ADM2, demo., analogue	13820-01	2
2	PHYWE power supply, universal DC: 0...18 V, 0...5 A / AC: 2/4/6/8/10/12/15 V, 5 A	13500-93	1
3	Demo Physics board with stand	02150-00	1
4	Switch on/off, module DB	09402-01	1
5	Connector interrupted, module DB	09401-04	3
6	Junction, module DB	09401-10	2
7	Support plate w. holder,module DB	09471-00	1
8	Glass tank, 100x50x120 mm	06620-10	1
9	Electr.symbols f.demo-board,12pcs	02154-03	1
10	Connector, angled, module DB	09401-02	2
11	Connector, T-shaped, module DB	09401-03	2
12	Plate electrode holder	06618-00	2
13	Emery paper, medium, 5 sheets	01605-02	1
14	Sodium sulphate dried 250 g	48344-25	1
15	Connecting cord, 32 A, 1000 mm, red	07363-01	3
16	Connecting cord, 32 A, 1000 mm, blue	07363-04	3
17	Connecting cord, 32 A, 250 mm, red	07360-01	1
18	Connecting cord, 32 A, 250 mm, blue	07360-04	1
19	Copper electrode, 76 mm x 40 mm	45212-00	2
20	Spoon,w.spatula end,18 cm,plastic	38833-00	1
Additional material:			
	Distilled water		
	Scissors		
	Cardboard or drawing cardboard		
	Absorbent cloth or paper towel		

Set-up and procedure

- Set up the experiment as shown in Fig. 1; fill about 250 ml of distilled water into the glass trough and scatter almost a spoonful of sodium sulphate so carefully on the water that no clumps form, then stir
- Cut out a strip of cardboard that fits in the middle of the glass trough and make small holes in it with a pin
- Position the well cleaned electrodes near the sides of the glass trough, and the perforated piece of cardboard in the middle
- Select the 1 0 V- and 3 A- measurement ranges, switch on the power supply, close the circuit and allow current to flow for 2 to 3 minutes
- Measure the current and observe the processes or changes that occur in the glass trough
- Note the measured values and observations

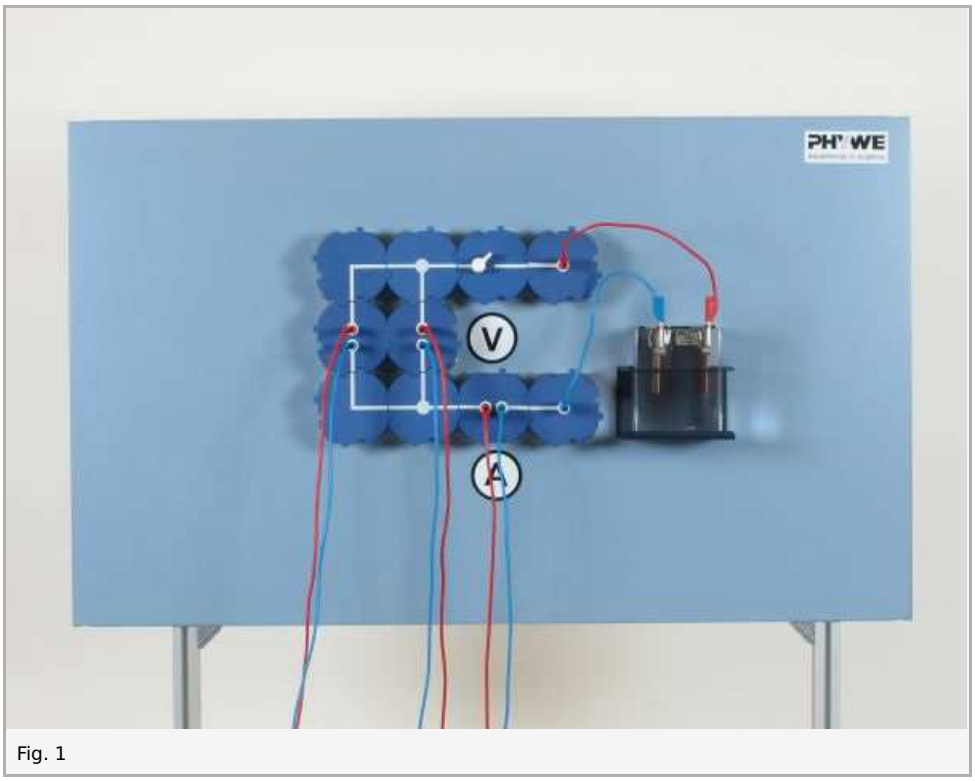


Fig. 1

Observation and evaluation

Observation

Current intensity $I = 1.4A$

Processes and Changes:

1. At the cathode; Lively formation of gas bubbles, which rise up in the aqueous solution and burst.
2. At the anode; Bluish-green colouration of the solution in the area between the anode and the piece of cardboard; gradual penetration of the perforated piece of cardboard by the coloured solution.

Evaluation

The sodium sulphate that has passed into solution dissociates:

$Na_2SO_4 \longrightarrow 2Na^+ + SO_4^{2-}$.

Na^+ ions migrate to the cathode and each takes up an electron there:

$Na^+ + e^- \longrightarrow Na$;

Atomic sodium splits water molecules:

$2Na + 2H_2O \longrightarrow 2NaOH + H_2 \uparrow$.

The gas bubbles that ascend at the cathode consist of hydrogen, and the sodium hydroxide that has formed dissociates again:

$NaOH \longrightarrow Na^+ + (OH)^-$.

The SO_4^{2-} ions migrate to the anode where they initiate the following reactions:

$SO_4^{2-} + Cu \longrightarrow CuSO4 + 2e^-$;

$CuSO_4 \longrightarrow Cu^{2+} + SO_4^{2-}$.

The bluish-green colouration of the solution is caused by the formation of copper sulphate, which immediately dissociates again, so that there is a continual increase in the copper ions present in the solution. Continually more sodium hydroxide and copper sulphate are formed in the aqueous solution of sodium sulphate. The decomposition of chemical compounds by electric current is designated electrolysis.

Remarks

In this experiment, the ammeter only serves to show that an electric current is flowing. The voltmeter can be done without.

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