Extration of Ag

Mac Arthur forest process / cyanide process

(1) Crushing

(2) Conc. → leaching

$$Ag_2S + NaCN \xrightleftharpoons{air(O_2)} Na[Ag(CN)_2] + Na_2S$$

$$Na_2S + O_2 + H_2O \longrightarrow NaOH + Na_2SO_4 + S\downarrow$$

(3) hydrometallurgic reduction

$$Na[Ag(CN)_2] + \underset{(C.R.A)}{Zn} \longrightarrow Na_2[Zn(CN)_4] + Ag$$

(4) purification

at anode

$$Ag \longrightarrow Ag^+ + e^-$$

at Cathode

$$Ag^+ + e^- \longrightarrow Ag$$

(2) Amalgamation

Extraction of Au from native ore

Mac Arthur forest process / cyanide process

1. Crushing
2. Conc. — leaching

$$4Au + 8KCN + O_2 + 2H_2O \longrightarrow 4K[Au(CN)_2] + 4KOH$$

Soluble

Function of O_2 = O.A

Hydrometallurgic reduction

$$2K[Au^{+}(CN)_2] + Zn^{0} \longrightarrow K_2[Zn^{+2}(CN)_4] + Au^{0}$$

(R.A)

Purification

1. Electrorefining
2. Amalgamation

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https://chat.whatsapp.com/FoWgW5D0tit3cg2glA43Dj

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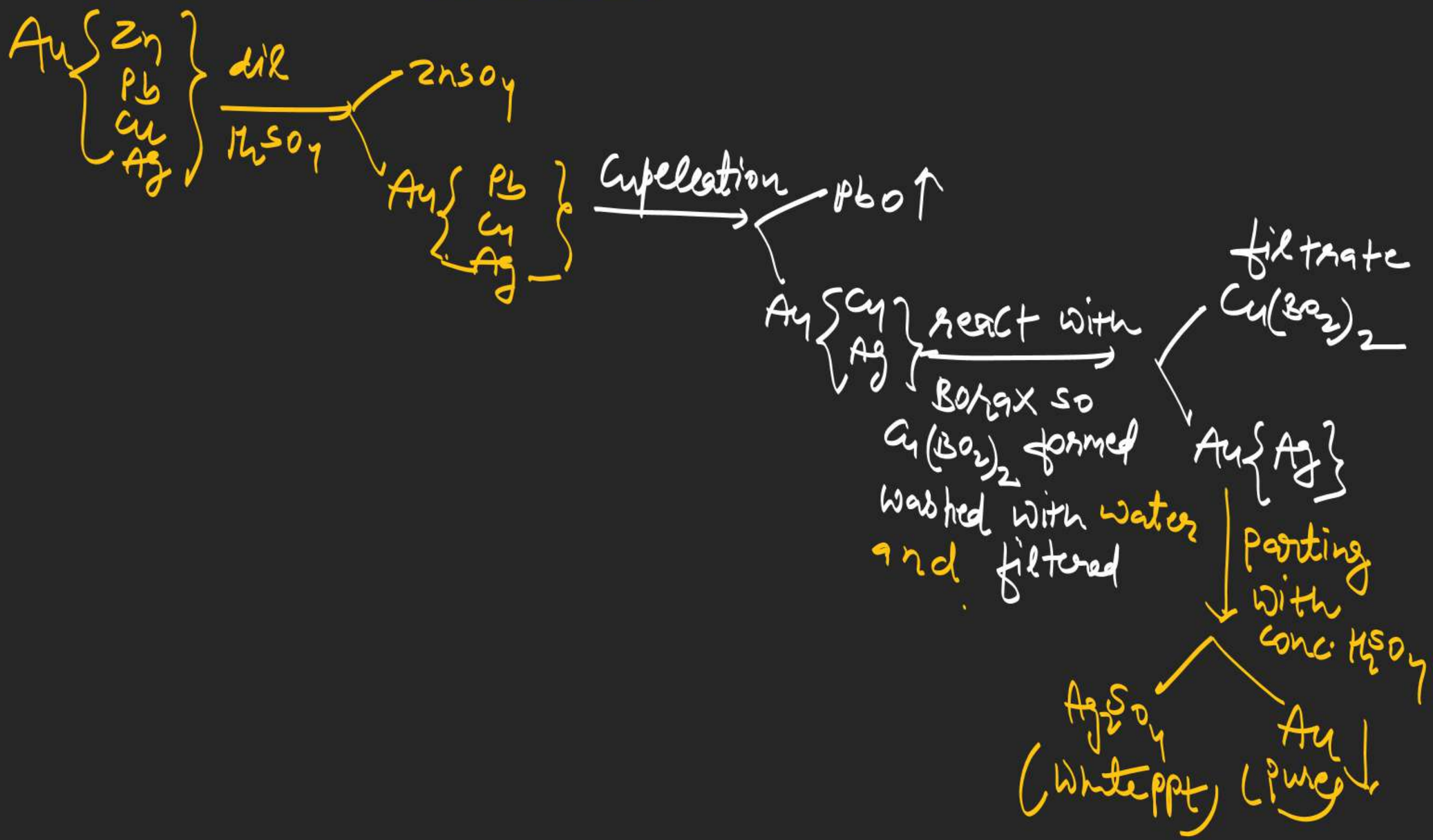
Purification of Au



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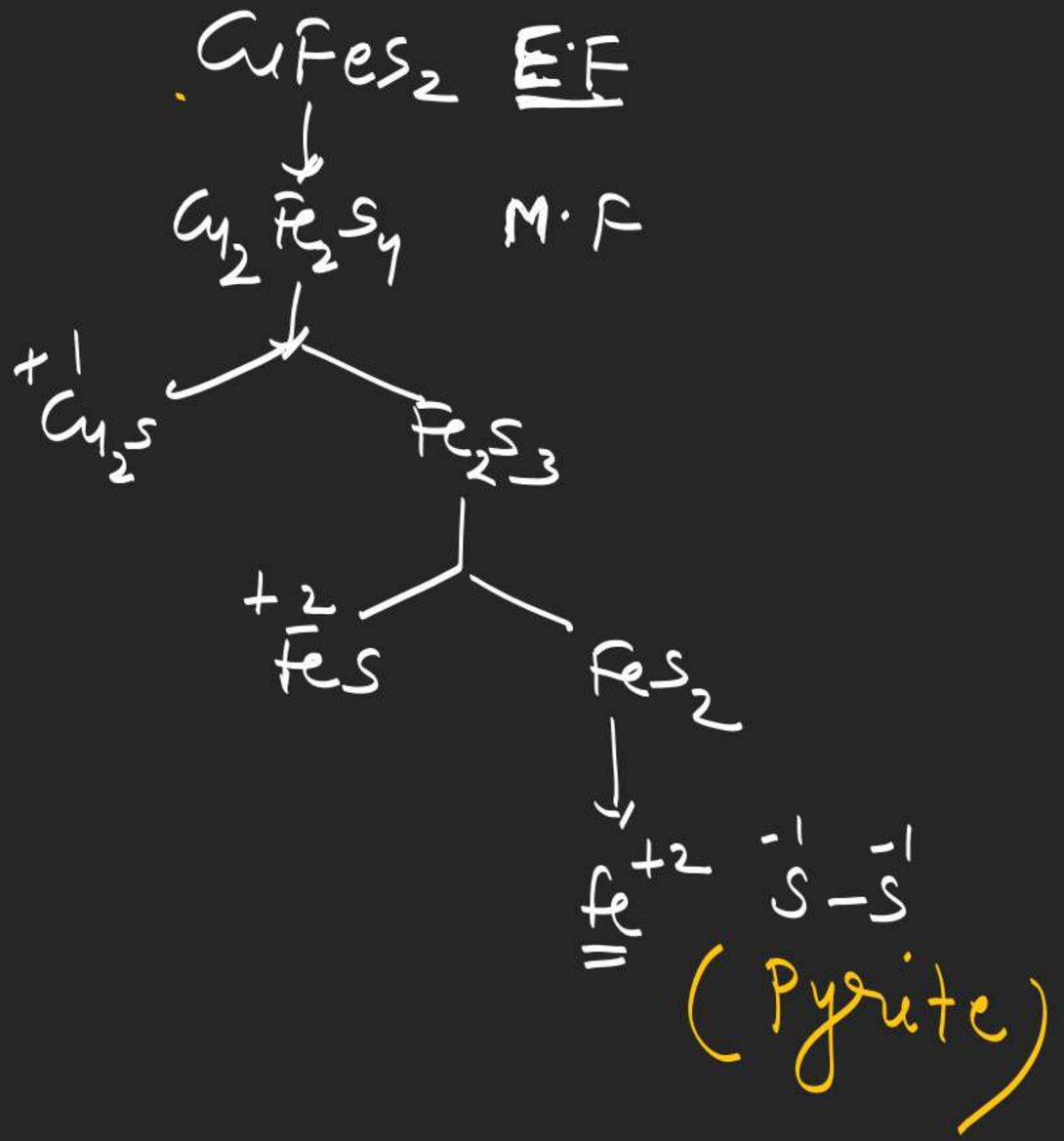
$CuFeS_2$

1. Crushing
2. Conc. → Froth flotation
3. Roasting

$$CuFeS_2 + O_2 \xrightarrow{\Delta} Cu_2S + FeO + SO_2\uparrow$$

Sometimes Roasting may not bring about Complete oxidation.



$$Cu_2S + O_2 \longrightarrow Cu_2O + SO_2$$

$$FeS + O_2 \longrightarrow FeO + SO_2$$

Iron has higher oxygen affinity so it will extract oxygen from Cu_2O

$$FeS + Cu_2O \longrightarrow FeO + Cu_2S$$

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Smelting

Roasted ore [FeO, Cu_2S, FeS and little Cu_2O] added in Blast furnace with Coke powder and SiO_2

Note ⇒ Coke powder here does not act as Reducing agent it act as fuel.

$FeO + SiO_2 \longrightarrow FeSiO_3$ (Slag)

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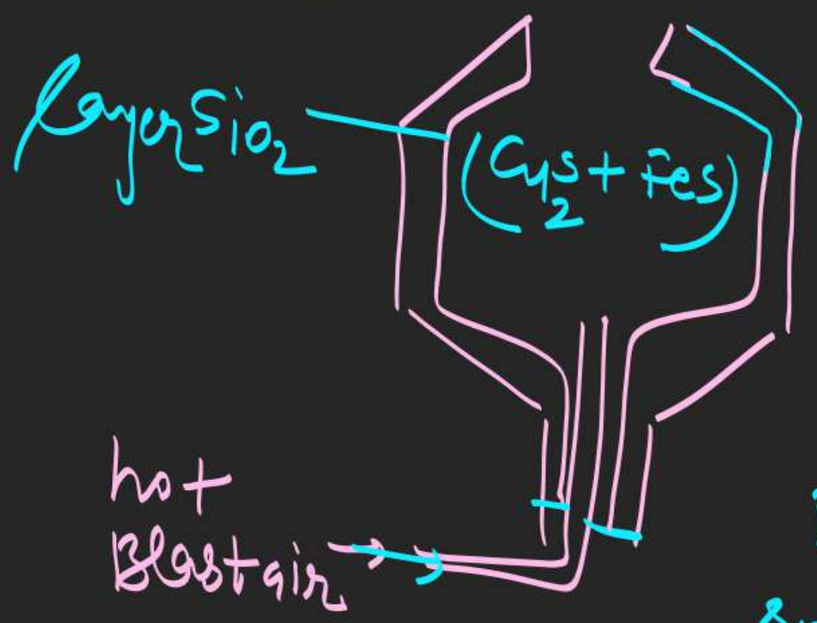
after removal of slag

$(Cu_2S + FeS)$ called copper matte

78% 2%

Copper matte introduce in Bessemer convertor

Bessemerisation



$FeS + O_2 \longrightarrow FeO + SO_2\uparrow$

$FeO + SiO_2 \longrightarrow FeSiO_3$ (slag)

Note ⇒ When FeO formed then green flame appears and disapperence of green flame indicate that slag formation is completed. So air cut off

$Cu_2S + O_2 \longrightarrow Cu_2O + SO_2$

$Cu_2S + O_2 \longrightarrow Cu_2SO_4$

Self Reduction

$Cu_2S + Cu_2O \longrightarrow Cu + SO_2$

$Cu_2S + Cu_2SO_4 \longrightarrow Cu + SO_2$

(Blister Cu)

98% Pure

Note ⇒ evolve SO_2 left blister appear so it is called blister Cu.

Purification :→

Electrorefining

Sn

1. Crushing
2. Conc → gravity sep. followed by magnetic sep. method for removal wolframite
3. Roasting →

$$S + O_2 \longrightarrow SO_2 \uparrow$$
$$As + O_2 \longrightarrow As_2O_3 \uparrow$$
$$Sb + O_2 \longrightarrow Sb_2O_3 \uparrow$$
$$CuS + O_2 \longrightarrow CuSO_4$$
$$FeS + O_2 \longrightarrow FeSO_4$$

SnO_2 + $FeSO_4$ + $CuSO_4$ } dissolve in water filter → filtrate ($FeSO_4$ / $CuSO_4$)

→ SnO_2 (residue)

Reduction [carbon reduction / smelting]

$$SnO_2 + C \longrightarrow Sn + CO$$

$$SnO_2 + CO \longrightarrow Sn + CO_2$$

if SiO_2 present as impurity then $CaCO_3$ is added as flux

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

$$CaO + SiO_2 \longrightarrow CaSiO_3 \text{ (Slag)}$$

Purification → poling

Electrorefining

ZnS

1. Crushing
2. Froth flotation
3. Roasting

$$\begin{cases} ZnS + O_2 \xrightarrow[850^\circ C]{\text{above}} ZnO + SO_2 \uparrow \\ ZnS + O_2 \xrightarrow[800^\circ C]{\text{below}} ZnSO_4 \end{cases}$$

Note ⇒ Roasting should be done above 850°C because at low temp. $ZnSO_4$ also form which converts back during Carbon reduction

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$$ZnSO_4 + C \longrightarrow \underline{ZnS} + \underline{CO_2}$$

Carbon Reduction / Smelting

$$ZnO + C \rightleftharpoons Zn + CO_2$$

excess amount of coke powder is used to stop production of CO_2 gas

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

$$ZnO + \underset{(excess)}{C} \longrightarrow Zn + \underline{CO}$$

(Spelter)

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Purification

1. Electrorefining
2. distillation