

# Silver

## **Introduction;**

Symbol : Ag

Latin Name: Argentum

Atomic Number: 47

Atomic mass: 107.9 amu

Valency : 1

## **Occurrence;**

Silver occurs in free as well as in combined states. Chief ores of silver are as;

- Argentite or Silver glance ;  $\text{Ag}_2\text{S}$
- Horn Silver ;  $\text{AgCl}$
- Ruby Silver ;  $\text{Ag}_2\text{SbS}_3$

The main producers of Ag are Mexico, USA , Peru, Canada, Australia, Russia and Chile.

## Extraction of silver by cyanide process

### 1. Crushing and pulverization

Big lumps of ores are crushed using jaw crushers to get crushed ore which is pulverized using a pulverizer or stamp mill to get powdered ore.

### 2. Concentration by froth floatation process

The powdered ore is taken in a tank containing water and a small amount of pine oil. The mixture is heated by a blast of air. Impurities are wetted by water and get collected at the bottom of the tank. Ore particles are wetted by oil and come to the surface as froth. The froth is skimmed off to collect concentrated ore.

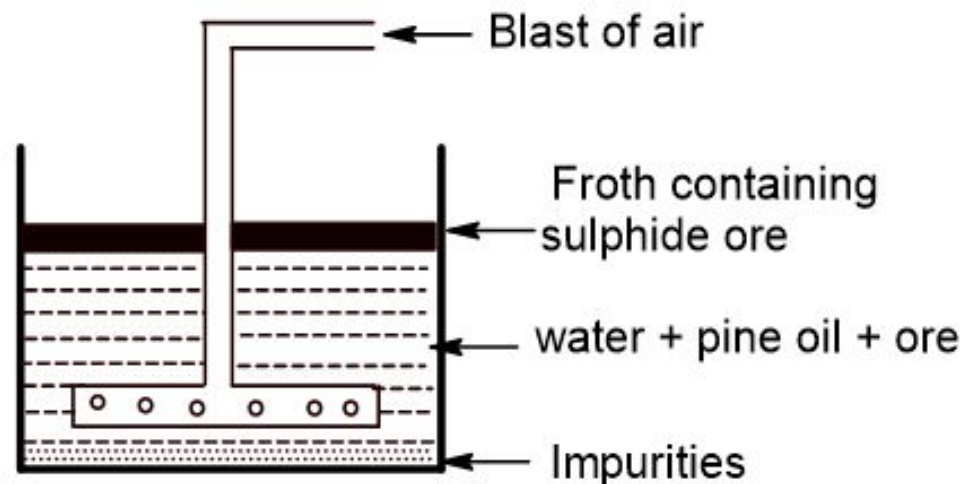
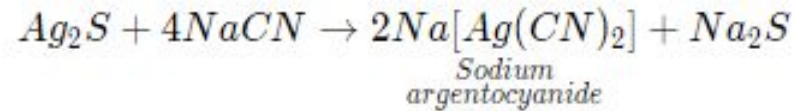


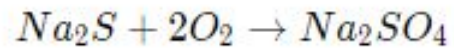
fig: Froth floatation process

### 3. Cyanide treatment

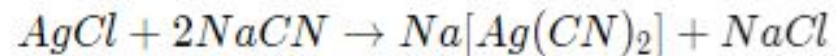
The concentrated ore is mixed with sodium cyanide solution using a current of air. Then the solution of sodium argentocyanide is formed.



The reaction is reversible. The air blown oxidizes sodium sulphide to sodium sulphate and drives this reaction to forward direction.

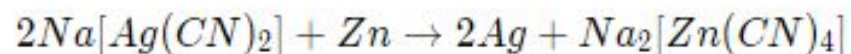


If the ore is horn silver, the following reaction occurs:



#### 4. Precipitation of silver

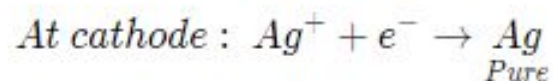
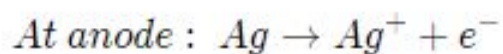
The solution obtained above is filtered and the filtrate is treated with zinc where Ag is precipitated in the dark amorphous powder.

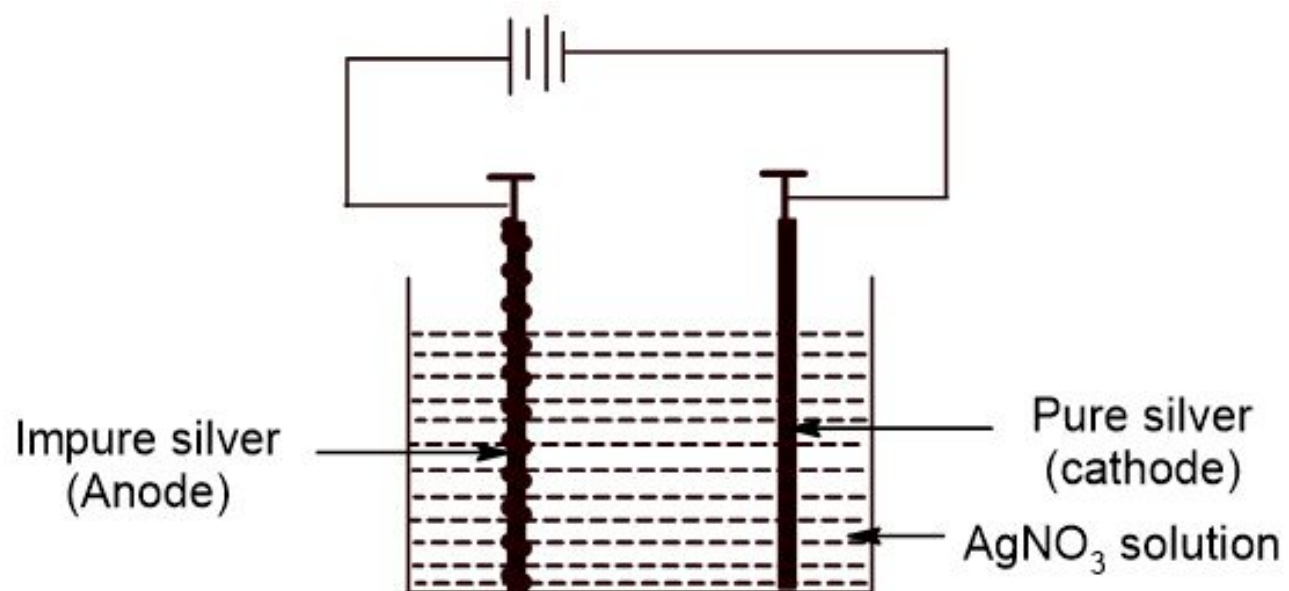


This silver is separated by filtration and fused with borax or  $\text{KNO}_3$  to get a compact mass of silver known as spongy silver.

#### 5. Purification

Silver thus obtained is purified by electrolytic refining. Impure silver is made anode and pure silver is made cathode. Acidified  $\text{AgNO}_3$  solution is used as an electrolyte. On electrolysis, silver deposits from the anode and gets collected in the cathode.





*Fig: Electrolytic cell for purification of silver*

## Uses of silver

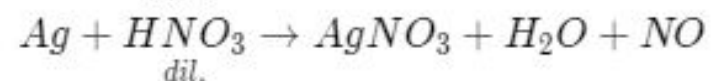
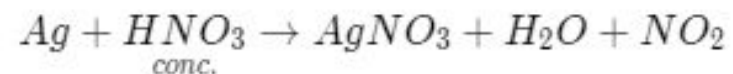
- To prepare coins and ornaments.
- In photography and electrical purpose.
- To prepare electrode and alloy.

## Compounds of silver

### A. Lunar caustic or silver nitrate: $\text{AgNO}_3$

#### Preparation

i. By the action of nitric acid on silver:



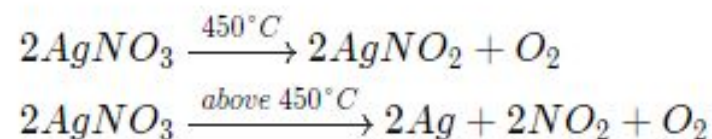
#### Physical properties

- It is a white crystalline solid.
- It is soluble in water and alcohol.

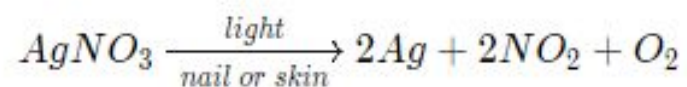


## Chemical properties

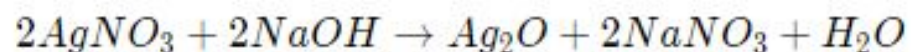
i. Action of heat:



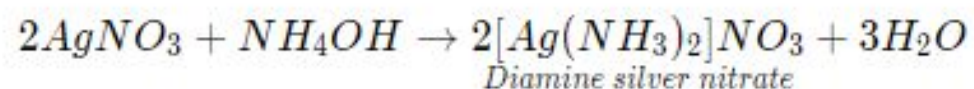
ii. Decomposition by organic matter: If silver nitrate comes in contact with the skin in presence of sunlight, a permanent black stain is formed on the skin. This property has been used in the preparation of indelible (that cannot be removed) ink which is used during elections for marking the voters who have cast the vote.



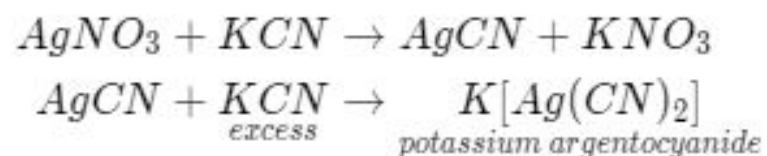
iii. Action with NaOH:



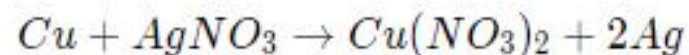
iv. Action with  $\text{NH}_4\text{OH}$ :



v. Action with KCN:

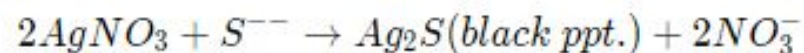
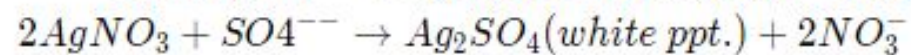
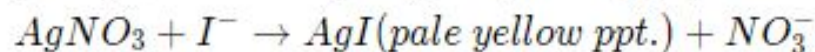
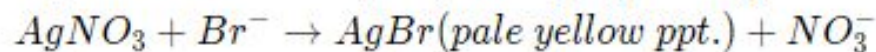
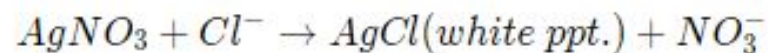


vi. Displacement reaction:





vii. Action with halides, sulphate, sulphide:



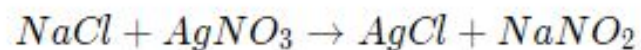
## Uses

- In silvering of mirror.
- To prepare indelible ink.
- In photography.
- To prepare Tollen's reagent:  $[Ag(NH_3)_2]OH$

## B. Horn silver or silver chloride: AgCl

### Preparation

By the action of sodium chloride and silver nitrate.

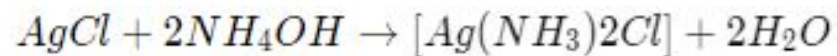


### Physical properties of horn silver

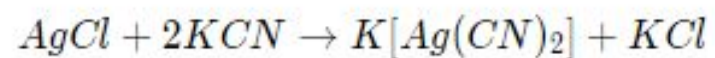
- It is white solid.
- It is insoluble in water.

### Chemical properties of horn silver

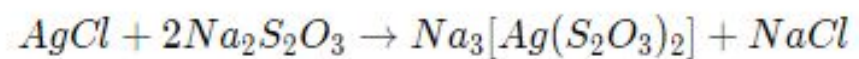
i. Action with ammonia:



ii. Action with KCN:



iii. Action with sodium thiosulphate:



## Uses

- In photography.

### **Multiple Choice Questions;**

- 1) Which of the following metal is leached by cyanide process  
a. Ag      b. Na      c. Al      d. Cu
- 2) Which of the following compound used to silvering a mirror?  
a. AgCl      b. AgNO<sub>3</sub>      c. AgS      d. AgBr
- 3) Lunar caustic is  
a. AgNO<sub>3</sub>      b. AgCl      c. Ag<sub>2</sub>C      d. AgNO<sub>3</sub> + NaOH
- 4) Which one is Ruby silver?  
a. Ag<sub>2</sub>S      b. Sb<sub>2</sub>S<sub>3</sub>      c. AgCl      d. Ag<sub>2</sub>SbS<sub>3</sub>
- 5) Cyanide process is concerned with extraction of  
a. Cu      b. Ag      c. Au      d. Pt
- 6) Black stain is produced when.....comes on contact of skin in presence of light.  
a. AgCl      b. NaNO<sub>3</sub>      c. AgNO<sub>3</sub>      d. AgBr
- 7) Which silver halide is used in photography?  
a. AgCl      b. NaNO<sub>3</sub>      c. AgNO<sub>3</sub>      d. AgBr

### **Short Answer Questions;**

1. Why is silver nitrate solution used for staining fingers of voters during election?
2. Why is black stain developed when  $\text{AgNO}_3$  is dropped to skin? Write an important use of silver nitrate.
3. What is lunar caustic? Why is it called so?
4.
  - a. How is presence of halide ions are tested with silver nitrate solution
  - b. Why silver ores are leached with metal cyanides for the extraction of silver?
  - c. what do you mean by noble metals? Name at least three noble metals you know.
5. Silver ( commonly called Chandi ) is used as ornamental purpose.
  - a. write formula of any two important ores of silver.
  - b. Hydrometallurgy is used for extraction of Ag. What is the meaning of term hydrometallurgy?
  - c. Discuss the Mac-Aurthur Forrest cyanide process for extraction of silver.
  - d. what happens when Ag is heated with dilute nitric acid? Write the reaction involved.
  - e. Why is the product formed on d. called lunar caustic? Why is it used as voter's ink?