Jassmate
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CLASS- X SUBJECT- CHEMISTRY

CHAPTER- 7 TEACHER- ANAMIKA

Extraction of Aluminium :-

Ore of Aluminium - Bauxite $Al_2O_3.2H_2O$

Concentration or purification of bauxite ore - Bauxite ore is purified by chemical method. The chemical used in concentrated caustic soda solution (NaOH). This method is called as Bayer's process.

Bayer's Process :-

1. Finely grinded bauxite is first heated to remove volatile impurities. Then the ore is heated with conc. NaOH solution under pressure for 2-8 hours.

$$\underset{\text{Bauxite}}{Al_2O_3.2H_2O} + 2NaOH \xrightarrow{150^\circ C} \underset{\text{Sodium meta aluminate}}{2NaAlO_2} + 3H_2O$$

Bauxite dissolves in NaOH forming sodium meta aluminate leaving behind the insoluble impurities. The impurities contain ferric oxide, sand etc. and are called red mud.

2. The impurities are filtered and sodium meta alumin - ate is diluted with water.

$$NaAlO_2 + 2H_2O \xrightarrow{50^\circ C} NaOH + \underset{\text{Aluminium hydroxide (ppt)}}{Al(OH)_3}\downarrow$$

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On cooling the solution forms precipitate of aluminium hydroxide. The impurities remain dissolved in NaOH.

3. The precipitate of aluminium hydroxide is filtered, washed, dried and heated at 1000°C to obtain aluminium oxide or alumina (Al_2O_3)

$$2Al(OH)_3 \xrightarrow[1000^\circ C]{Heat} \underset{\text{Alumina}}{Al_2O_3} + 3H_2O$$

Reduction of Alumina (Al_2O_3)

Aluminium oxide is a very stable compound because of the strong affiny of aluminium for oxygen. It can not be reduced by heating with common reducing agents thus alumina is reduced by electrolytic.

Electrolytic Reduction of fused Alumina

For electrolysis molten alumina was required, but it melts at very high temperature 2050°C and at this temperature the aluminium obtained vaporises thus it was difficult to collect aluminium. Hall discovered that instead of using pure alumina if a mixture of alumina (20%), another ore of aluminium called cryolite (60%) and calcium fluoride (20%) is used as electrolyte, it melts at 950°C. After this discovery,

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Aluminium could easily be extracted and it became a cheap metal.

Students, let us discuss the next topic of this chapter which is 'Hall-Heroult's Process'

Hall - Heroult's Process

Electrolytic cell :- It is made of a rectangular iron tank with sloping bottom. The inner lining of tank is make of gas carbon.

Electrolyte :- Mixture of molten alumina 20%, cryolite (Na_3AlF_6) 60% and fluorspar (CaF_2) 20%. Powdered coke is sprinkled on the surface of electrolyte.

Temperature :- The electrolyte is kept in molten state by electrical heating at 950°C.

Voltage :- 5 to 6 Volts.

Anode :- Thick graphite rods suspended into the fused (molten) electrolyte.

Cathode :- Inner carbon lining of the electrolytic cell.

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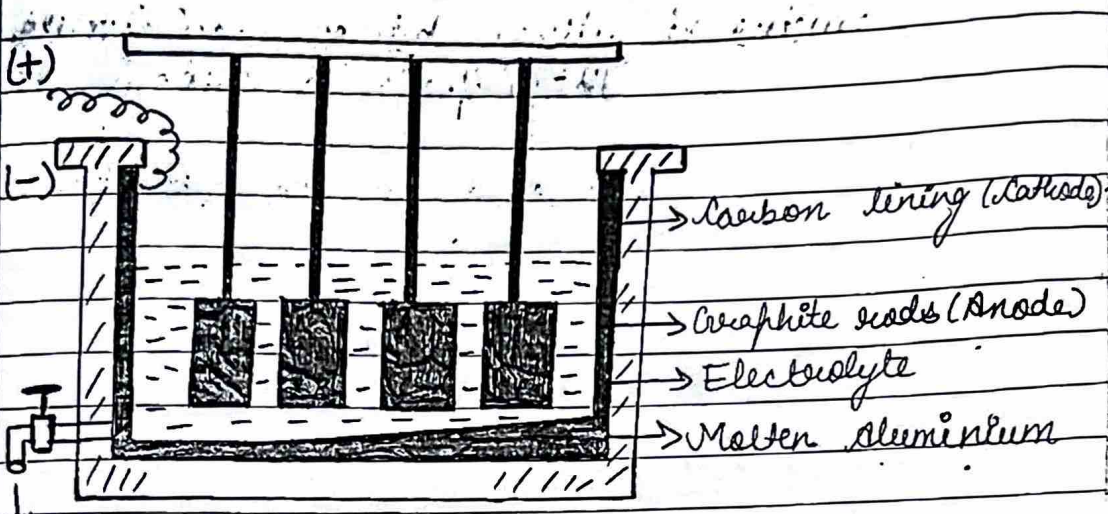

REACTIONS :-

The components of electrolyte decompose to produce the following ions—

Cryolite :- $Na_3AlF_6 \rightleftharpoons 3Na^+ + Al^{3+} + 6F^-$

Fluorspar :- $CaF_2 \rightleftharpoons Ca^{2+} + 2F^-$

Alumina :- $Al_2O_3 \rightleftharpoons 2Al^{3+} + 3O^{2-}$

Cations — Na^+, Al^{3+} and Ca^{2+}

Al^{3+} will get discharged at the cathode as it is lower in the electrochemical series.

Anions — F^- and O^{2-}

O^{2-} is lower in the series and is discharged at anode.

Cathode reaction :-

$$Al^{3+} + 3e^- \rightarrow Al$$

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Anode reaction :-

$$O^{2-} - 2e^- \rightarrow O$$

$$O + O \rightarrow O_2$$

The oxygen evolved at anode reacts with carbon of anode to form carbon monoxide, which further forms carbon dioxide.

$$2C + O_2 \rightarrow 2CO$$

$$2CO + O_2 \rightarrow 2CO_2$$

The Graphite anodes get oxidised by the oxygen evolved into CO_2. Thus they have to be replaced from time to time.

Function of cryolite :-

(i) Acts as a solvent for the electrolytic mixture.

(ii) Lowers the fusion temperature from 2050°C to 950°C and also enhances the conductivity of alumina.

Function of fluorspar :-

(i) Acts as a solvent for the electrolytic mixture.

(ii) Increases the conductivity of alumina.

Function of Powdered coke

It is sprinkled over the surface of electrolytic mixture.

(i) It reduces the heat loss by radiation

(P.T.O)

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(iii) It prevents the burning of anode.

Now, I will ask you three a very short Questions. You will get a three minutes break to write the answers.

The Questions are:-

Q1:- Name the two states in which metals are found in the Earth's Crust.

Q2:- Give the formula of cryolite

Q3:- What should be the range of voltage in Hall-Heroult's Process

I hope you all have written the answers by now. Let us check the answers by now.

Ans1:- free or combined.

Ans2:- Na_3AlF_6

Ans3:- 5 to 6 volt.

Now, I am ending the lesson for today by giving 'Instructions' and 'Homework'

HOMEWORK & INSTRUCTIONS:-

Students kindly read the topics from text-book & then from the given notes. Do Questions 3, 4 & 7 from Exercise 7(C) given on page no 132