

## e-CTLT

### Class-XII

### Topic- General principles and process of isolation of elements

### Master topic- Extraction of Aluminium

#### Concept detail

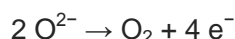
Aluminium forms strong **chemical bonds** with oxygen. Compared to most other metals, it is difficult to extract from ore, such as **bauxite**, due to the high reactivity of aluminium and the high melting point of most of its ores. For example, direct reduction with **carbon**, as is used to produce **iron**, is not chemically possible because aluminium is a stronger reducing agent than carbon. Indirect carbothermic reduction can be carried out using carbon and  $\text{Al}_2\text{O}_3$ , which forms an intermediate  $\text{Al}_4\text{C}_3$  and this can further yield aluminium metal at a temperature of 1900–2000 °C. This process is still under development; it requires less energy and yields less  $\text{CO}_2$  than the **Hall-Héroult process**, the major industrial process for aluminium extraction.<sup>[19]</sup> Electrolytic smelting of alumina was originally cost-prohibitive in part because of the high melting point of alumina, or aluminium oxide, (about 2,000 °C (3,600 °F)). Many minerals, however, dissolve into a second already molten mineral, even if the temperature of the melt is significantly lower than the melting point of the first mineral. Molten **cryolite** was discovered to dissolve alumina at temperatures significantly lower than the melting point of pure alumina without interfering in the smelting process. In the **Hall-Héroult process**, alumina is first dissolved into molten cryolite with **calcium fluoride** and then electrolytically reduced to aluminium at a temperature between 950 and 980 °C (1,740 and 1,800 °F). Cryolite is a chemical compound of aluminium and **sodium fluorides**: ( $\text{Na}_3\text{AlF}_6$ ). Although cryolite is found as a mineral in **Greenland**, its synthetic form is used in the industry. The aluminium oxide itself is obtained by refining bauxite in the **Bayer process**.

The electrolytic process replaced the **Wöhler process**, which involved the reduction of anhydrous aluminium chloride with **potassium**. Both of the **electrodes** used in the electrolysis of aluminium oxide are carbon. Once the refined alumina is dissolved in the electrolyte, it disassociates and its ions are free to move around. The reaction at the **cathode** is:



Here the aluminium ion is being **reduced**. The aluminium metal then sinks to the bottom and is tapped off, usually cast into large blocks called **aluminium billets** for further processing.

At the **anode**, oxygen is formed:



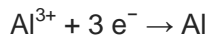
To some extent, the carbon anode is consumed by subsequent reaction with oxygen to form carbon dioxide. The anodes in a reduction cell must therefore be replaced regularly, since they are consumed in the process. The cathodes do erode, mainly due to electrochemical processes and metal movement. After five to ten years, depending on the current used in the electrolysis, a cell must be rebuilt because of cathode wear.

#### Activity

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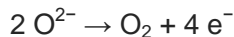
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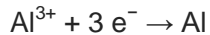
### **Diagnostic concept**

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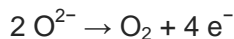
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1. What is meant by electrolysis?
  2. What is the difference b/w ore and mineral?
  3. What is the name of chief ore of bauxite?
  4. What are cathode and anode?
  5. Why cryolite is add to the ore?
1. what is the difference b/w ore and mineral?
  2. what is meant by term gauge?
  3. what is the chief ore of aluminium
  4. why cryolite is add to the alumina?
  5. what are alloys?

6. what is the chief alloy of aluminum used for making of aircraft?

#### Assignment A

1. what are ore and minerals?

2. Define Gangue?

#### Assignment B

What is the chief ore of bauxite?

#### Assignment C

What are the steps of extraction of aluminum?