Nishant Jindal

Al $Al_2O_3 \cdot 2H_2O$ [bauxite]

① crushing

② Conc. → leaching

bauxite

→ Red bauxite having impurities of Fe_2O_3 (maj.), SiO_2, TiO_2 } min.

Bayer's process, Hall process

→ White bauxite having impurities of SiO_2 (maj.), TiO_2, Fe_2O_3 } min.

Serpek's process

Bayer's Process

① leaching agent → NaOH

based on Amphoteric nature of Al_2O_3

$Al_2O_3 \cdot 2H_2O$
Fe_2O_3
SiO_2
TiO_2

(i) Calcination
(ii) digested with 40% NaOH and filtered

$Na[Al(OH)_4]$, Na_2SiO_3 → filtrate

Red mud (Fe_2O_3, TiO_2) → Red mud (Residue)

$Al_2O_3 + NaOH \longrightarrow Na[Al(OH)_4]$ (soluble)

$Fe_2O_3 + NaOH \longrightarrow \times$

$TiO_2 + NaOH \longrightarrow \times$

$SiO_2 + NaOH \longrightarrow Na_2SiO_3$ (soluble)

$Na[Al(OH)_4]$ $\xrightarrow[\text{(ii) acidification by passing } CO_2 \text{ gas}]{\text{(i) dilution with huge water}}$ $Al(OH)_3$ (White ppt.)

$\downarrow$ 1100°C

$Al_2O_3 + H_2O\uparrow$

(pure)

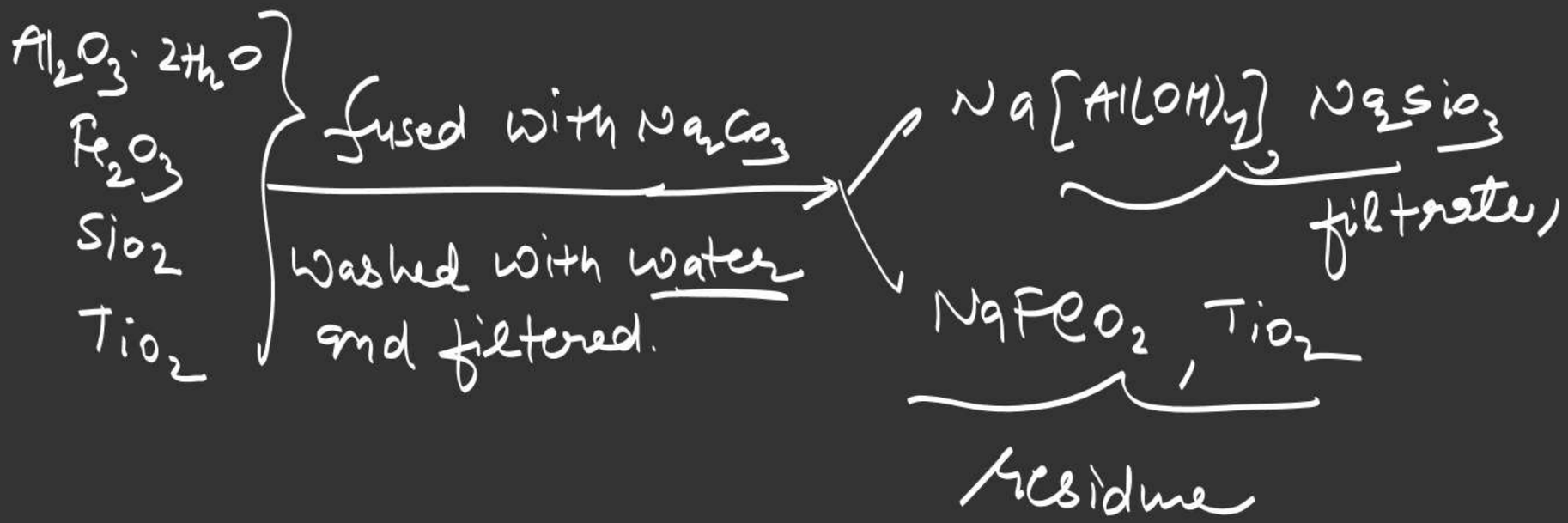
(Corundum)

$$Na[Al(OH)_4] + H_2O \rightleftharpoons NaOH + Al(OH)_3$$

$$CO_2 + H_2O \rightleftharpoons H_2CO_3$$

$$H_2CO_3 \rightleftharpoons 2H^+ + CO_3^{-2}$$

Hall process



$$Al_2O_3 + Na_2CO_3 \xrightarrow{\Delta} NaAlO_2 + CO_2\uparrow$$

Sodium meta aluminate

$$\underbrace{NaAlO_2 + H_2O} \rightleftharpoons Na[Al(OH)_4]$$

Sodium meta aluminate

$$Fe_2O_3 + Na_2CO_3 \xrightarrow{\Delta} NaFeO_2 + CO_2\uparrow$$

$$SiO_2 + Na_2CO_3 \longrightarrow Na_2SiO_3 + CO_2\uparrow$$

$$TiO_2 + Na_2CO_3 \longrightarrow \times$$

$$Na[Al(OH)_4] + H_2O + CO_2 \text{ (excess from out side)} \longrightarrow Al(OH)_3 + NaCO_3$$

$$Al(OH)_3 \xrightarrow{1100^\circ C} Al_2O_3 + H_2O$$

Nishant Jindal

Serpek's Process

$$Al_2O_3 + C + N_2 \xrightarrow{1800^\circ C} AlN + CO\uparrow$$

$$SiO_2 + C \xrightarrow{1800^\circ C} Si\downarrow + CO\uparrow$$

$$AlN + NaOH + H_2O \longrightarrow Na[Al(OH)_4] + NH_3\uparrow$$

Nishant Jindal

Pidgen Process → extraction of Mg from dolomite

$$CaCO_3 \cdot MgCO_3 \xrightarrow{\Delta} CaO \cdot MgO + CO_2 \uparrow$$

Reduction

$$CaO \cdot MgO + \underset{\text{ferro silicon}}{Fe-Si} \longrightarrow \underline{Mg} + Fe + Ca_2SiO_4$$

Nishant Jindal

Kroll process

$$TiCl_4 + \underset{(R.A)}{Ca/Mg} \xrightarrow{\Delta} Ti + CaCl_2/MgCl_2$$

Nishant Jindal

Li
K
Ca
Na
Mg
Al

Electrolytic reduction [Hall-Heroult process]

Problems in electrolytic reduction of Al_2O_3

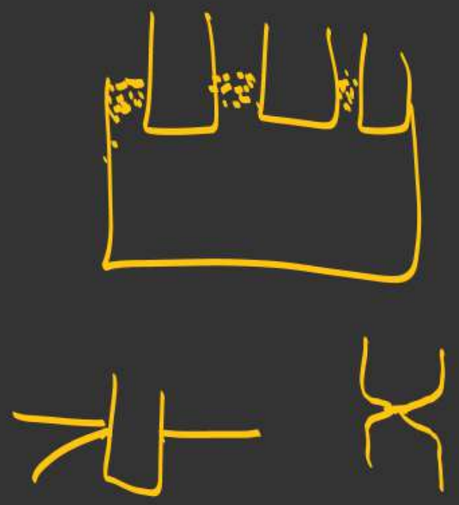
1. high M.P of Al_2O_3
2. Al_2O_3 is bad conductor

for removal these problem Na_3AlF_6 and CaF_2

Nishant Jindal

Function of Na_3AlF_6 and CaF_2

1. ↑ Conductivity of Al_2O_3
2. ↓ M.P of Al_2O_3



$$Na_3AlF_6 \longrightarrow \underline{NaF} + \underline{AlF_3}$$

$$NaF \longrightarrow Na^+ + F^\ominus$$

$$AlF_3 \longrightarrow Al^{+3} + 3F^\ominus$$

at cathode

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

at anode

$$F^\ominus \longrightarrow \frac{1}{2}F_2 + e^-$$

F_2 further react with Al_2O_3

$$Al_2O_3 + F_2 \longrightarrow AlF_3 + O_2$$

O_2 react with anode

$$C + O_2 \longrightarrow CO$$
$$CO + O_2 \longrightarrow CO_2$$

Function of layer of coke powder

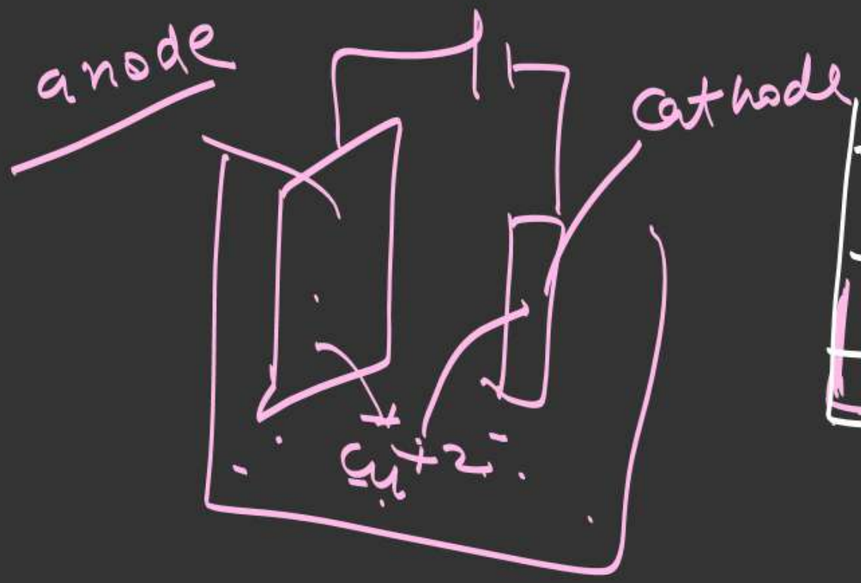
① it prevents corrosion of graphite rod.

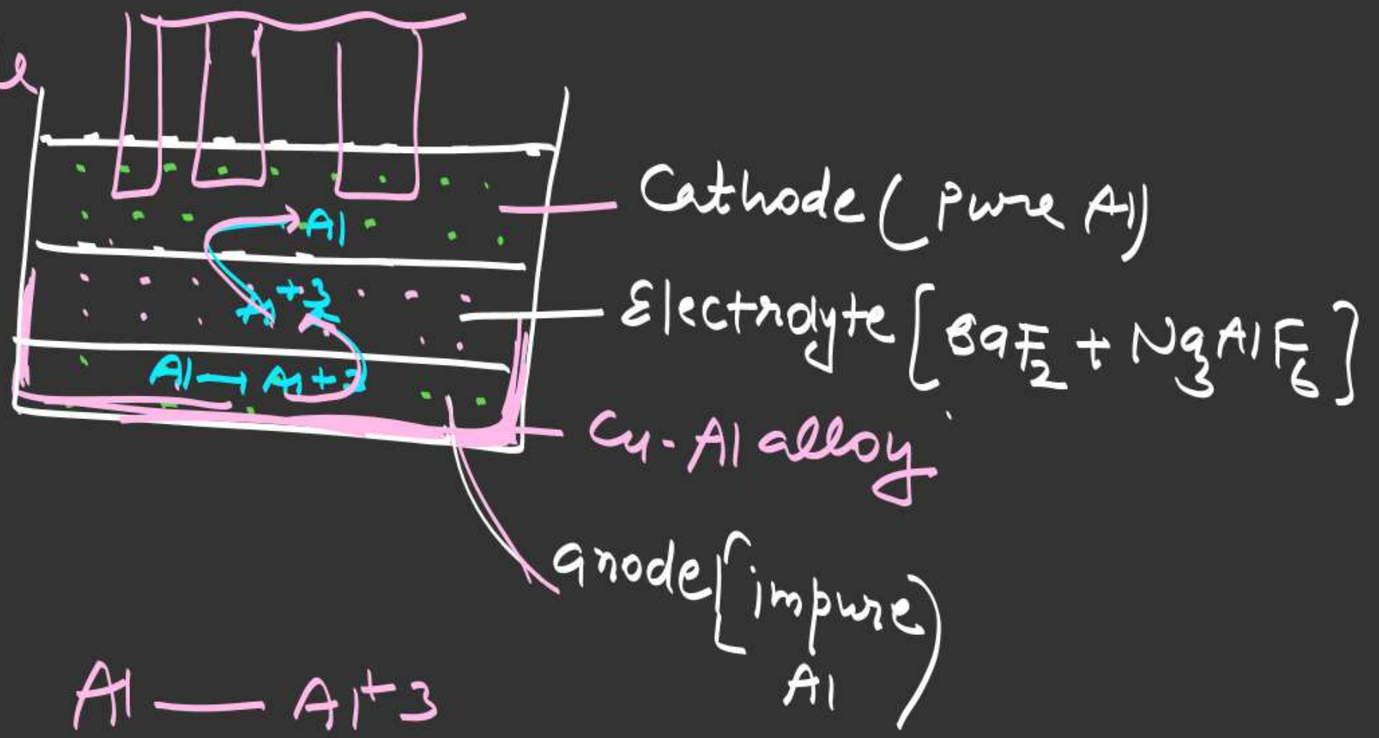
② it does not allow to escap to Heat

Nishant Jindal

Purification

Hoop's





$Al \rightarrow Al^{+3}$