

ALUMINIUM

USES, PROPERTIES AND EXTRACTION



Answer all the questions below then check your answers.

- Which ore is primarily used for the extraction of aluminium?
 - Hematite
 - Bauxite
 - Chalcopyrite
 - Galena
- What is the main reducing agent used in the Hall-Hérout process?
 - Carbon
 - Aluminium oxide
 - Cryolite
 - Electricity
- At which electrode is aluminium metal deposited during the Hall-Hérout process?
 - Anode
 - Cathode
 - Both electrodes
 - Neither electrode
- Which of the following is added to lower the melting point of aluminium oxide in the Hall-Hérout process?
 - Sodium chloride
 - Cryolite
 - Limestone
 - Silica
- Fill in the gaps to complete the sentences below:

During the Hall-Hérout process, aluminium oxide is dissolved in _____ to reduce its melting point.

b. In the Hall-Hérout process, aluminium is formed at the _____ electrode.

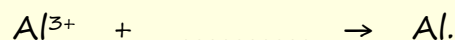
c. The chemical formula of cryolite is _____.

6. Match the following terms with their correct descriptions:

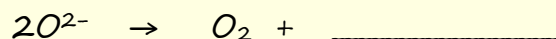
| Term | Description |
|----------|--|
| Bauxite | Ore from which aluminium is extracted |
| Cryolite | Added to reduce melting point of aluminium oxide |
| Cathode | Electrode where aluminium is deposited |
| Anode | Electrode where oxygen is formed |

7. Complete the sentences below to describe and explain the steps involved in the extraction of aluminium from bauxite using the Hall-Héroult process.

- Bauxite is first p_____ to obtain aluminium oxide (Al_2O_3).
- Aluminium oxide is then dissolved in _____ cryolite (Na_3AlF_6) to lower its melting point.
- The mixture is subjected to e_____ in a cell with _____ electrodes.
- Aluminium ions (Al^{3+}) are r_____ to form aluminium metal at the cathode (negative electrode), an equation for this reaction is:



- Oxygen ions (O^{2-}) are o_____ to form oxygen gas at the anode (positive electrode), an equation for this reaction is:



- Write the overall equation for the electrolysis of aluminium oxide during the Hall-Héroult process.

8. Why is cryolite used in the Hall-Héroult process?

9. Describe the role of the anode and cathode in the Hall-Héroult process.
10. What are the environmental concerns associated with the Hall-Héroult process?

Answers

1. Which ore is primarily used for the extraction of aluminium?

- a) Hematite b) Bauxite c) Chalcopyrite d) Galena

Answer: b) Bauxite

2. What is the main reducing agent used in the Hall-Hérout process?

- a) Carbon b) Aluminium oxide c) Cryolite d) Electricity

Answer: d) Electricity

3. At which electrode is aluminium metal deposited during the Hall-Hérout process?

- a) Anode b) Cathode c) Both electrodes d) Neither electrode

Answer: b) Cathode

4. Which of the following is added to lower the melting point of aluminium oxide in the Hall-Hérout process?

- a) Sodium chloride b) Cryolite c) Limestone d) Silica

Answer: b) Cryolite

5. Fill in the gaps to complete the sentences below:

During the Hall-Hérout process, aluminium oxide is dissolved in _____
to reduce its melting point.

Answer: Cryolite

b. In the Hall-Hérout process, aluminium is formed at the _____ electrode.

Answer: negative (the cathode)

c. The chemical formula of cryolite is _____.

Answer: Na_3AlF_6

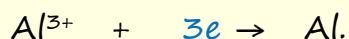
6. Match the following terms with their correct descriptions:

| Term | Description |
|----------|--|
| Bauxite | Ore from which aluminium is extracted |
| Cryolite | Added to reduce melting point of aluminium oxide |
| Cathode | Electrode where aluminium is deposited |
| Anode | Electrode where oxygen is formed |

7. Complete the sentences below to describe and explain the steps involved in the extraction of aluminium from bauxite using the Hall-Héroult process.

Answer:

- Bauxite is first **purified** to obtain aluminium oxide (Al_2O_3).
- Aluminium oxide is then dissolved in **molten** cryolite (Na_3AlF_6) to lower its melting point.
- The mixture is subjected to **electrolysis** in a cell with **carbon (graphite)** electrodes.
- Aluminium ions (Al^{3+}) are **reduced** to form aluminium metal at the cathode (negative electrode), an equation for this reaction is:



- Oxygen ions (O^{2-}) are **oxidised** to form oxygen gas at the anode (positive electrode), an equation for this reaction is:



- Write the overall equation for the electrolysis of aluminium oxide during the Hall-Héroult process.



8. Why is cryolite used in the Hall-Héroult process?

Answer: Cryolite is used in the Hall-Héroult process to dissolve aluminium oxide and lower its melting point, which reduces the energy required for electrolysis.

9. Describe the role of the anode and cathode in the Hall-Héroult process.

Answer:

The cathode is the electrode where reduction occurs, and aluminium metal is deposited.

The anode is the electrode where oxidation occurs, and oxygen gas is released. However the oxygen gas formed at the anode cause the carbon anode to burn or combust to form carbon dioxide gas, this means that the anode is slowly burning away in the cell and needs to be regularly replaced.

10. What are the environmental concerns associated with the Hall-Héroult process?

Answer:

The process consumes a significant amount of electricity, often derived from non-renewable sources, contributing to carbon emissions.

The carbon anodes are consumed, producing carbon dioxide.

Disposal of the spent electrolyte and other by products can lead to environmental pollution if not managed properly.