

formula Cu_2O .

Uses:-

- Used for making ruby red glass.
- Used as red antifrust paint.

Zinc (Zn)

Group IIB elements, placed ~~with~~ along with the d-block elements.

electronic configuration ~~(n-1)d n s²~~
~~(Ar)3d¹⁰, 4s²~~

Atomic number: 30

Oxidation state: +2

Occurrence:-

zinc does not occur in free state. The important ore are

1) zinc blende: ZnS

2) zinc spar or calamine ZnCO_3 .

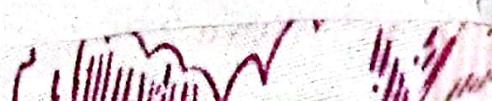
3) zincite or red zinc ore; ZnO

4) willemite ~~ZnSiO_4~~ ZnSiO_4

The chief (main) one of zinc is zinc blende (ZnS)

MP 2

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Extraction of zinc

Zinc is extracted from its chief ore ~~ZnS~~ zinc blende (ZnS) by the carbon reduction process.

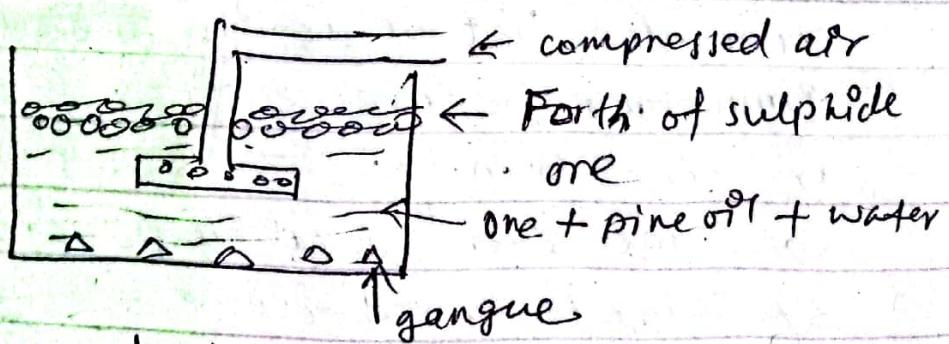
The steps involved are.

(a) crushing and pulverization:-

The ore is first crushed in a jaw crusher into small pieces and then pulverized in ball mills.

(b) Concentration:-

Pulverized ore is concentrated by froth floatation process. In which ore is mixed with ^{fine} oil and water and vigorously stirred. The froth produced rises to the surface and carries ore particle. The gangue settles at the bottom.



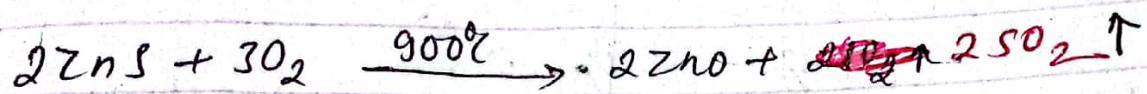
Dig. - froth floatation process.

Dig. Froth floatation process.

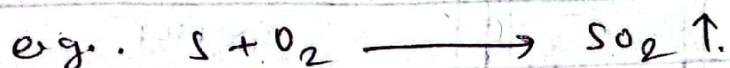
(c) Roasting:-

The concentrated ore is roasted in reverberatory furnace in

presence of an excess of air at about 900°C , where ore is oxidized into zinc oxide (ZnO)



During roasting, impurities like P, S, As, Sb, etc are removed as their volatile oxides.



① Reduction:- (or conversion of ZnO to Zn) -

zinc oxide thus produced is reduced to metal by heating with carbon or coke.



It is carried out into vertical retort furnace. The retort is heated internally by producer gas ($\text{N}_2 + \text{CO}$) at 1400°C . The vapour of zinc and carbon monoxide produced during reduction are carried into retort from the condenser by a mild current of producer gas passed into retort from the bottom where zinc is condensed and carbon monoxide escape out. Zinc thus obtained is known as. zinc spelter.

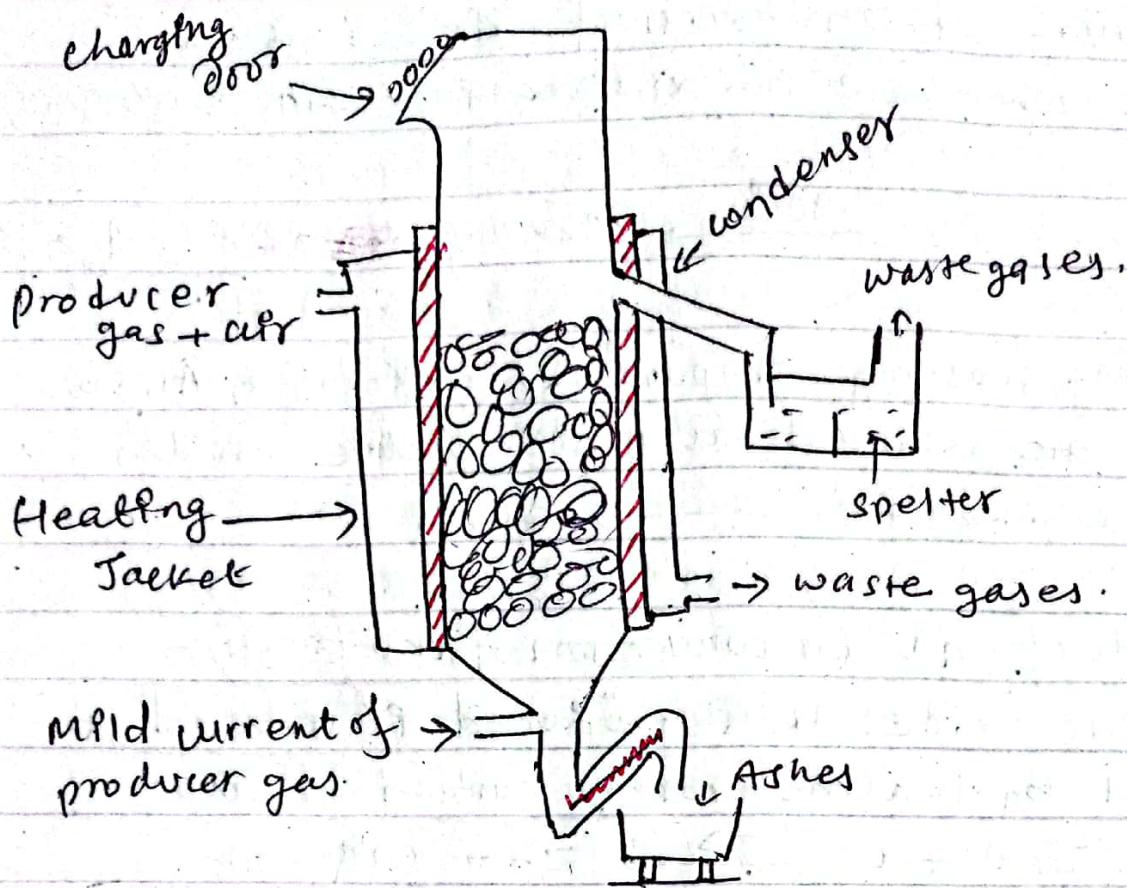


Fig:- Vertical retort process for extraction of zinc.

① Purification:-

The zinc thus obtained contains impurities such as Pb, Fe, Cd, As, Sb etc. (~~97.8%~~ pure). The impurities are removed from the zinc by following methods.

→ ② Fractional distillation:-

When distillation is carried out at 1000°C , only zinc and cadmium distill,

which is redistilled again at 800°C , cadmium

$\{ \text{Zn, Fe, Pb, Cd distill at } 1000^{\circ}\text{C} \rightarrow \text{Zn & Cd distil out}$

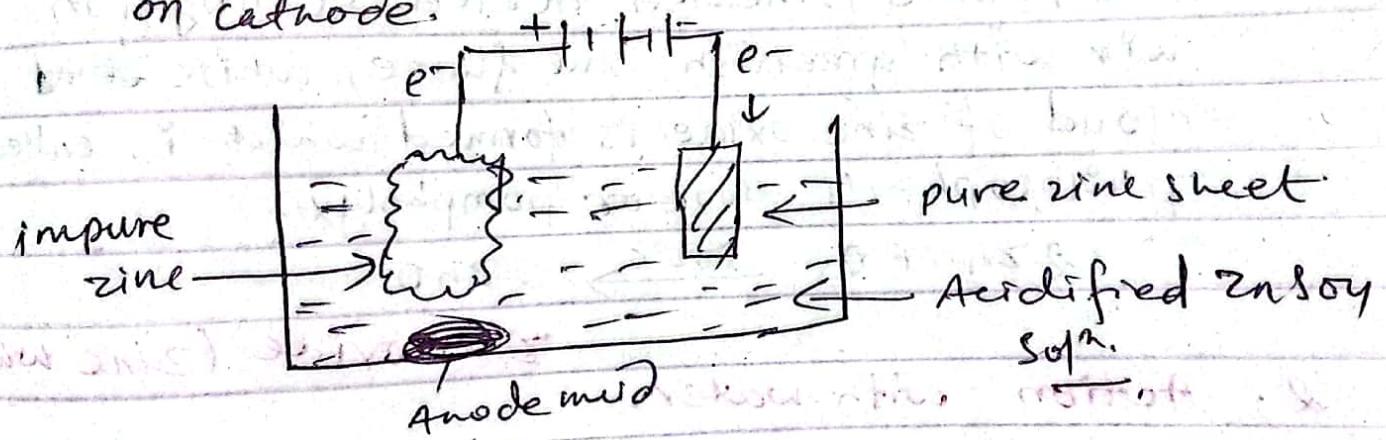
$\text{Zn, Cd distil at } 800^{\circ}\text{C} \rightarrow$

$\text{Cd distil out leaving pure Zn}$

distil over (b.p. 750°C) leaving behind zinc.
zinc thus obtained is 99% pure

→ (ii) Electrolytic method:- Electrolysis.

In this method, pure zinc and impure zinc are made cathode and anode respectively in the electrolytic solution of ZnSO_4 (zinc sulphate) containing sulphuric acid. When electricity is passed through the electrolytic solution, pure zinc is obtained on cathode.



Properties of Zn.

Physical properties

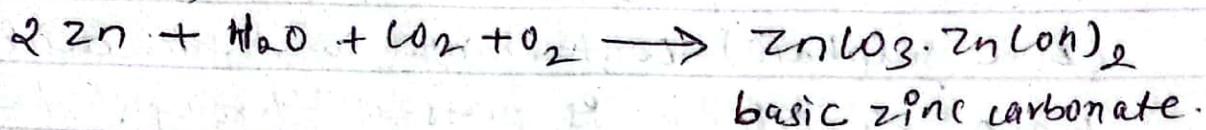
- (i). Bluish-white metal.
- (ii). It is brittle at ordinary temperature but malleable and ductile between 150°C - 150°C . It becomes brittle again at 200°C .

Chemical properties of zinc

S.V.R.

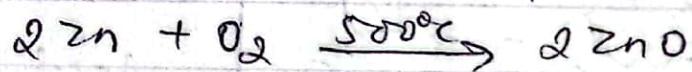
I. Action of air.

zinc is not affected by dry air, But in moist air, a layer of basic zinc carbonate (grey colour) is formed.



V.V.R. what is 'philosopher's wool or pompholyx'?

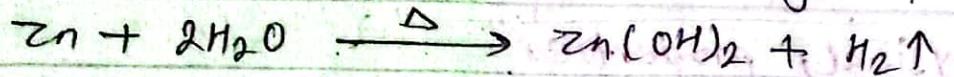
When zinc is heated strongly in air with greenish-blue flame, white ~~smoke~~ cloud of zinc oxide is formed which is called philosopher's wool or pompholyx.



Zinc oxide (zinc white)

2. Action with water.

pure zinc does not react with water but impure zinc evolves hydrogen gas from steam.

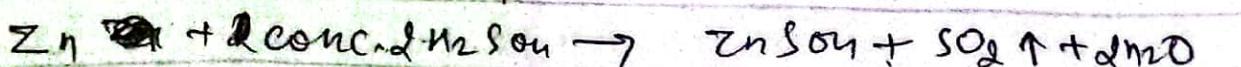
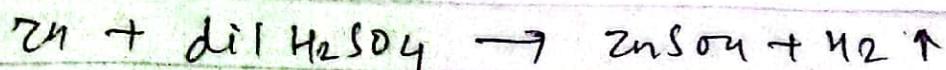


3. Action of acid.

i) with HCl



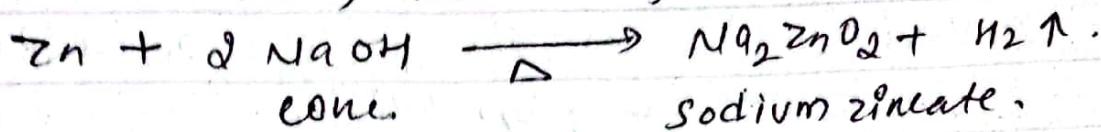
ii) with H₂SO₄.



V.VI

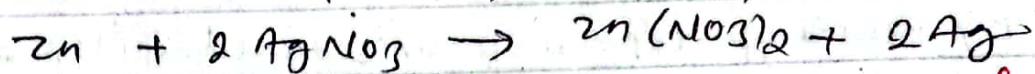
4. Action with alkali

Zinc reacts with hot and conc. NaOH (hot and conc caustic alkali) to form sodium zincate (metal zincate) and hydrogen.



5. Displacement reaction.

Zinc displaces less electropositive metals like copper, silver, gold etc. from their salts.



Q. Why does zinc displace copper from copper sulphate solution?

Ans. Because zinc is more electropositive than copper.

Uses of zinc.

- i). used for galvanizing (deposition of zinc over surface of iron) iron sheets.
- ii). Used in extraction of gold and silver.
- iii). For making alloys like brass ($\text{Cu} + \text{Zn}$), German silver ($\text{Cu} + \text{Zn} + \text{Ni}$), coins etc.
- iv). Preparation of anode of dry cell.

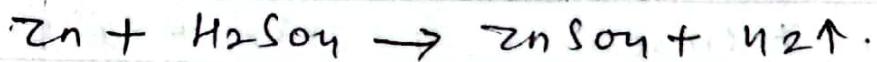
Chemistry of white vitrol, (preparation, properties and uses.)

(ZnSO₄ · 7H₂O)

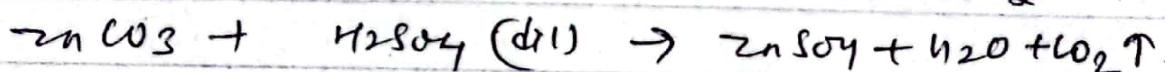
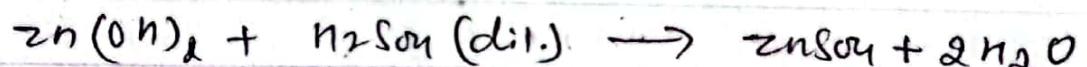
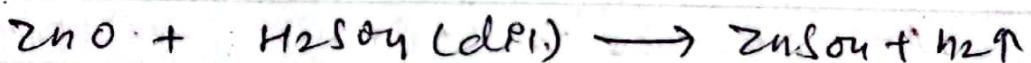
Heptahydrated zinc sulphate crystals are called white vitrol. & its molecular formula is ZnSO₄ · 7H₂O.

Preparation:-

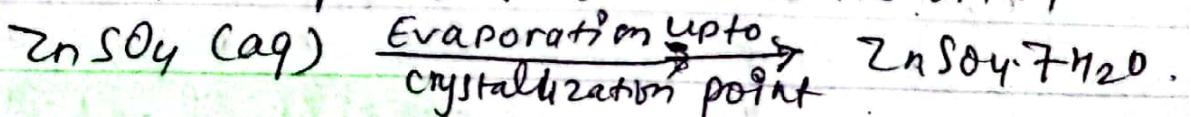
- i) By reacting dilute sulphuric acid with granulated zinc.



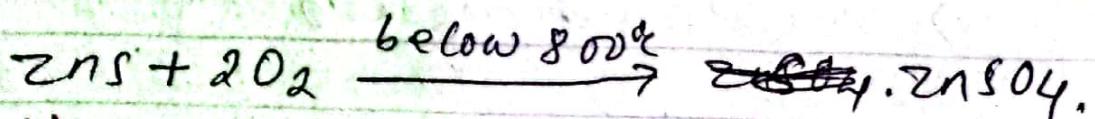
- ii) By reacting d_l. sulphuric acid with excess oxides, hydroxides, and/or ~~the~~ carbonates of zinc.



- The aqueous solution is heated to crystallization point to obtain white vitrol



- iii) In large scale, zinc sulphate is prepared by roasting the zinc blende (ZnS) below 800°C,

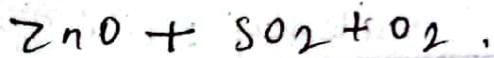
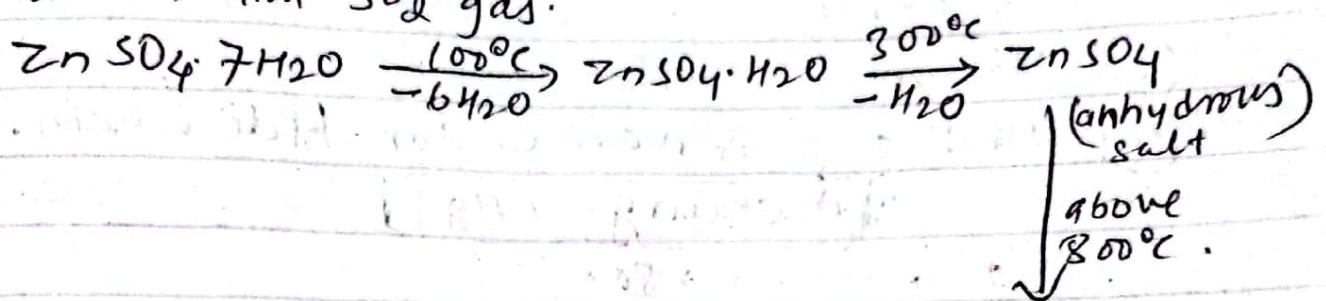


Properties.

- ① White crystalline solid.
- ② Highly soluble in water.

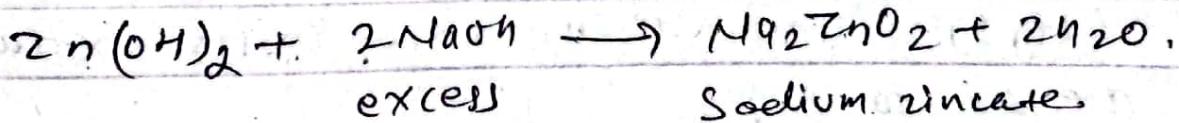
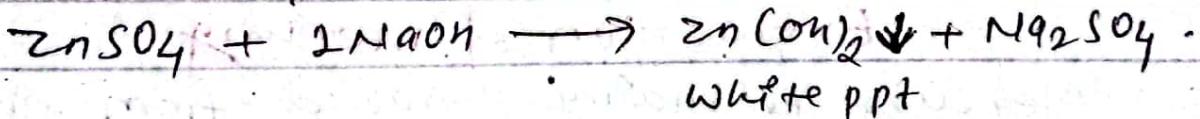
1. (iii) Action of heat :-

- White vitrol loses 6 molecule of water at 100°C and becomes anhydrous salt at 300°C . On further heating it decomposes to zinc oxide, and SO_2 gas.



IV). Action with caustic soda, (NaOH):-

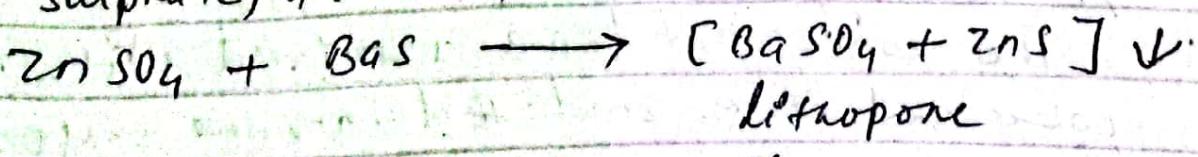
- When caustic soda (NaOH) is added to the solution of zinc sulphate, a white precipitate of zinc hydroxide is formed which dissolves in excess of NaOH forming sodium zincate.



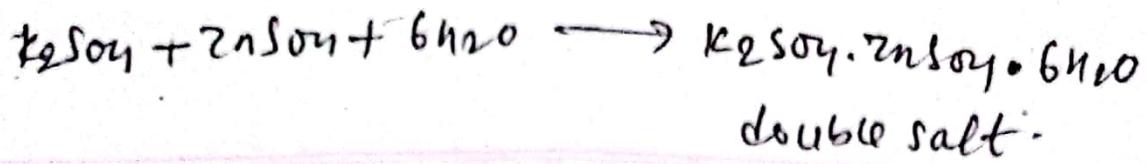
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v). Action with barium sulphide:-

7. Action with barium sulphide:-
Zinc sulphide react with barium sulphide to give mixture of zinc sulphide and barium sulphate, a white paint known as Lithopone.



vii). With potassium sulphate it produces double salt. p-23



Uses of white vitrol.

- ① Used in the preparation of white pigment called lithopone (white paint).
- ② In medicine, especially in eye drops and lotion.
- ③ As an electrolyte.
- ④ Used as preservative for hide & skin.

Mercury (Hg)

Atomic no \rightarrow 80.

valency : 1 & 2.

State \rightarrow liquid

occurrence

occurs in free as well as combined state.

Important one is cinnabar (HgS)

Extraction of mercury.

Mercury is mainly extracted from cinnabar (HgS). The various steps in its extraction are as follows.

1) concentration:-

The crushed and pulverized ore (powdered ore) is concentrated by froth floatation method.

1D. Roasting and distillation:-

The concentrated ore is mixed with 20% coke and lime and fed into the shaft furnace. The furnace is heated by burning fuel.

(coke) and ore is wasted in sufficient air, Unbar is first oxidized to mercuric oxide which then decomposes to mercury. The mercury vapours along with waste gas (SO_2 , CO_2 etc) come out from the furnace which pass through an earthen ware-Y-shape condenser pipes, where mercury vapours condense into liquid and collected at the bottom of receiver while gases escape out.

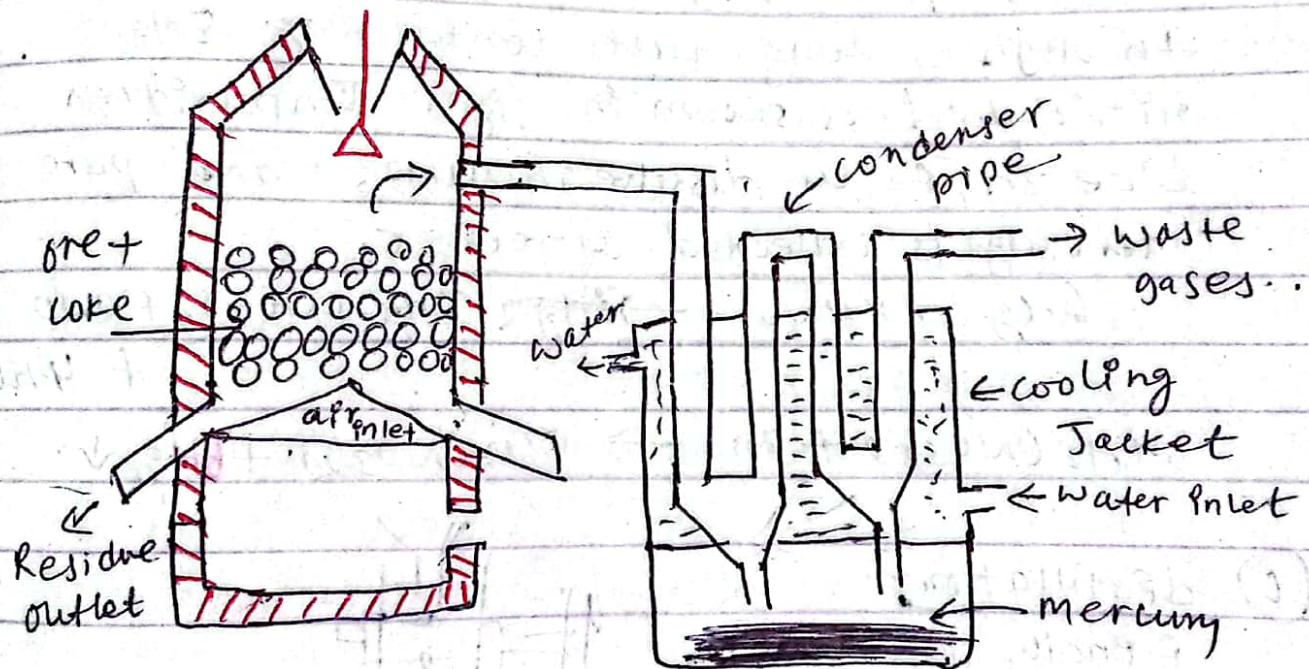
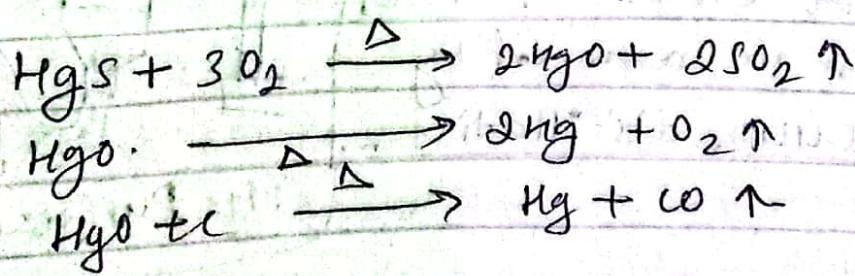


Fig:- Roasting and distillation in a shaft furnace.



III). Purification :-

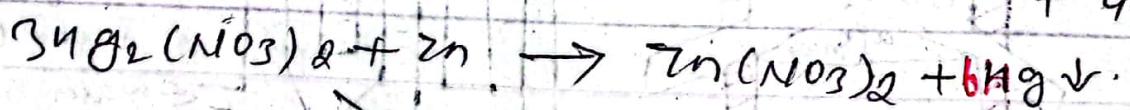
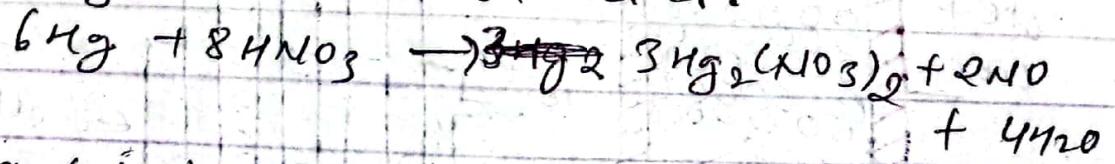
Mercury thus obtained may contains Zn, Cu, Pb, Sn & Bi etc as impurities. It is purified by following steps.

(a) Filtration:-

Impure mercury is filtered through chamois leather (i.e soft leather of goat or sheep) to remove impurities.

(b) Treatment with 5% HNO₃:-

After filtration, mercury is dropped through a long tube containing 5% nitric acid as shown in fig. Impurities like Zn, Fe, Cu dissolve in HNO₃ and pure mercury is collected at receiver.



(c) Distillation:-

Finally mercury may contain Au, Ag, Pt etc as impurities. These are removed by vacuum distillation.

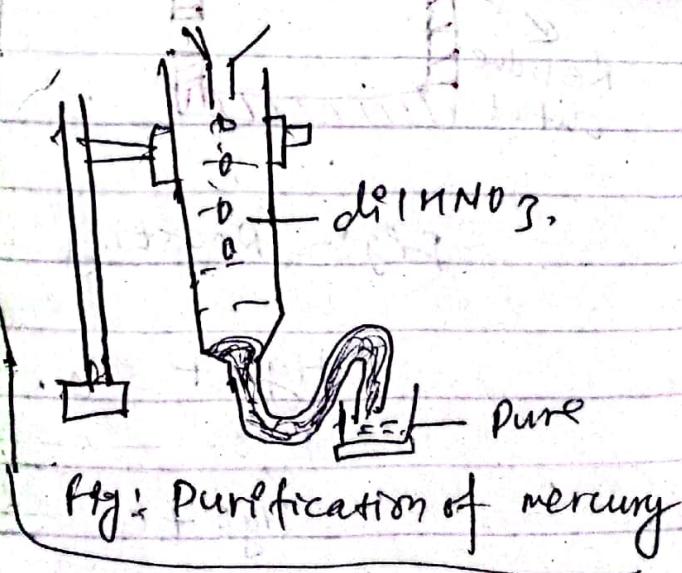


Fig: Purification of mercury

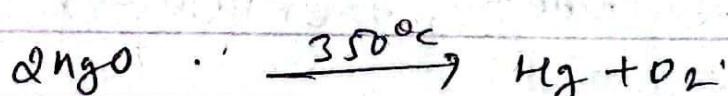
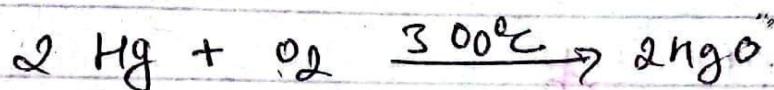
* Properties of mercury.

- ② Silvery-white metallic liquid at room temperature.
- ③ Heavy metal with density 13.6 g/cm³/cc
- ④ It does not wet the wall of glass.
- ⑤ melts at -38.4°C and boils at 757°C.

Chemical properties.

① Action with air:

Mercury does not react with air at room temperature but when heated it is oxidized to mercuric oxide.



② Action with water → No action.

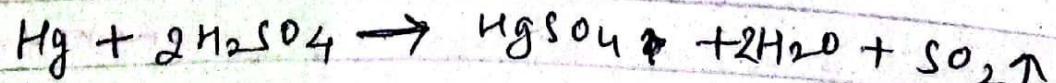
③ Action with alkali → No action

④ Action with acid

(I) with dilute and conc. HCl → No action.

(II) with H₂SO₄.

→ does not react with dil H₂SO₄ but hot and conc H₂SO₄ gives sulphur dioxide



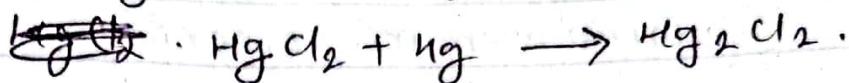
Compounds of mercury -

Chemistry of calomel (Hg_2Cl_2)

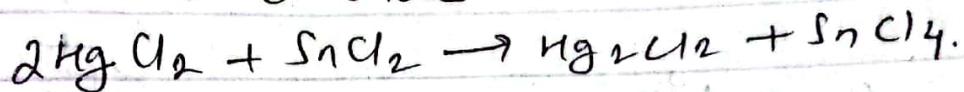
Mercurous chloride is commonly called calomel. Its molecular formula is $HgCl_2$.

Preparation:- It is prepared by;

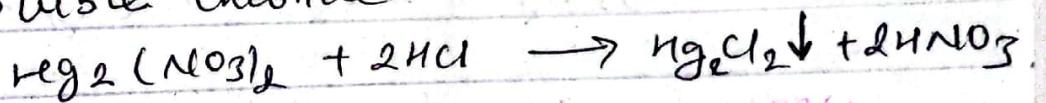
I) By heating mercuric chloride and mercury.



II) By reducing mercuric chloride with stannous chloride



III) By treating mercurous nitrate with soluble chloride.

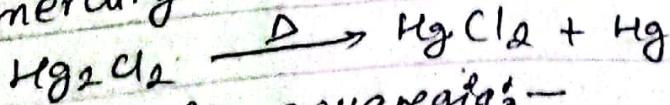


Properties:-

- ① It is white amorphous tasteless solid
- ② It is insoluble in water but soluble in hot water.

Chemical properties:-

→ ① On heating it gives mercuric chloride and mercury.

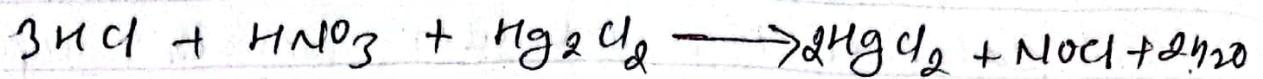


② Action with aqua regia:-

It dissolve in ~~nitric acid~~ aqua regia

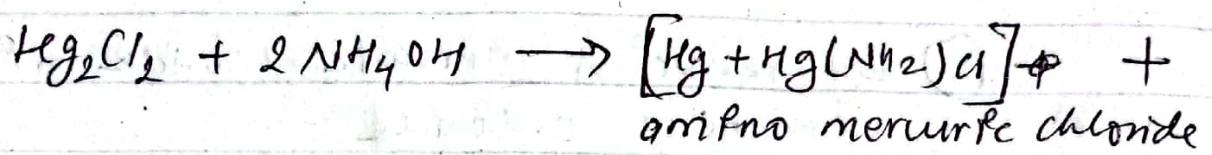
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aqua regia to form mercuric chloride.



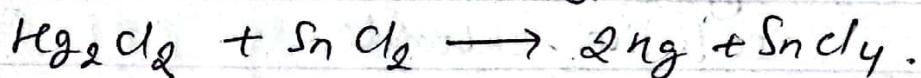
(3) Action with ammonia:-

It turns black due to formation of amino mercuric chloride.



(4) Action with stannous chloride :-

It reduces to mercury.



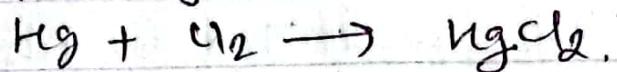
Uses of calomel.

- (I). Used as antiseptic and germicide
- (II). Used for making calomel electrode
- (III). Used in medicine as purgative
(to remove constipation)

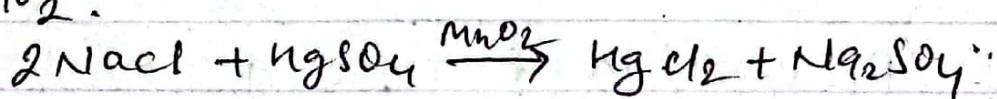
16. To Corrosive sublimate ($HgCl_2$).

Mercuric chloride is known as corrosive sublimate. It is corrosive in nature and is prepared in dry process of sublimation, preparation:-

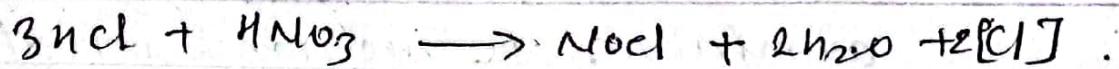
i) By passing Cl_2 gas over heated mercury.



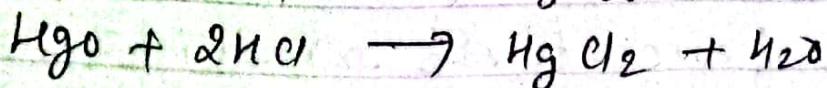
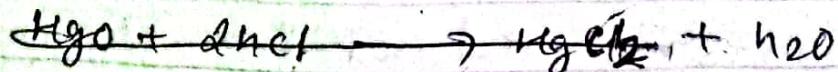
ii). By heating dry sodium chloride and mercuric sulphate in the presence of MnO_2 .



iii). By dissolving mercury or calomel in aqua-regia.

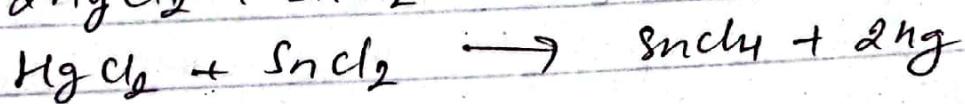
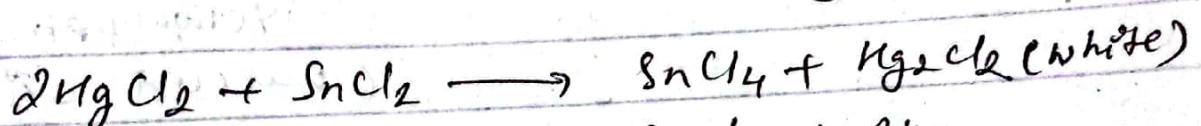


iv). By treating mercuric oxide with dil. HCl.



Properties:-

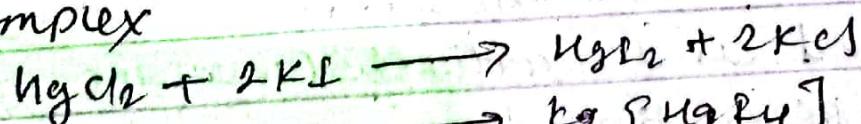
- I) It is colourless crystalline needle shaped solid.
- II). sparingly soluble in cold water and organic solvents and soluble in hot water.
- III). Highly poisonous, when intake 0.2gm, it may be fatal.
- IV). Stannous chloride reduces it first to mercuric chloride and then Hg.



~~V.V.S~~

V). Action with KI.

It gives mercuric iodide (yellow or scarlet red ppt) which dissolve in excess of KI form ~~so~~ potassium tetratodo mercurate(II) complex



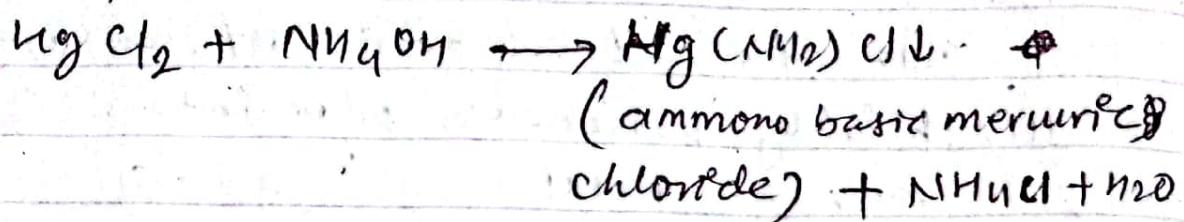
Potassium tetrabromo mercurate(II) complex

The alkaline solution of this complex either in KOH or NaOH is called Mesmer's reagent.

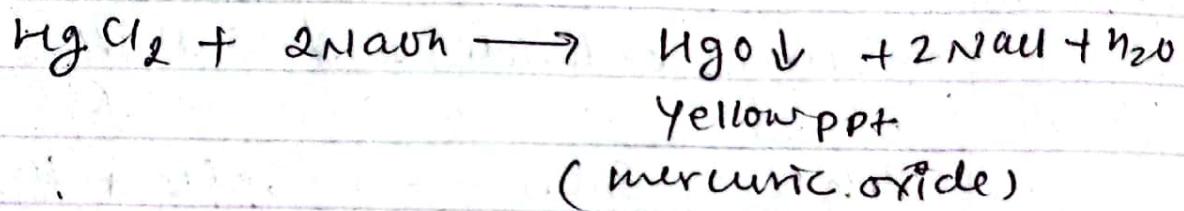
(V) Action with ammonia (yellow ppt)



(VI) Action with ammonia:-



(VII) Action with caustic alkali :-



Uses:

- I) 0.1% dilute soln is used as an antiseptic for sterilizing Land and surgical instruments.
- II) Used to prepare Messler's reagent to test ammonium salts.
- III) Used as an antidote (medicine against poison)
- IV) Preservation of wood and fur
- V)