

13. PRINCIPLES OF METALLURGY

Questions and Answers

1. List three metals that are found in nature as Oxide ores.

A. The oxide ores are as follows.

| Metal | Oxide ore | Formula |
|-----------|-----------|---|
| Aluminium | Bauxite | $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$ |
| Zinc | Zincite | ZnO |
| Iron | Haematite | Fe_2O_3 |

2. List three metals that are found in nature in uncombined form.

A. The metals which are having less reactivity are found in nature in uncombined form. Those are
(i) Gold (Au) (ii) Silver (Ag) (iii) Platinum (Pt)

3. Write a note on dressing of ore in metallurgy?

A. The first step in extraction of metals from their ores is dressing or concentration of ore. Ores that are mined from the earth are usually contaminated with large amount of impurities such as soil and sand. These impurities are called gangue. Removing of gangue from the ore is called dressing of ore.

Various physical methods are adopted to enrich the ore according to the difference between physical properties of ore and impurities. Some dressing methods are (i) Hand picking (ii) Washing (iii) Froth floatation (iv) Magnetic separation

4. What is an ore? On what basis a mineral is chosen as an ore?

A. Mineral : The compound of metal that occur in nature is called mineral of that metal.

Ore: Minerals which can be used to obtain the metal profitably and conveniently are called ores.

* On the basis of following terms a mineral can be chosen as ore.

- (i) convenience
- (ii) profitability
- (iii) with out economic loss

5. Write the names of any two ores of iron?

A. The ore of iron are (i) Haematite – Fe_2O_3
(ii) Magnetite – Fe_3O_4

6. How do metals occur in nature? Give examples to any two types of minerals.

A. Metals occur in nature according to their reactivity. The earth's crust is the major source for the ores of metals.

(i) The high reactive metals occur in the form of their oxides, carbonates, sulphates, halides.

Ex: Rock salt (NaCl)
Magnesite (MgCO_3)

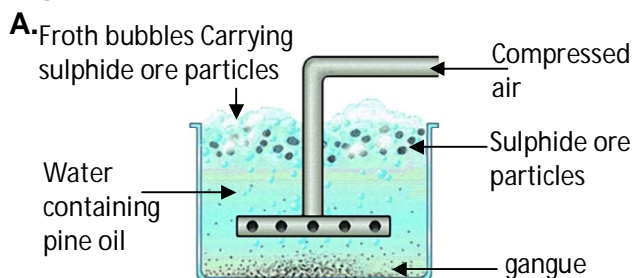
(ii) The moderate reactive metals occur in the form of their oxides, carbonates and sulphides.

Ex: Haematite (Fe_2O_3)
Zincite (ZnO)
Galena (PbS)

(iii) The less reactive metals occur in the free state.

Ex: Gold (Au), Silver (Ag), Platinum (Pt)

7. Write short notes on froth floatation process?



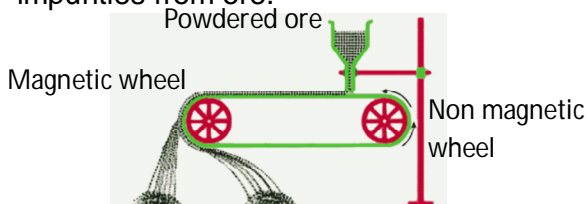
Froth floatation : This method is mainly useful for sulphide ores which have no wetting property whereas the impurities get wetted.

The ore with impurities is finely powdered and kept in water taken in a floatation cell. Add a few drops of pine oil. Air under pressure is blown to produce froth in water. Froth so produced, takes the ore particles to the surface. The impurities settle at the bottom. Froth is separated and washed to get ore particles.

8. When do we use magnetic separation method for concentration of an ore?

Explain with an example?

- A. If the ore or impurity, one of them is magnetic substance and the other is non magnetic substance then we can use magnetic separation to separate the impurities from ore.

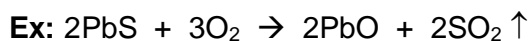


Non magnetic ore Magnetic ore
Ex: The ores like magnetite is concentrated by this method. The ore is a magnetic substance and the impurities are non magnetic substances here. The crushed ore is allowed to pass through a belt attached around the magnetic and non magnetic wheels. The gangue particles are collected at first and the ore particles are collected in a separate place.

9. Write short notes on each of the following :

i) Roasting ii) Calcination iii) Smelting.

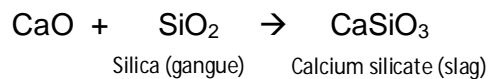
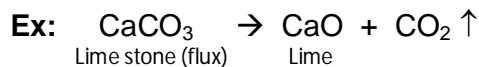
- A. (i) Roasting : It is the process of heating ore in the presence of air. This method is used for sulphide ores. In this process the sulphide ores are oxidised converted to oxides.



- (ii) Calcination : It is the process of heating ore in the absence of air. This method is used for carbonate ores or hydrated ores to remove volatile impurities present in the ore. In this process ores are decomposed.



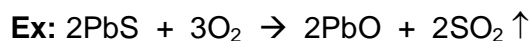
- (iii) Smelting : It is a pyro chemical process. In this method the ore is mixed with flux and then strongly heated with fuel. During smelting the impurities in the ore react with flux to form slag, a feasible material. Slag can be removed. Generally blast furnace is used for smelting an ore.



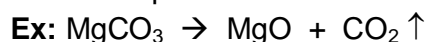
10. What is the difference between roasting and calcinations?

Give one example for each?

- A. (i) Roasting : It is the process of heating ore in the presence of air. This method is used for sulphide ores. In this process the sulphide ores are oxidized, converted to oxides.



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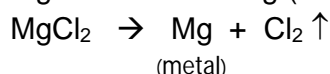
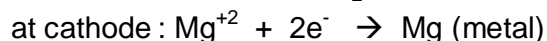
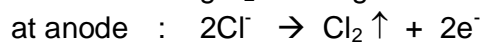
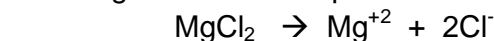
11. Define the terms i) gangue ii) slag.

- A. (i) Gangue: The impurities present in the ore is called gangue.
(ii) Slag: In the process of smelting, ore is mixed with flux and then strongly heated with fuel. The gangue reacts with flux and form a feasible material called slag.

12. Magnesium is an active metal if it occurs as a chloride in nature, which method of reduction is suitable for its extraction?

- A. Magnesium is a high reactivity metal. If it occurs as a chloride in nature, electrolytic reduction is suitable for extraction of Mg metal.

In this process steel container used as cathode (-) and graphite rod is used as anode (+). Due to electrolytic reduction the following reactions take place.



13. Mention two methods which produce very pure metals?

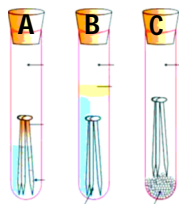
- A. The method of obtaining pure metal from the impure metal is called refining of metal. Some refining methods are
 (i) Poling (ii) Liquation
 (iii) Distillation (iv) Electrolytic refining

14. Which method do you suggest for extraction of high reactivity metals? Why?

- A. The only method to extract the high reactivity metals from their ores is electrolysis of their fused compounds.
 The simple chemical reduction is not possible for these metals because they do not feasible at lower temperatures. Also it is more expensive. So electrolysis is the best method.

15. Suggest an experiment to prove that the presence of air and water are essential for corrosion. Explain the procedure.

- A. Take three test tubes and place clean iron nails in each of them. Label these test tubes A, B and C. Pour some water in test tube A and cork it. Pour boiled distilled water in test tube B, add about 1 ml of oil and cork it. The oil will float on water and prevent the air from dissolving in the water. Put some anhydrous calcium chloride in test tube C and cork it. Anhydrous calcium chloride will absorb the moisture, if any, from the air.



Leave these test tubes for a few days and then We will observe that iron nails rust in test tube A, but they do not rust in test tubes B and C.

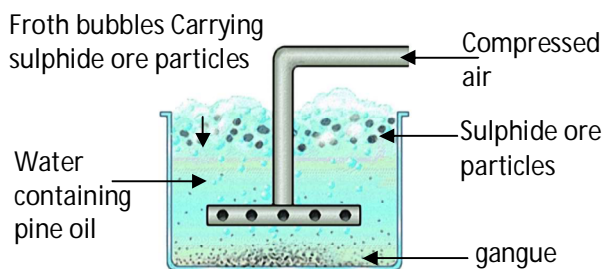
In the test tube A. The nails are exposed to both air and water. In the test tube B, the nails are exposed to only water, and the nails in test tube C are exposed to dry air.

So we conclude that Corrosion of iron (commonly known as rusting) occurs in presence of water and air.

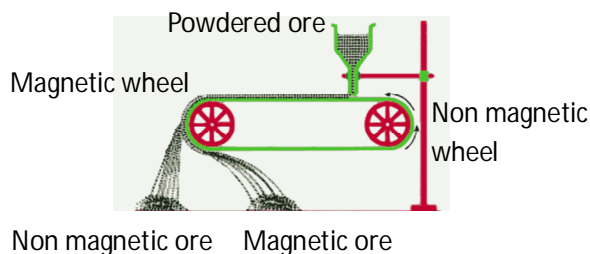
17. Draw the diagram showing

- i) Froth floatation**
ii) Magnetic separation.

A. (i) The diagram showing Froth floatation:

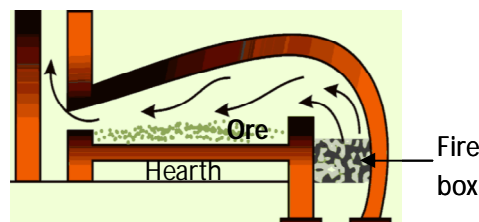


(ii) The diagram showing Magnetic separation:



18. Draw a neat diagram of Reverberatory furnace and label it neatly?

A.



19. What is activity series? How it helps in extraction of metals?

- A. Activity series:** Arrangement of metals in descending order of their reactivity is known as activity series.

The activity series of metals is ...

| | | |
|-------------------|---------------------|-----------------|
| K, Na, Ca, Mg, Al | Zn, Fe, Pb, Cu, Hg | Ag, Pt, Au |
| High reactivity | Moderate reactivity | Less reactivity |

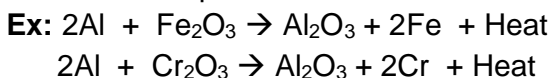
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Significance of activity series in extraction of metals:

- (i) High reactivity metals are extracted by electrolytic reduction of their fused ores.
- (ii) Moderate reactivity metals are found in the form of sulphides or carbonates. These are roasted and reduced into their oxides.
- (iii) Less reactivity metals are often found in free state. Sometimes the oxides or sulphides of these metals can be reduced by heat alone or by displacement from their aqueous solutions.
- (iv) Activity series is very useful to select the process in which the metal is extracted from its ore easily.

20. What is thermite process? Mention its applications in daily life?

A. Thermite process: An exothermic redox reaction between a metal and a metal oxide as reactants such as aluminium and iron oxide is called thermite process. High reactivity metals such as Na, Ca, Al, etc., used as reducing agents. A large amount of heat is evolved in this process. So the metals produced in molten state.



Uses:

- (i) It is used to join railings of railway tracks.
- (ii) It is used to join cracked machine parts.
- (iii) It is used in metal refining.

21. Where do we use handpicking and washing methods in our daily life? Give examples. How do you correlate these examples with enrichment of ore?

A. (i) We use hand picking in separating stones from rice and dal in our daily life. This method is adopted to separate the impurities from ore.

Hand picking: If the ore particles and the impurities are different in one of the properties like colour, size etc., Using that property either ore particles or impurities are handpicked to separate them.

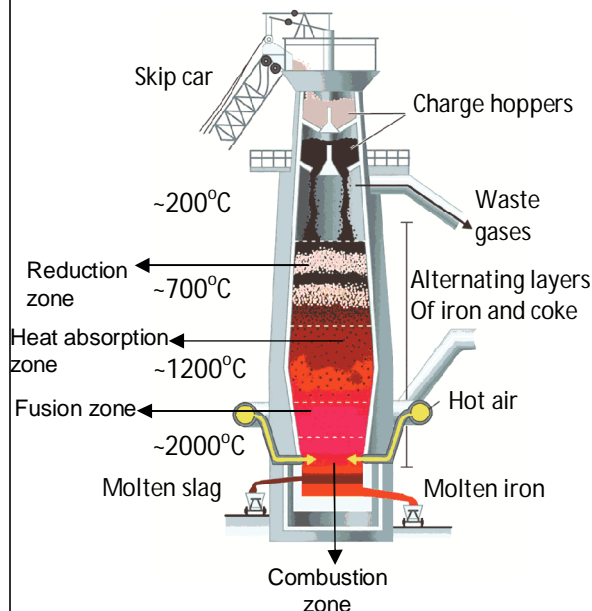
(ii) We use washing to separate dust from vegetables, rice and dal in our daily life. This method is adopted to separate the impurities from ore.

Washing: Ore particles are crushed and kept on a slopy surface. They are washed with controlled flow of water. Less dense impurities are carried away by water flow, leaving the more dense ore particles behind.

ADDITIONAL QUESTIONS

- 22. Draw a neat labeled diagram of blast furnace.
- 23. How can we prevent corrosion?
- 24. Define furnace. What are the important parts in a furnace?
- 25. What are the differences between blast furnace, reverberatory furnace and open hearth furnace?

Blast Furnace Diagram



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