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Fe_2O_3

① Crushing

② Conc. → gravity sep. Method followed by magnetic sep. method.

③ Roasting

Fe_2O_3

Impurities { $FeCO_3$ $\xrightarrow{\Delta}$ $FeO + CO_2$; $Fe_2O_3 \cdot 3H_2O$ $\xrightarrow{\Delta}$ $Fe_2O_3 + H_2O$; Fe_3O_4 $\xrightarrow{\Delta}$ $FeO + Fe_2O_3$; SiO_2 }

$Fe_2O_3 + SiO_2 \rightarrow X$

$FeO + SiO_2 \rightarrow FeSiO_3$ (Slag)

$FeO + \frac{1}{2}O_2 \rightarrow Fe_2O_3$

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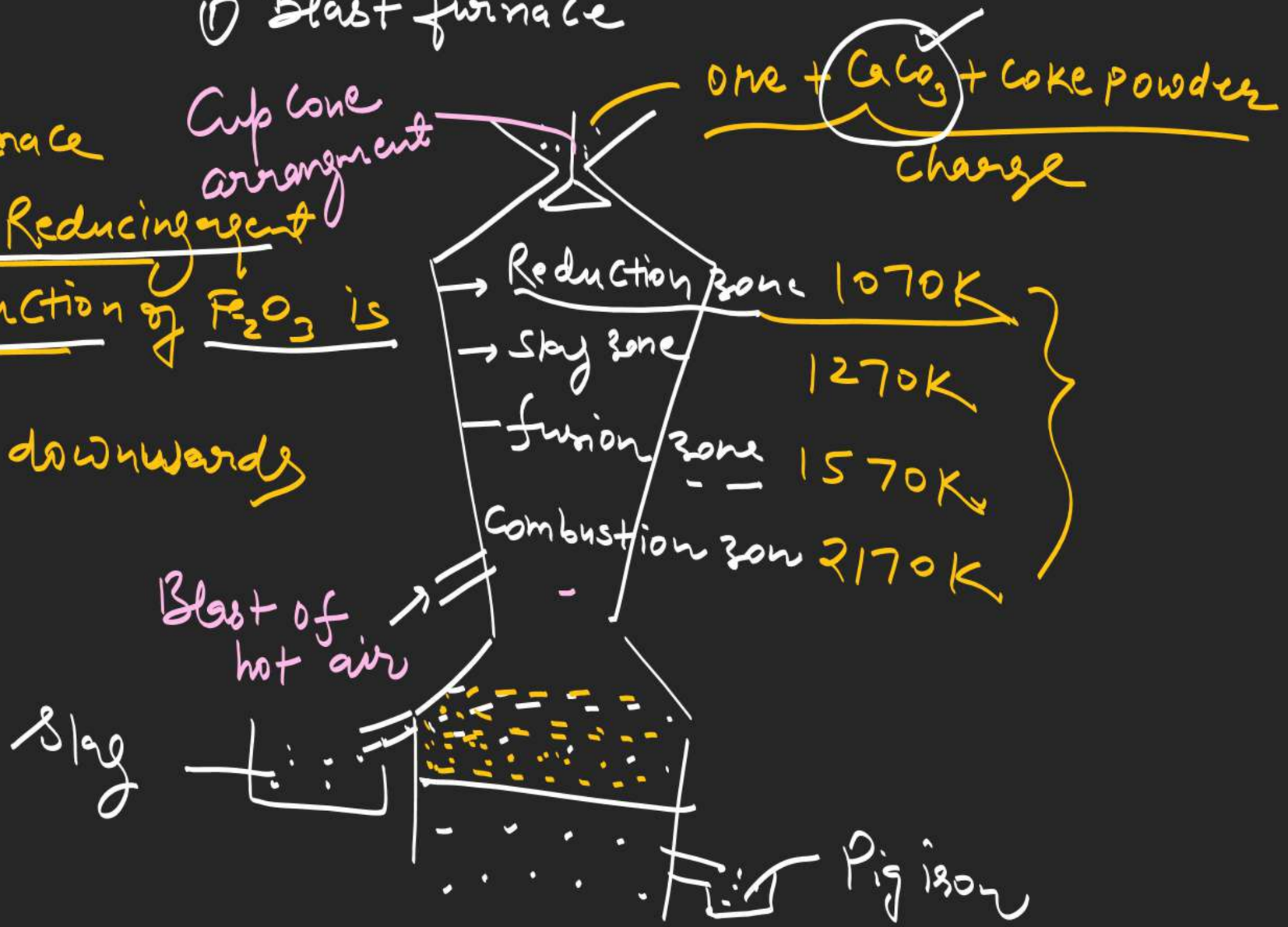
Carbon Reduction (Smelting)

① Blast furnace

① Blast furnace
② Principle Reducing agent for reduction of Fe_2O_3 is CO
③ reactions downwards



Function of layer of slag

it prevent the oxidation of iron.

Combustion zone

$$C + O_2 \longrightarrow CO_2$$

$$CO_2 + C \longrightarrow \underline{\underline{CO}}$$

Reduction

$$Fe_2O_3 + \underline{\underline{CO}} \longrightarrow Fe + CO_2$$

Stepwise

$$Fe_2O_3 + \underline{\underline{CO}} \longrightarrow \underset{(FeO + Fe_2O_3)}{Fe_3O_4} + CO_2$$

$$Fe_3O_4 + \underline{\underline{CO}} \longrightarrow FeO + CO_2$$

$$FeO + \underline{\underline{CO}} \longrightarrow Fe + CO_2$$

(Spongy iron)

Note ⇒

above 710°C → Carbon good reducing agent

below 710°C → Carbon mono oxide is good R.A

Slag

$$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$$

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

(Slag)

Fusion Zone

$$MnO_2 + C \longrightarrow Mn + CO_2\uparrow$$

$$SiO_2 + C \longrightarrow Si + CO_2\uparrow$$

$$SO_2 + C \longrightarrow S + CO_2\uparrow$$

$$P_4O_{10} + C \longrightarrow P_4 + CO_2\uparrow$$

Impurities of Fe

Mn Si S P C

मान सी सुंदर है प्रथम चोपड़ा की

Note ⇒ iron is obtained from blast furnace is called Pig iron
it is cast in diff. variety of shapes

(4% Carbon impurity) Pig iron is diff. from cast iron (3% Carbon impurity) and made by heating of Pig iron with coke powder and scrap iron by passing hot blast air.

Cast iron is extremly hard and brittle

Purification iron

Puddling process

in this process puddling furnace/reverberatory furnace. used having inner lining of Fe_2O_3, and Fe_2O_3 0.4

$Mn + Fe_2O_3 \longrightarrow MnO + Fe$

$Si + Fe_2O_3 \longrightarrow SiO_2 + Fe$

$MnO + SiO_2 \longrightarrow MnSiO_3$ (Slag)

$S + Fe_2O_3 \longrightarrow SO_2\uparrow + Fe$

$C + Fe_2O_3 \longrightarrow CO\uparrow + Fe$

$P_4 + Fe_2O_3 \longrightarrow P_4O_{10} + Fe$

$P_4O_{10} + Fe_2O_3 \rightarrow FePO_4$ (Slag)

type of iron

	impurity
Cast iron	2 to 5%
Steel	0.5 to 2%
Wrought iron	< 0.5

(purest form of Fe)

Commercial iron

Melable iron

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Steel

1. Bessemerisation [Thomas process]
2. Open hearth process [Simen martin process]
3. L-D process [B.O.P]
   - Lin
   - Donawitz

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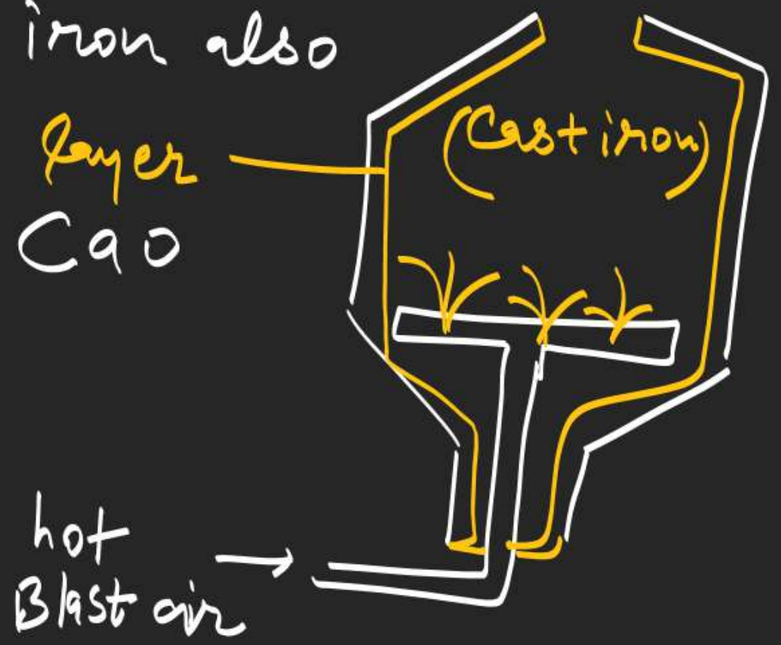
Bessemerisation

Bessemer convertor

Note ⇒ 10 - 15% iron also oxidised and iron nitride



$Mn + O_2 \longrightarrow MnO$

$Si + O_2 \longrightarrow SiO_2$

$MnO + SiO_2 \longrightarrow MnSiO_3$ (slag)

$S + O_2 \longrightarrow SO_2 \uparrow$

$C + O_2 \longrightarrow CO_2 \uparrow$

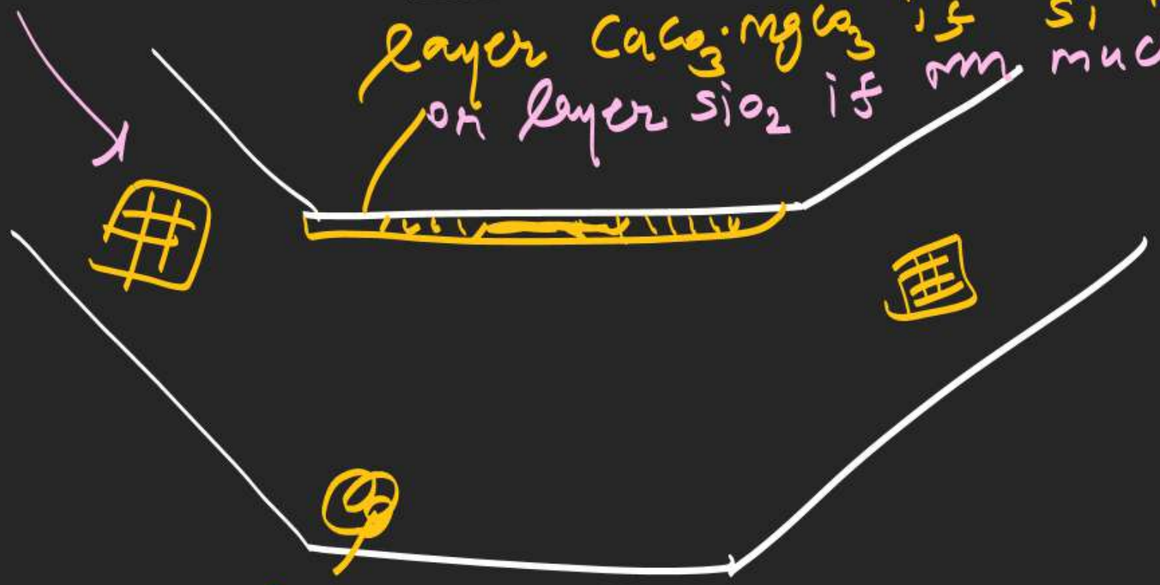
$P_4 + O_2 \longrightarrow P_4O_{10}$

$P_4O_{10} + CaO \longrightarrow Ca_3(PO_4)_2$

Thomas slag

Open Hearth process

Producer gas
$(CO + N_2)$



Cast iron + Fe_2O_3 + Scrap iron
(O.A)

Note ⇒ In this process only 5% iron oxidised.

L.D [Basic oxygen process]

1. Electric furnace
2. Heating effect produced by electricity
3. pure oxygen is used instead of air

Now-a-days steel is produce by L.D process.

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treatment of steel

- Heating
  - Annealing
  - Quenching
  - tempering
- Surface
  - Case Hardning
  - nitriding

Annealing ⇒ Process of Heating of steel up to bright Redness and then cooling it Slowly so steel becomes soft and elastic

Quenching ⇒ Process of Heating of steel up to bright Red ness then Cooling it suddenly

So steel becomes hard and brittle.

tempering :— Process of heating of Quenched steel below Redness and then cooling it slowly so hardness remains same but brittleness disappear.

Surface treatment

① Case hardning → Process of Producing hard coating of iron carbide by treating it with Charcoal.

② Nitriding → Process of Producing hard coating of iron nitride by treating it with N_2