

MODUL:

Recycling: Aluminium air batteries for easy recycling

DESCRIPTION OF PRACTICAL:

The purpose of the practical is to prepare a galvanic couple (battery) from aluminium and steel/copper. Aluminium can be recycled, so the use of aluminium increases for various applications, including the production of batteries (i.e., air batteries). They produce electricity from the reaction of oxygen in the air with aluminium. They also have one of the highest energy densities of all batteries.

To understand the mechanism of such batteries, we will perform battery galvanic coupling of two different metals presenting an anode and a cathode. The reduction reaction and the anode oxidation reaction take place on the cathode. This is an electrochemical process where the anode dissolves. The galvanic process is also comparable with the corrosion process. Both are carried out on two poles, cathodic and anodic. At anodic part, the metal dissolves; oxidation takes place, while hydroxide ions are released on the cathode as water is reduced.

MATERIAL:

- 500 mL beaker
- 1 L flask
- A piece of aluminium foil
- Steel cloth
- A piece of copper
- Ammeter with associated cables and connectors
- Paper towel
- Tweezers
- NaCl
- 1 L of distilled water



Figure 1: Basic supplies for experiment.

METHODS OF WORK:

1. First prepare 1 L of a 3.5 % NaCl solution, which represents an electrolyte. In a 500 mL beaker, place a crumpled piece of aluminium foil that has been punctured with tweezers. This enables access of the electrolyte to the inside. Aluminium is first electrode, representing one half of the galvanic couple. The aluminium is covered with a paper towel, which represents a semi-permeable membrane and a barrier between the two metals. Then another piece of metal is added to the beaker, e.g. a steel cloth representing the second half of the galvanic couple. Then the NaCl solution is added to the beaker. We connect both wires to the ammeter and measure current and potential.
2. In the second part of the experiment, the steel cloth is replaced with a piece of copper and the current and potential are again measured.
3. After the end of the exercise, pour the solution into the drain, rinse the metals and return them to the assistant.

RESULTS:

Enter the changes you see in the table.

	Measured current [mA]	Measured potential [mV]
Aluminium + copper		
Aluminium + steel cloth		

REPORT:

Observe the experiment and answer the questions.

TEST:

1. Describe the process of manufacturing the aluminium. Find the data regarding how much aluminium is currently recycled.
2. Write the reaction in battery consisting of aluminium and copper. Draw battery schematically.
3. Which metal represents the cathode/anode?
4. Write the reactions that take place in the individual metals.
5. Write the reaction equations for the aluminium air battery: anode oxidation and cathode reduction.
6. Write the reaction equations for aluminium-ion batteries.
7. Describe how the shown experiment is related to galvanic corrosion.
8. Aluminium alloy contains zinc and copper inclusions. Why are aluminium alloys less corrosion-resistant than pure aluminium?
9. What is the sacrificial electrode for anodic protection in the case of an iron boiler?
10. Draw an anode protection case.

EVALUATION OF THE PRACTICAL:

Knowledge for practical			
Experimental Exercise			
Results and answers			
Compliance with security rules:			
Review date:		Supervisor signature:	