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CHEMISTRY

Class 10th (KPK)

NAME: _____

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ROLL #: _____ SUBJECT: _____

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UNIT 16

EXERCISE

SHORT QUESTIONS

Q1. How could you convert $NaHCO_3$ into Na_2CO_3?

Ans: Calcination: sodium bicarbonate ($NaHCO_3$) is converted into sodium carbonate (Na_2CO_3) by the process called calcination, in this process $NaHCO_3$ is heated in rotatory funnel call calcinatory, to give anhydrous sodium carbonate.

$$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2\,(g)} + H_2O$$

Q2. Enlist the different uses of urea?

Ans: Uses of urea:

it is a white crystalline organic compound. It is important due to the following usage.

1. Fertilizer: about 86% of urea is used as solid fertilizer.

2. Resins: Urea-formaldehyde resins are used as a polywood adhesive/glues.

3. Use as explosive: Urea can be used to make urea nitrate, which is highly explosive.

4. Chemical Industry: Urea is used as a raw material for manufacture of many important chemical compounds like plastics, resins, and various adhesives etc.

6. Flame proofing agent: Urea is used as a flame proof in agent.

7. Cosmetics:it is used as an ingredient in hair conditioners, facial cleaners and lotions.

8.Repellent to Corrosion:It is used as an alternative to rock salt in the deicing roadways and runways. It does not promote metal corrosion to extent that salt does.

9. Cigarette: It is also used as flavor enhancing additive for cigarette.

10. Medicinal uses:urea containing creams are used as tropical dermatological products to promote rehydration of skin.

Q3. Differentiate between minerals and ore.

Ans: Minerals: The naturally combined state of metal is called is called mineral.

Ores: An aggregate of mineral and other impurities is known as ore.

Q4. What is metallurgy? What are its types?

Ans: Metallurgy: The art and science of making of making metals and alloys from their ores with properties suitable for practical uses is called metallurgy. OR

The science that deals with the procedures used in extracting metals from their ores, purifying**,** alloying metal sand creating useful objects from metal is called metallurgy.

Types of metallurgical operations: In metallurgy the ores are mined and subjected to various mechanical and chemical processes. There is no single method for extracting metals from their ores, But certain basic operation are , required that is,

i. Concentration of ores

ii. Extraction of metal (roasting and reduction)

iii. Refiningof metal**.**

Q5. What is the function of forth floatation?

Ans: Forth floatation: A separating method of the mineral particles of ore from the gangue that depends on the wetting of the minerals pieces.

Function of forth floatation: It is a process for selectively separating hydrophobic materials from hydrophilic. In this process the ore is wetted with water. And the water insoluble impurities float on the surface and thus separated from the ore.

Q6. On what basis the different fraction of petroleum are separated?

Ans: Fractional distillation: The type of distillation in which different fractions of petroleum are separated according to difference in their boiling point is called Fractional distillation.

Basic principle of Fractional distillation: The fractions are separated according to difference in their boiling point. The substances having less boiling points boils out first leaving behind others.

Q7. What is slaked lime? How slaked lime is produced.

Ans: Slaked lime: Slaked lime is calcium hydroxide $Ca(OH)_2$.

Preparation: when quick lime (CaO) and water are mixed together in calculated amount and the mixture is heated, slaked lime is produced.

$CaO + H_2O \rightarrow Ca(OH)_2$

Q8. Assess the composition of urea and calculate the percentage of nitrogen in it.

Ans: Composition of urea**:** urea is one of the most important nitrogenous fertilizers. Its chemical formula is NH_2CONH_2. The formula shows that urea is composed of nitrogen, hydrogen. Carbon and oxygen. **Percentage of nitrogen in urea:**

Percentage of an element in a compound can be calculated by using following formula:

$$\text{Percentage of element} = \frac{Atomic\ masss\ of\ element \times no.of\ aatoms\ in\ compoun}{molecular\ mass\ of\ the\ compound} \times 100$$

Molecular formula of Urea = N_2H_4CO

Molecular mass of urea = $14\times2 + 1\times4 + 12 + 16 =$

$= 28+ 4+ 12 + 16 = 60g/mol.$

Q9. What is gangue and where it is found?

Ans: Gangue: The earthy material like sand, rock, clay, lime stone, etc. attached with ores are called gangue. Gangue are the impurities mostly found in ores

Q10. How blistered copper is purified?

Ans: Purification of blistered copper: The blistered copper is purified/refined by electrolytic process.

Electro-refining of Copper: the process of electro refining of copper involves following steps.

Construction:i. Anode: a large plate of blistered copper is made anode.

ii. Cathode: a thin sheet of pure copper is made cathode.

iii. Electrolyte: The solution of copper sulphate ($CuSO_4$) and dil. Sulphuric acid (H_2SO_4) solution is used as an electrolyte.

Working: During electrolysis, pure copper is deposited on the cathode.

The impurities (Ag, Au and Pt. along with Cu_2O) in the anode and settle s\down at the bottom and are

removed as anode mud. The copper obtained by this method is 99.9% pure.
Reaction at anode: $Cu_{(s)} \rightarrow Cu^{+2}_{(aq)} + 2e^-$

Reaction at Cathode: $Cu^{+2}_{(aq)} + 2e^- \rightarrow Cu_{(s)}$

LONG QUESTIONS

Q1. How could you convert the concentration ore to its oxide?
Ans: Concentration ore to its oxide: Following methods are used to convert the concentration ore to its oxide form.

1. **Roasting:** It is the process in which concentrated ore is heated alone or in the presence of some other materials in excess of air in a process.
   Procedure: the ore of metals such a copper and nickel when roasted in a furnace in the presence of air between 5000^0C and 7000^0C are converted into their oxide i.e.
   $CuCO_{3(s)} \rightarrow CuO_{(s)} + CO_{2\,(g)}$
   $Cu\,(OH)_{2(s)} \rightarrow CuO_{(s)} + H_2O_{\,(g)}$
   $2CuFeS_{2(s)} \rightarrow Cu_2S_{(s)} + 2FeS_{(s)} + SO_{2\,(g)}$
2. **Smelting:** It is the process in which the oxide ore in the fused state is reduced with reducing agents such as coke to get the metal is called roasting.
   Procedure: The roasted ore is mixed with coke and sand and smelted into blast furnace. During smelting iron sulphide (FeS) get oxidized to iron oxide (FeO). The iron oxide then react with silica (SiO_2) forming iron silicate ($FeSiO_3$).
   $2FeS_{(s)} + 3O_{2\,(g)} \rightarrow 2FeO_{(s)} + 2SO_{2\,(g)}$
   $FeO_{(s)} + SiO_{2(s)} \rightarrow FeSiO_3$
   Cuprous sulphide (Cu_2S) is also oxidizes and form copper oxide (Cu_2O).
   $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_{2\,(g)}$
   Cu_2O then reacts with un-reacted FeS and form Cu_2S and FeO.
   $Cu_2O_{(s)} + FeS_{(s)} \rightarrow Cu_2S_{(s)}\ FeO_{(s)}$
   The$Cu_2S$and FeS is called matte and is removed through slag hole.
3. **Bessemerization:**
4. **History:** Bessemer process was invented by Henry Bessemer.

Bessemer converter: This process is carried out in a special kind of egg shaped or pear shaped furnace. This furnace is called Bessemer.
Procedure: In Bessemerization matte is reacted with sand. Iron sulphide (FeS) oxidized to Iron oxide (FeO). This iron oxide (FeO) reacts with sand (SiO_2) forming ($FeSiO_3$), slag which is float on the surface.

$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$
$FeO + SiO_2 \rightarrow FeSiO_3$

Similarly Cuprous sulphide (Cu_2S) is converted to cuprous oxide (Cu_2O). This Cu_2O reacts with Cu_2S to produce copper (Cu) in molten form and sulphur dioxide (SO_2). This copper is known as blister copper (95-97% pure).

$2Cu_2S + 3O_2 \rightarrow 2Cu2O + 2SO_2$
$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

Q1. b. How would you use the roasting in extraction of copper?
Ans: Roasting: It is the process in which concentrated ore is heated alone or in the presence of some other materials in excess of air in a process.
Procedure: The concentrated ore of copper when roasted in a furnace between 5000^0C and 7000^0C in the presence of air are converted into their oxide i.e.
$CuCO_{3(s)} \rightarrow CuO_{(s)} + CO_{2\,(g)}$ $Cu(OH)_{2(s)} \rightarrow CuO_{(s)} + H_2O_{\,(g)}$ $2CuFeS_{2(s)} \rightarrow Cu_2S_{(s)} + 2FeS_{(s)} + SO_{2\,(g)}$

Q1.c. What inference can you make of smelting in extraction of copper?
Ans: Smelting: It is the process in which the oxide ore in the fused state is reduced with reducing agents such as coke to get the metal is called roasting.
Procedure: The roasted ore is mixed with coke and sand and smelted into blast furnace. During smelting iron sulphide (FeS) get oxidized to iron oxide (FeO). The iron oxide then react with silica (SiO_2) forming iron silicate ($FeSiO_3$).

$2FeS_{(s)} + 3O_{2(g)} \rightarrow 2FeO_{(s)} + 2SO_{2(g)}$ $FeO_{(s)} + SiO_{2(s)} \rightarrow FeSiO_3$
Cuprous sulphide (Cu_2S) is also oxidizes and form copper oxide (Cu_2O).
$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_{2\,(g)}$
Cu_2O then reacts with un-reacted FeS and form Cu_2S and FeO.
$Cu_2O_{(s)} + FeS_{(s)} \rightarrow Cu_2S_{(s)}\ FeO_{(s)}$
The$Cu_2S$and FeS is called matte and is removed through slag hole.

Q1. D. can you elaborate the reason of electro-refining of copper?
Ans: Purpose of electro-refining of copper: The blistered Copper is 95-97% pure copper, beside, this it contains iron (Fe), manganese (Mn), silver (Ag), gold (Au) etc. copper when used for electrical industries must be highly pure. Therefore in order to purify the blistered copper the electro-refining of copper is done.

Q2. A. List the raw materials used in Solvay process?
Ans: Solvay process: Sodium carbonate which is also known as soda ash is commercially prepared by a process known as Solvay process.
Raw materials used in Solvay process: Raw materials used for the manufacture of sodium carbonate are:

- Sodium chloride (NaCl)
- Lime stone ($CaCO_3$)
- Ammonia (NH_3)
- Water (H_2O)

Q2.b. What basic reaction would you use to support the manufacture of soda ash?
Ans: Basic reaction:
Solvay process consists of following steps.
1. Preparation of Brine solution: At first step, a saturated solution of sodium chloride is prepared which is known as brine.
2. Preparation of ammoniacal Brine: In this step, saturated brine solution is allowed to flown down in ammoniating tower, where ammonia is dissolved in brine.
3. Preparation of carbon dioxide and Slaked lime: Carbon dioxide is produced by heating limestone in lime kiln. $CaCO_{3(s)} \rightarrow CaO_{(s)} + CO_{2\,(g)}$
Carbon dioxide is fed into the carbonating tower from top. Calculated amounts of quick lime (CaO)

and water mixed to produce slaked lime Ca (OH) $_{2\,(aq)}$

$CaO_{(s)} + H_2O \rightarrow Ca\,(OH)_{2(aq)}$

4. Carbonation of Ammoniacal brine: in this step, ammoniacal brine is allowed to enter the carbonating tower, where ammoniacal brine is mixed with carbon dioxide gas, carbon dioxide reacts with ammoniacal brine to form ammonium carbonate $(NH_4)_2CO_3$

$2NH_{3(g)} + CO_2 + H_2O \rightarrow (NH_4)_2CO_{3(aq)}$

Ammonium carbonate reacts with sodium chloride and form sodium bicarbonate ($NaHCO_3$) and ammonium chloride (NH_4Cl).

$(NH_4)_2CO_{3\,(aq)} + NaCl \rightarrow NaHCO_{3(s)} + NH_4Cl\,_{(aq)}$

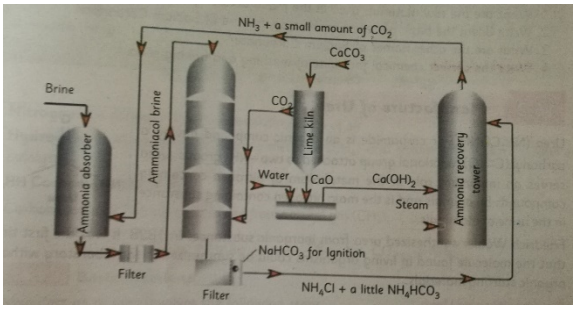
5.Filtration: The precipitate of sodium bicarbonate ($NaHCO_3$) is separated from the solution by filtration. It is used as baking soda.

6. Calcination: dry sodium bicarbonate ($NaHCO_3$) is heated in rotatory funnel call calcinatory, to give anhydrous sodium carbonate.

$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2\,(g)} + H_2O$

7. Recovery of Ammonia: Ammonia is recovered from ammonia chloride solution and slaked lime. Slaked lime is heated with ammonium chloride to form ammonia and calcium chloride which is the by product.

$2NH_4Cl_{(s)} + Ca\,(OH)_{2(aq)} \rightarrow CaCl_{2\,(aq)} + 2NH_{3\,(g)} + 2H_2O_{\,(l)}$



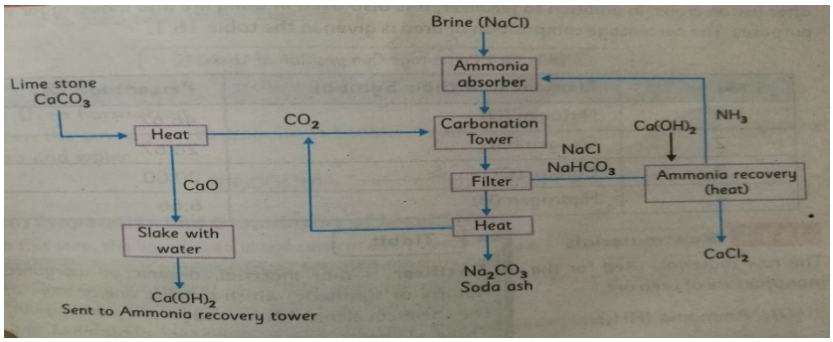
Q2.c. predict the by-products in the Solvay process.

Ans: By-products in the Solvay process:

the by-products of Solvay process is calcium chloride.

Q2.d. sketch the flow sheet diagram of the Solvay process.

Ans:



Q3.a. Enlist raw material used in the manufacture of urea?

Ans: Urea: Urea is an organic compound having a carbonyl (C═O) functional group attached to two –

NH_2. . Urea is one of the most important nitrogenous fertilizers. Its chemical formula is NH_2CONH_2. The formula shows that urea is composed of nitrogen, hydrogen. Carbon and oxygen.

Raw material used in the manufacture of urea material used in the manufacture of urea are following.

- Ammonia (NH_3)
- Carbon dioxide (CO_2)

Ammonia (NH_3): ammonia is prepared by Haber process. In this process, nitrogen and hydrogen react when they are passed over iron catalyst at 450^0C and 200 atmosphere pressure. It produces ammonia.
$N_{2\,(g)} + 3H_{2\,(g)} \rightarrow 2NH_{3\,(g)}$**Carbon dioxide:** it can be prepared from natural gas (CH_4).
$CH_{4\,(g)} + H_2O_{\,(g)} \rightarrow CO_{2\,(g)} + 4H_{2\,(g)}$

Q3.b. What basic reactions would you use to support the manufacture of urea?
Ans: Basic reaction:
Manufacture of urea involves the following steps.

1. Reaction of Ammonia and carbon dioxide: ammonia and carbon dioxide are heated at 17o – 200^0C and 100-200 atmospheric pressure to form ammonium carbamate.

$2NH_{3\,(g)} + CO_{2\,(g)} \rightarrow NH_2COONH_4$
2.Urea formation: when ammonium carbamate is heated it decomposes and produce water and urea.

$NH_2COONH_4 \rightarrow NH_2CONH + H_2O$

3. Evaporation and granulation of liquid: in this step, liquid urea is concentrated in vacuum evaporators. It is sprayed from top of tower under pressure and hot current of air in introduced from the bottom in opposite direction. It evaporates water from urea. It is rapidly cooled and sent to the granules. This urea is stored to be marketed.

Q3.c. What is the advantage of recycling of untreated compound in manufacture of urea?

Ans: Advantages of Recycling: manufacture urea contain untreated ammonia and carbon dioxide and ammonium carbamate. Ammonium carbamate is removed by reduction the pressure. When heating ammonia and carbon dioxide is separated. The advantage of this process is that ammonia and carbon dioxide can be recycle back to the process. Which increases urea yield.

Q3.d. Sketch the flow sheet diagram of urea manufacture process.

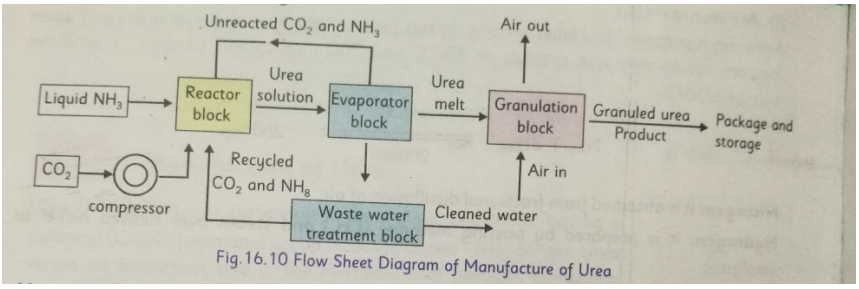


Fig.16.10 Flow Sheet Diagram of Manufacture of Urea

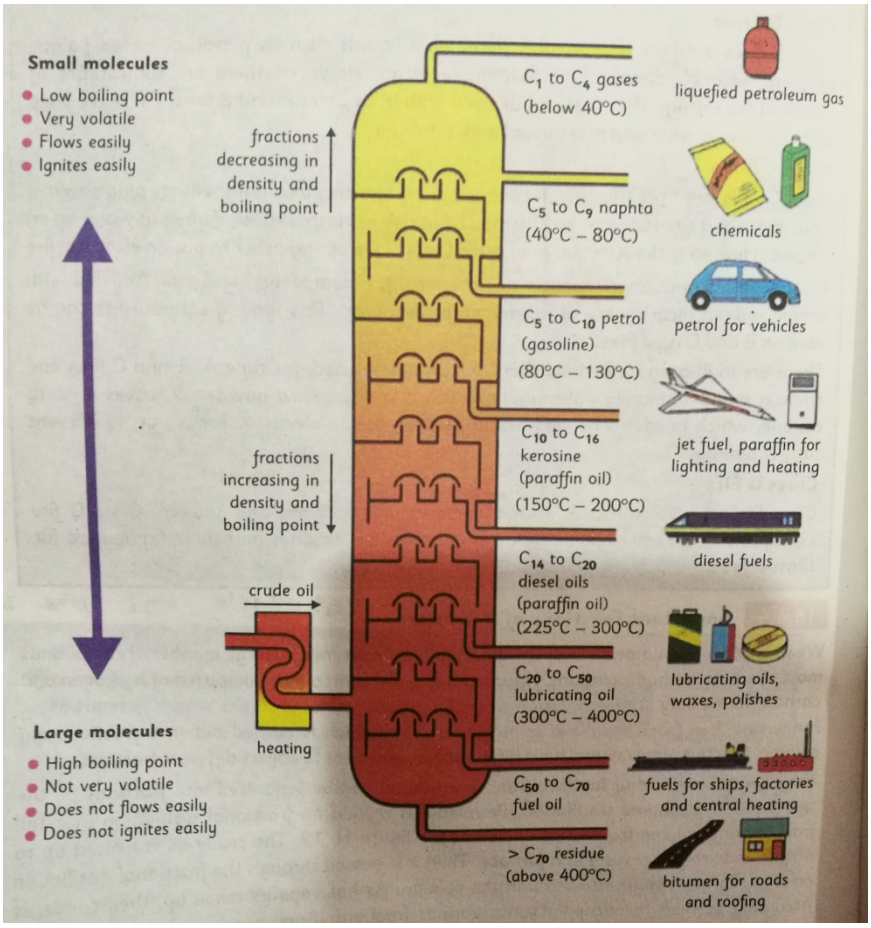
Q4.a.Define refining of petroleum. Describe the composition of petroleum?
Ans: Refining of petroleum:
the conversion of crude oil into useful products with different boiling range and d free from impurities is called refining of petroleum.

Composition of petroleum: petroleum is the mixture of various hydro carbons. It includes petroleum gas such as methane, ethane, propane and butane, naphtha petrol which range from $C_4 – C_1$. Kerosene oil ranges from $C_{12} – C_{16}$, diesels oils from $C_{14} – C_{25}$, lubricating oil $C_{20} – C_{70}$ and residue which is above C70.

Q4.b. What are the two theories about origin of petroleum?
Ans: There are two theories about origin of petroleum.
Inorganic origin: This theory was put forward by Russian chemist Mendeleev. He proposed that steam reacted with metallic carbides at high temperature and pressure under the surface of the earth produced petroleum. This theory did not gain popularity. According to this theory petroleum is originated from non-living source.

Organic origin: according to this theory, the remain of plants and animals were buried under the soil millions of year ago. These dead organic matter were converted into petroleum by the action of bacteria under the influence of temperature and pressure of the earth. These deposits trapped between the layers of nonporous rocks. The oil and gas thus formed could not come out and collected underground. This theory gain popularity.

Q.4.c. write a detail note on fractional distillation of petroleum.
Ans: Fractional distillation: The type of distillation in which different fractions of petroleum are separated according to difference in their boiling point is called Fractional distillation.
Basic principle of Fractional distillation: The fractions are separated according to difference in their boiling point. The substances having less boiling points boils out first leaving behind others.
Fractional Column: Fractional distillation is carried out in fractionating column. It has different compartment to collect different fractions**.**
Fractional distillation of petroleum: First of all crude oil is heated up to 400^0C under high pressure in a furnace. The heated mixture then passed through the fractional distillation column. The fractionating g column is divided into different compartment. Each compartment has definite range of temperature as hot vapours move up, they condense according to their boiling point into various fractions. Compound with high boiling point will condense first near bottom, while those compounds having low boiling points move to the top of column. Thus crude oil is separated into different fractions.



S.No	Fraction	Number of carbon atoms per molecule	BoilingPoint	Uses
1	Refinery Gas	$C_1 – C_4$	Below 40^0C	Methane (CH_4) coking, ethane another gaseous fuel, carbon-3 and carbon-4 as portable energy source and butane for camping gas
2	Naphtha-petrol (gasoline)	$C_4 – C_{12}$	40^0C - 130^0C	Naphtha used as a solvent and important chemical and as light engine oil

3	Kerosene (paraffin oil)	$C_{12} – C_{16}$	150^0C - 200^0C	Less volatile, less flammable than petrol, used for domestic heating fuel (paraffin), aircraft jet fuel (kerosene)
4	Diesel Oils	$C_{14} – C_{225}$	225^0C - 300^0C	Less volatile than petrol, used as a fuel in large vehicle such as trucks, trains etc.
5	Lubricating oil	$C_{20} – C_{70}$	300^0C - 400^0C	Viscous and used as lubricating oil and greases
6	Residue (bitumen/ Asphalt)	Above C_{70}	Above 400^0C	Used on roads as it forms a thick, black, tough and resistant adhesive surface on cooling, also used as a roofing water proofing material

Q5.a. write a detail note metallurgical operations.

Ans: Metallurgy: The art and science of making of making metals and alloys from their ores with properties suitable for practical uses is called metallurgy. OR
The science that deals with the procedures used in extracting metals from their ores, purifying**,** alloying metal sand creating useful objects from metal is called metallurgy.
Basic metallurgical operations: In metallurgy the ores are mined and subjected to various mechanical and chemical processes. There is no single method for extracting metals from their ores, But certain basic operation are required that is,
i. Concentration of ores
ii. Extraction of metal (roasting and reduction)
iii. Refining of metal**.**
1. Concentration of ore: the removal of useless rocky portion of the ore is called concentration of ore.

Explanation: Ore is impure metal containg large amount of sand and rocky material. These impurities must be removed from the ore before the extraction of metal.

Crushing and grinding: Huge lumps of ores are broken down into small pieces and then reduced to fine powder with the help of ball mill or stamp mill. This process is called pulverization.

Method used: there are mostly physical methods of concentration and also some chemical methods.

1. Hand picking: in this method the ores are concentrated to sufficient degree of purity by simple picking it with hand and breaking the rock stones with hammer.

2. Hydraulic washing:
Basis: This method is based on difference in densities of the ore and gangue.
Procedure: In this process, the ore particles are poured over a hydraulic classifier which is vibrating inclined able with grooves and a jet of water is allowed to flow over it. The denser are settled in the grooves while the lighter gangue particles are washed away.

Forth floatation: A separating method of the mineral particles of ore from the gangue that depends on the wetting of the minerals pieces.
Function of forth floatation: It is a process for selectively separating hydrophobic materials from hydrophilic. In this process the ore is wetted with water and pine oil. And the water insoluble impurities float on the surface and thus separated from the ore.
Steps:
1. Floatation tank: concentration of copper ore is carried out in floatation tank.
2. Crushing and grinding: In this step the ore is reduced to fine powder through crushing and grinding.

3. Froath formation: the powdered ore is suspended in water, soap or pine oil is added and a blast of air is bubbled through the suspension to produce froth.
4. Particle of ore: the particle are wetted by oil and float at the top of the mixture in container from which it is collected.
5. Concentrated Ore: the froth is washed with water and then filtered to obtain concentrated ore. While undissolved particles settle down at the bottom.
ii. Extraction of metal (roasting and reduction)

See L.Q 1 (part b and c).

iii. Refining of metal.

See L.Q 1 part d.

Q5.b. Explain the process of smelting and Bessemerization with reference to copper extraction.
Ans: Smelting: It is the process in which the oxide ore in the fused state is reduced with reducing agents such as coke to get the metal is called roasting.
Procedure: The roasted ore of copper is mixed with coke and sand and smelted into blast furnace. During smelting iron sulphide (FeS) get oxidized to iron oxide (FeO). The iron oxide then react with silica (SiO_2) forming iron silicate ($FeSiO_3$).

$2FeS_{(s)} + 3O_{2(g)} \rightarrow 2FeO_{(s)} + 2SO_{2(g)}$
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$Cu_2O_{(s)} + FeS_{(s)} \rightarrow Cu_2S_{(s)}$ $FeO_{(s)}$
The$Cu_2S$and FeS is called matte and is removed through slag hole.

Bessemerization:
History: Bessemer process was invented by Henry Bessemer.
Bessemer converter: This process is carried out in a special kind of egg shaped or pear shaped furnace.
This furnace is called Bessemer.

Procedure: In Bessemerization matte is reacted with sand. Iron sulphide (FeS) oxidized to Iron oxide (FeO). This iron oxide (FeO) reacts with sand (SiO_2) forming ($FeSiO_3$), slag which is float on the surface.

$2FeS + 3O_2 \rightarrow 2FeO + 2SO_2$
$FeO + SiO_2 \rightarrow FeSiO_3$

Similarly Cuprous sulphide (Cu_2S) is converted to cuprous oxide (Cu_2O). this Cu_2O reacts with Cu_2S to produce copper (Cu) in molten form and sulphur dioxide (SO_2). This copper is known as blister copper (95-97% pure).

$2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$
$2Cu_2O + Cu_2S \rightarrow 6Cu + SO_2$

Q.5.c. Enlist the different uses of urea.
Ans: Uses of urea:
it is a white crystalline organic compound. It is important due to the following usage.
1. Fertilizer: about 86% of urea is used as solid fertilizer.
2. Resins: Urea-formaldehyde resins are used as a poly-wood adhesive/glues.

3. Use as explosive: Urea can be used to make urea nitrate, which is highly explosive.
4. Chemical Industry: Urea is used as a raw material for manufacture of many important chemical compounds like plastics, resins, and various adhesives etc.

5. Flame proofing agent: Urea is used as a flame proof in agent.
6. Cosmetics: it is used as an ingredient in hair conditioners, facial cleaners and lotions.
7. Repellent to Corrosion: It is used as an alternative to rock salt in the deicing roadways and runways. It does not promote metal corrosion to extent that salt does.

8. Cigarette: It is also used as flavor enhancing additive for cigarette.
9. Medicinal uses: urea containing creams are used as tropical dermatological products to promote rehydration of skin.

TOPIC WISE QUESTIONS

Q2. What is drilling of petroleum?

Ans: Drilling of petroleum: the process by which petroleum is taken out from the earth by the use of various equipment is called drilling of petroleum.
Naturally: petroleum usually occurs at the depth of 500 feet of more. Crude oil is often associated with natural gas which exerts pressure on the oil surface and drives it out through natural opening of earth.

Artificially: in case of artificial mining, mines are bored. If the natural gas is present with the petroleum its pressure forces the petroleum to come out. If there is no natural gas then the air pressure is applied to force the oil from the well.