(Basic ideas)-advantages-hard and soft water-carbonate, non - carbonate hardness-methods of expressing hardness-mg/lit, ppm-simple problems-Estimation of total hardness by EDTA method-problems involving total, carbonate, non-carbonate hardness in ppm-softening of hard water ion- Exchange method, Reverse Osmosis method -standards of drinking water-Municipal water supply-purification (sedimentation, filtration and sterilization)-Disadvantages of hard water in boilers -Scale formation, Corrosion of boiler metal, Caustic Embrittlement - Priming and Foaming.

2.3 SOLID STATE 3 Hrs

Structure of Solids- Definition and examples for ionic, Molecular, Covalent and Metallic solids- Unit cell- bcc, fcc and hcp packing of metals –examples and properties reflected by the packing of atoms. (no numerical problems)

UNIT III

COLLOIDS, NANO PARTICLES AND PHOTO CHEMISTRY

3.1 COLLOIDS 5Hrs

Definition- sols-True solution and Colloidal solution- differences-Types-Lyophilic & Lyophobic sols- Differences.- Properties- Tyndall effect, Brownian movement, Electrophoresis, Coagulation – Industrial applications- Smoke Precipitation - Cottrell's method, Purification of water, Cleaning action of soap, tanning of leather and sewage disposal

3.2 NANO PARTICLES 2Hrs

Definition- Area of application - Medicine, Electronics and biomaterials.

3.3 PHOTOCHEMISTRY 7Hrs

Introduction-Important terms- charge transfer, electronic energy migration, emission, Excited state, Frequency, Ground state, Fluorescence, Phosphorescence, Chemiluminescence - photo electric cell- photo emission cell- photo synthesis-general chemical reactions-chlorophyll and accessory pigents - Mechanism of light reactions-Dark reaction-photosynthesis and acid rain.

4. Find the volume occupied by the following
   - i) 16g of oxygen at NTP
   - ii) 44g of carbondioxide at NTP
   - iii) 28g of nitrogen at NTP

5. Find the mass of the follwing
   - i) 1000ml of CO_2 at NTP
   - ii) 2 litres of ammonia NTP
   - iii) 96g of oxygen at NTP

6. How many molecules are present in the following?
   - i) 4g of Nitrogen
   - ii) 16g of Oxygen
   - iii) 32g of Methane

7. What is the mass of the following?
   - i) One molecule of CO_2
   - ii) One molecule of H_2O

8. Which one is heavier in the following at NTP?
   - i) 1 litre of CO_2 (or) 2 litres of NH_3
   - ii) 3 moles of H_2O (or) 1 mole of H_2SO_4

QUESTIONS

Part-A

1. Define molecular mass of a substance.
2. Define mole
3. What is molecular formula?
4. State Avogadro's hypothesis.
5. What is known as vapour density?
6. Define gram molecular volume.
7. Define Avogadro's number.

Part – B

1. What are the applications of Avogadro's hypothesis?
2. Derive the relationship between vapour density and molecular mass.

TEST YOUR UNDERSTANDING

Calculate the molecular mass of Washing soda ($Na_2CO_3.10H_2O$) and Blue vitriol ($CuSO_4.5H_2O$)

1.2. EQUIVALENT MASS

1.2.1 Introduction:-

Elements combine among themselves in a definite ratio by mass to form compounds. The term equivalent mass expresses the combining capacity of an element or a compound in terms of mass with reference to some standard.

Consider the formation of hydrogen chloride.

$$H \quad + \quad Cl \quad \rightarrow HCl$$

Atomic mass 1.008 35.45.

Here the mass of chlorine combining with 1.008 g of hydrogen is 35.45g.

Consider the formation of water

$$2H \quad + \; O \quad \rightarrow \; H_2O.$$

2 x 1.008 16

Here the mass of oxygen combining with 1.008g of hydrogen is 8g.

In the above two cases 35.45g of chlorine and 8g of oxygen are equivalent as they combine with the same mass of H_2 i.e., 1.008g.

Expressed without units, the numbers 35.45 and 8 are the equivalent masses of chlorine & oxygen respectively. So, 1.008 parts by mass of hydrogen is taken as a standard. Certain metals which do not combine with hydrogen displace it from dilute acids. Then the equivalent mass is the number of parts by mass of the metal which displaces 1.008 parts by mass of hydrogen.

Many metals do not either combine with hydrogen or displace hydrogen from acids. But almost all elements combine with oxygen and chlorine. Hence 8 parts by mass of oxygen and 35.45 parts by mass of chlorine are also chosen as standards.

1.2.2 Definition

Equivalent Mass of an element is the number of parts by mass of the element which combines with or displaces 1.008 parts by mass of hydrogen or 8 parts by mass of oxygen or 35.45 parts by mass of chlorine or one equivalent mass of any other element.

Explanation :

The atomic number of Nitrogen is 7.

The electronic configuration $1s^2, 2s^2, 2p^3$.

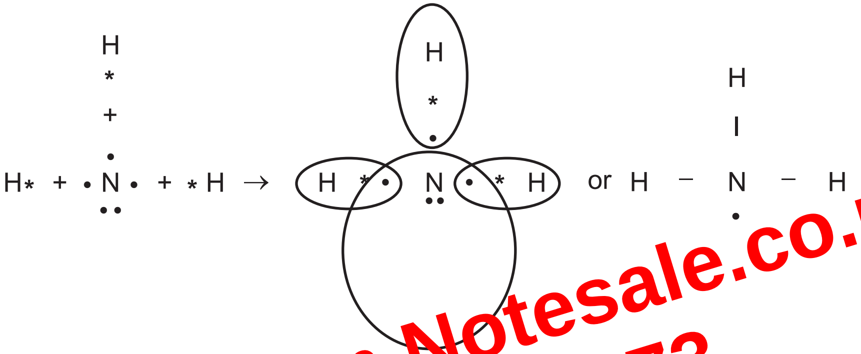
The electron dot formula of Nitrogen is

The atomic number of Hydrogen is 1

H·

The electronic configuration is $1s^1$.

The electron dot formula of hydrogen is



To get stable electronic configuration, Nitrogen shares its three electrons with electrons of 3 Hydrogen atoms.

Thus Ammonia Molecule is formed by 3 covalent bonds.

(3) Co-ordinate covalent bond

It is yet another type of linkage by virtue of which atoms acquire a stable configuration. Both transfer as well as sharing of electrons is involved in this mode of bond formation. The “shared pair” of electrons is supplied by one atom only and the other atom simply takes part in sharing. Thus “co-ordinate linkage is one in which the electron pair is contributed by one atom only and the sharing is done by both combining atoms”. The atom which provides the shared pair of electrons (called lone pair) is termed the **donor** and the atom which accepts this pair for the purpose of forming the molecule is called the **acceptor** atom. The co-ordinate linkage is shown by an arrow mark (→). The direction of the arrow points to the acceptor atom.

kernels in the metallic crystal. Therefore a metal crystal consists of an assembling of positively charged kernels immersed in a sea of mobile valance electrons. The positively charged kernels are stationary. There is considerable electrostatic force of attraction between positively charged kernels and the negatively charged mobile valence electrons. This force of attraction between the metal atom is called metallic bond.

SUMMARY

In this chapter, students have studied the different types of bonding including the nature of bonding in metals.

QUESTIONS

Part—A

1. What are the types of bonding?
2. Define ionic bond.
3. Define covalent bond.
4. Define co-ordinate covalent bond.
5. What is metallic bond?

Part—B

1. Explain electrovalent bond with an example.
2. Explain covalent bond with an example.
3. Explain co-ordinate covalent bond with an example.
4. Explain metallic bond by electron sea model theory.
5. Predict the nature of the bond in the following and give explanation.

   i) NaCl II) NH_3 III) NH_4^+

TEST YOUR UNDERSTANDING

Try to find the type of bonds in CO_2 and SO_4^{2-}

QUESTIONS

Part – A

1. Define molarity.
2. Define molality
3. Define a molar solution.
4. Define a molal solution.
5. Define mole fraction of solute
6. Define normality.
7. Define deci-normal solution.

Part – B

1. Calculate the Molarity of a solution containing 5.2 g. of calcium bromide ($CaBr_2$) in 200ml.
2. Calculate the Molarity of a solution containing 6.516 g. of sodium chromate (Na_2CrO_4) in 100ml of solution.
3. Calculate the weight of potassium hydroxide (KOH) required to prepare 400ml of 0.082 M solution.
4. Find the mass of urea (Molecular mass = 60) required to prepare a decimolar solution of it, in 250 ml of solution.
5. Calculate the Molality of a solution containing 5.6 g of potassium hydroxide in 250 g of water.
6. Find the mass of sugar required to prepare m/10 solution of it in 300ml of water.
7. Find the Molality of a solution of 2 g of sodium chloride in 450 g of water.
8. 64g of methyl alcohol (CH_3OH) is dissolved in 144g of water. Calculate the mole-fraction of methanol and water.
9. An aqueous solution contains 10% glucose by weight. Find the mole-fraction of both solute and solvent.
10. Find the mole-fraction of both solute and solvent in a solution containing 1.12g of potassium hydroxide in 179.64 g of water.
11. A solution of sodium carbonate contains 1.06 g of Na_2CO_3 dissolved in 100 ml of water. Calculate its concentration in normality.

2.2 TECHNOLOGY OF WATER

2.2.1 Introduction

Water is the most essential compound for all living matter on the earth. It plays an important role in human living and industries.

Sources of water

The two important sources of water are (1) surface water and (2) underground water.

Surface water

The water available on the earth's surface is called as surface water. Surface water includes rainwater, river water, lake water and seawater.

Underground water

Underground water includes water present between the rocks in the earth crust, spring water, well water etc.

2.2.2 Depletion of underground water

The decrease in the quantum of underground water is depletion of water. Depletion of water is mainly caused by

1. Modernization, industrialization and population growth
2. Global warming causing excess evaporation of surface water
3. Deforestation
4. Decrease in rainfall caused by seasonal changes and
5. Effluents from the industries spoiling the ground water source.

To meet out this depletion of ground water sources, it is essential to find alternate plans using water management techniques to recharge the ground water sources. One of the techniques adopted is rainwater harvesting.

2.2.3 Rain water Harvesting

Rainwater harvesting (RWH) is collection of rainwater for useful purposes . The methods employed are

1. Roof top harvesting
2. Open space harvesting

and Magnesium Phosphate which can be removed by blow down operation.

2. In external conditioning methods water is purified either by Zeolite process or by ion-exchange method before being fed into boilers.

(2) Corrosion of Boiler metal

The impurities such as dissolved oxygen, dissolved Carbon di oxide, mineral acids, dissolved salts of calcium and magnesium, organic matter etc.are responsible for the corrosion of boilers.

The dissolved matter undergoes hydrolysis and forms acids. The acid slowly attacks the inner part of the boiler.

The dissolved oxygen attacks iron at high temperature. The CO_2 and H_2O form carbonic acid (H_2CO_3), which slowly attacks the metal.

Prevention of Boiler Corrosion

1. By using proper water treatment procedures.
2. By degasification to remove the dissolved gases like oxygen, CO_2 , etc.,
3. The dissolved CO_2 can be removed by the addition of limewater.
4. Adding calculated amount of base could neutralize the mineral acids.

(3) Caustic Embrittlement:

Sometimes cracks appear inside the boiler parts, particularly at the places, which are under stress. Metal becomes brittle at these places. It is due to the high concentration of caustic soda (NaOH) and a little amount of silica in water. This is called as caustic embrittlement.

Caustic soda is formed by the hydrolysis of Na_2CO_3.

$Na_2CO_3 + H_2O \text{ ----------> } 2NaOH + CO_2$

Removal of Na_2CO_3 present in water can prevent caustic embrittlement.

This can be done by the following methods.

1. By adding sulphuric acid.
2. By adding $CaSO_4$ and $CaCl_2$ to boiler water
3. By adding Na_2SO_4.
4. By adding trisodium phosphate.

(4)Foaming and Priming

Foaming

Foaming is nothing but the formation of foam. Bubbles of water will enter the surface of water inside the boilers and results in the formation of foam. Foam comes out of the boiler along with the steam. Hence the steam becomes wet and the heat content of the steam is reduced considerably. This type of wet steam spoils the machine parts where it is used.

The main cause for foaming is the presence of dissolved salts in water. Hence soft water should be used in boilers to avoid foaming.

Priming

Priming is violent and rapid boiling of water inside the boiler. Due to priming the water particles mix up with the steam when it comes out of the boiler. Like foaming, priming also reduces the heat content of the steam and reduces the efficiency of the steam.

Main reasons for Priming

a) Defective design of the boiler.

b) Presence of large quantities of dissolved salts, oily matter, alkaline and suspended matter.

Control

1. Priming can be controlled by proper design of the boiler
2. By uniformly heating the water in the boiler.
3. By using a better sample of water.

Summary

Students have learnt about rain water harvesting, estimation of hardness, methods of softening and bad effects of hard water in boilers.

QUESTIONS

Part – A

1. Define hard and soft water.
2. List the salts that cause Carbonate hardness in a water sample.
3. List the salts that cause Non-carbonate hardness in water.
4. What is rain water harvesting?
5. Mention any two disadvantages of hard water.
6 List any two methods of softening of hard water.

same sample after boiling required 13ml of the same EDTA. Calculate (i) carbonate hardness and (ii) non-carbonate hardness in ppm of $CaCO_3$.

16. 100ml of a sample of water consumed 30ml of 0.01M EDTA. Calculate the hardness in (i) mg/l of $CaCO_3$ (ii) ppm of $CaCO_3$.

17. A sample of water has 15mg of $MgSO_4$ in 500ml. Express the hardness of this sample of water in ppm of $CaCO_3$

18. A sample of 50ml of water when treated with 0.01M EDTA solution consumed 6.2 ml of EDTA. Calculate the hardness of this sample of water in ppm of $CaCO_3$.

TEST YOUR UNDERSTANDING

1. In an EDTA titration 20ml of standard solution of Calcium carbonate containing 2.5mg of $CaCO_3$.in 100ml of distilled water required 25 ml of EDTA solution. When 100ml of a sample of hard water was titrated against the same EDTA solution, it required 33.4ml of EDTA solution. Calculate the hardness of water in mg/litre of $CaCO_3$.
2. A hard water contains 20mg of $CaCl_2$, 15 mg of $MgSO_4$ and 25 mg of NaCl in 100 ml of the sample. Find the volume of 0.01M EDTA solution required in a hardness estimation experiment.

Example: - Dry ice and Ice

Dry ice is solid carbon dioxide. In dry ice the particles present are CO_2 molecules and the force of attraction operating between these particles is 'Vander wall's force of attraction'.

In ice the particles present are H_2O molecules and the force of attraction operating between H_2O molecules is dipole-dipole attraction.

4.METALLIC SOLIDS

All metal crystals are metallic solids. Metals show the following properties.

a. They have high melting point and density.
b. They conduct electricity.
c. On heating they emit electrons. This property is called 'Thermionic emission'.

A new type of bonding called 'metallic bonding' explains all these properties.

TYPE OF PACKING IN METAL CRYSTALS

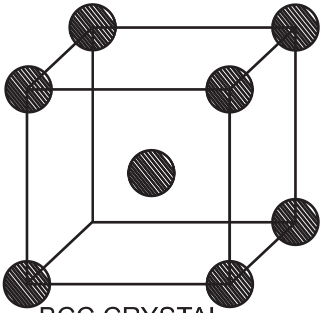
The three type of packing generally present in metal crystals are

(I) Body centered cube (BCC)
(ii) Face centered cube (FCC)
(iii) Hexagonal Close Packing (HCP)

(I) Body Centered Cube (BCC)

This type of packing is present in metals like sodium, potassium etc. The diagram of the unit cell is as follows.

Diagram



BCC CRYSTAL

Unit III

COLLOIDS, NANO PARTICLES AND PHOTO CHEMISTRY

3.1 COLLOIDS

3.1.1 Introduction

An aqueous solution of salt or sugar is homogeneous and it contains the solute particles as single molecules or ions. This is called a true solution. The diameter of the dispersed particles ranges from 1A° to 10A° [1A° = 10^{-8} cm]; whereas in a suspension of sand stirred in water, the diameter of the dispersed particles will be more than 2000A°. The particles which are larger than a molecule and smaller than a suspended particle are said to be colloids and such solutions are called colloidal solution or sol.

Moleculer size < colloids < suspension
(1A° - 10A°) (10A° - 2000A°) (More than 2000A°)

Definition

A colloidal system is made up of two phases. The substance distributed as colloidal particles is called the dispersed phase (analogous to solute) and the phase where the colloidal particles are dispersed is called the dispersion medium (analogous to solvent). A colloidal solution can form eight different types based upon the physical state (solid, liquid, gas) of dispersed phase / dispersion medium. The common example of colloids are milk, curd, cheese, clouds, paint etc. The properties of these colloidal solution are in many ways different from that of true solution.

(3)Cleaning action of soap

The dirt particles stick to the cloth or body by the greasy oily substance. It forms an emulsion with soap. The dirt particles get detached from the cloth / body and washed away along with soap with excess of water.

(4)Tanning of leather

Animal hides are colloidal in nature. When a hide, positively charged particles, soaked in tannin, a negatively charged particle, mutual coagulation takes place. This results in hardening of leather. The process is called tanning. Chromium salts are used as tannin.

(5)Disposal of sewage

Sewage dirt particles are electrically charged. So the sewage is allowed to pass through disposal tanks. It is then subjected to high potential. The sewage particles lose the charges and coagulated. Clean water is recycled or used for gardening. Sludge is used as manure.

QUESTIONS

Part-A

1. What is a colloid?
2. Give any two examples for colloid.
3. What are the two types of colloids?
4. Give any two example for lyophilic colloid.
5. Define Tyndall effect.
6. What is called Brownian movement?
7. What is meant by electrophoresis?
8. Define coagulation of colloid.

Part-B

1. Distinguish between true solution and colloidal solution.
2. What are the differences between lyophilic and lyophobic colloids?
3. Write notes on (i) Brownian movement (ii) Tyndall effect.
4. Write notes on (i) Electrophoresis (ii) Coagulation of colloids.
5. Write down any five applications of colloids.

6. What is coated on the cathodic area of a photo emissive cell?
7. Define photosynthesis.
8. What is the role of chlorophyll- in a green leaf?
9. Mention the disadvantage of deforestation.
10. Define photo chemistry.

Part-B

1. Write notes on (i) flurescence (ii) Phosphorescence.
2. Explain chemi luminescence.
3. Explain the mechanism of photo synthesis.
4. Explain the importance of photosynthesis in preventing acid rain.

TEST YOUR UNDERSTANDING

1. What makes the sky appear blue?
2. Think about a town/city-plan that is free from deforestation.

Cathodic reaction:

At the cathode, H^+ ions get reduced to hydrogen atoms by gain of electrons.

$$H^+ + e^- \rightarrow H \quad \text{(reduction)}$$

$$2H \rightarrow H_2 \text{ (gas)}$$

Hydrogen gas is liberated at the cathode.

Thus, hydrochloric acid decomposes into hydrogen and chlorine.

Electrolysis depends on the following factors:

(i) Nature of electrodes used and (ii) Physical nature of electrolytes used.

4.1.5 Industrial Applications of Electrolysis

Electrolysis is applied in

(i) Electroplating

(ii) Anodization of Aluminium

(iii) Electrolytic refining of metals.

4.1.6 Electroplating

Electroplating is coating of a more noble metal over a less noble metal by electrolysis. Electroplating is done for the following purpose.

(a) To make the surface corrosion resistant.

(b) To improve the surface appearance.

In electroplating,

The metal which is to be electroplated (base metal) is taken as cathode; the metal to be coated on (coat metal) is taken as anode. A salt solution of coat metal is taken as electrolyte.

Example: Chrome plating, silver plating, copper plating, gold plating etc.

4.1.7 Preparation of surface

It is essential to clean the article thoroughly before applying a coating. The cleaning of the article is called as 'preparation of surface'.

- First, a surface is buffed with emery sheet to get a polished (cleaned) surface.

10. What is chrome plating?
11. What is the anode and electrolyte used in chrome plating?
12. What is electroless plating?
13. Give any two advantages of electroless plating over electroplating.
14. Give any two applications of electroless plating.

PART - B (6 Marks)

1. Explain electrolysis with a suitable example.
2. What are the steps involved in preparation of surface?
3. What are the factors affecting the stability of coating?
4. Explain electroplating with an example.
5. Describe chrome plating with a neat diagram.
6. Explain electroless plating with an example.
7. I) What are the advantages of electroless plating over electroplating?
   ii) Give the applications of electroless plating.

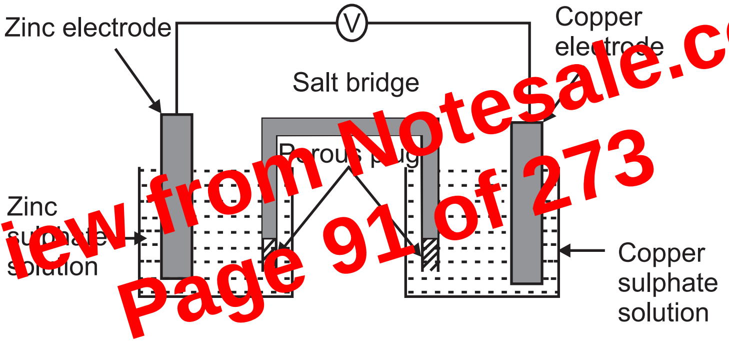
Where, M_1 & M_2 are Anode and Cathode respectively and M_1^+ & M_2^+ are the metal ions in respective electrolyte. The symbol || denotes salt bridge. The above representation of galvanic cell is known as galvanic cell diagram.

Example: The typical example for galvanic cell is Daniel cell.

4.2.5 Daniel Cell

This cell consists of a zinc rod as anode dipped in zinc sulphate solution (electrolyte) in a glass tank and copper rod as cathode dipped in copper sulphate (electrolyte) in another glass tank. Each electrode is known as half cell. The two half cells are inter-connected by a salt bridge and zinc and copper electrodes are connected by a wire through voltmeter. The salt bridge contains saturated solution of KCl in agar-agar gel. The cell diagram of Daniel cell is

$Zn / Zn^{2+} || Cu^{2+} / Cu$ or $Zn / ZnSO_4 || / CuSO_4 ||Cu$



Redox reaction occurs at Daniel cell:

At anode

$Zn \longrightarrow Zn^{2+} + 2e^-$ (Oxidation)

At cathode

$Cu^{2+} + 2e^- \longrightarrow Cu$ (Reduction)

Overall Cell reaction

$Zn + Cu^{2+} \longrightarrow Cu + Zn^{2+}$

Part - B

1. Explain electrochemical cell with example.
2. Explain the construction and working of Daniel cell.
3. Describe a galvanic cell with cell reactions.
4. What are the applications of electrochemical series?
5. Explain the construction and working of a concentration cell with example.

The cell is represented as

$Cd \mid Cd(OH)_2 \parallel KOH\,(aq) \mid NiO_2 \mid Ni$

Construction and Working:

When the nickel battery operates, Cd is oxidized to Cd^{2+} ions at anode and the insoluble $Cd(OH)_2$ is formed. NiO_2 is reduced to Ni^{2+} ions which further combines with OH^- ions to form $Ni(OH)_2$. It produces about 1.4 V. The following cell reactions occur.

Anodic reaction:

$$Cd\,(s) + 2OH^- \longrightarrow Cd(OH)_2\,(s) + 2e^-$$

Cathodic reaction:

$$NiO_2\,(s) + 2H_2O + 2e^- \longrightarrow Ni(OH)_2\,(s) + 2OH^-$$

Overall cell reaction during discharging:

$$Cd\,(s) + NiO_2\,(s) + 2H_2O \longrightarrow Cd(OH)_2\,(s) + Ni(OH)_2\,(s) + \text{Energy}$$

From the above cell reactions, it is clear that $Cd(OH)_2$ and $Ni(OH)_2$ are deposited at both the anodes and cathodes respectively. So, this can be reversed by recharging the cell.

Overall cell reaction during recharging:

The cell can be charged by passing electric current in the opposite direction. The electrode reactions get reversed. As a result, Cd is deposited on the anode and NiO_2 on the cathode.

$$Cd(OH)_2\,(s) + Ni(OH)_2\,(s) + \text{Energy} \longrightarrow Cd\,(s) + NiO_2\,(s) + 2H_2O$$

Advantages of Ni-Cd battery:

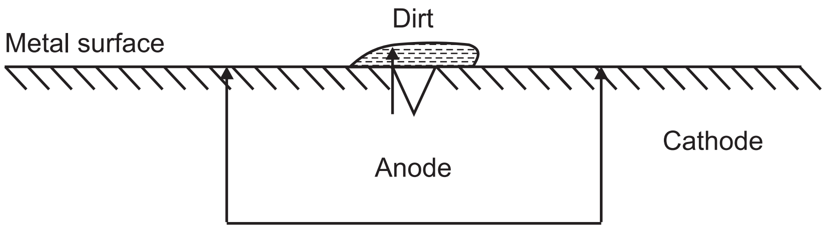
1. It is portable and rechargeable cell.
2. It has longer life than lead – acid battery.
3. It can be easily packed like dry cell since it is smaller and lighter.

Uses:

1. It is used in calculators.
2. It is used in gas electronics flash units.
3. It is used in transistors, cordless electronic appliances, etc.

The less oxygenated area acts as Anode (gets corroded)

The more oxygenated area acts as the Cathode (Protected from Corrosion)



Reaction

At anode (less oxygenated area)

$Fe \rightarrow Fe^{2+} + 2e^-$ (oxidation or corrosion)

At the cathode (more oxygenated area)

$2H_2o + O_2 + 4e^- \rightarrow 4OH^-$ (Reduction)

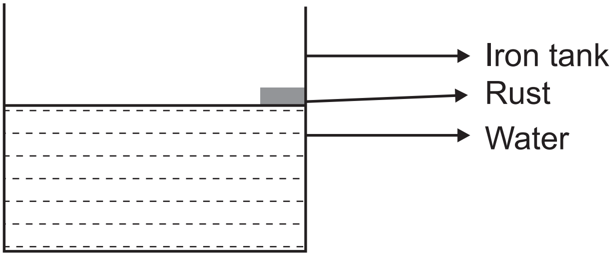
$Fe^{2+} + 2OH^- \rightarrow Fe(OH)_2$

$Fe(OH)_2$ is further oxidized to $Fe(OH)_3$. Since the anodic area is small and the cathodic area is large, corrosion is more concentrated at the anode. Thus, a small hole is formed on the surface of the metal. This type of intense local corrosion is called **pitting**.

Other examples for differential aeration corrosion are:

1. Corrosion noted on the barbed wire fencing, In a wire fence, the areas where the wires cross are less accessible to air than the rest of the fence and hence corrosion takes place at the wire crossings which are anodic.

2. Corrosion noted in the iron water tanks near the water level water line corrosion.



Acid Dyes:

Salts of organic acids are called acid dyes. It donate colour cellulose fibres. They can readily dye only animal fibres.

Eg: Methyl red, Methyl Organe etc.

Basic Dyes.

They are salts of colour bases with hydrochloric acid or Zinc chloride. Basic dyes can dye animal fibres directly and vegetable fibres after the fibres are mordanted with tannin. Basic dyes are mostly used for dyeing silk and cotton.

Eg: Magenta, Para-rosaniline dye, Aniline Yellow.

Mordant or Adjective dyes:

A mordant is any substance, which is fixed to the fibre before dyeing. Commonly used mordants are hydroxides or basic salts of chromium, aluminium or iron. Tannic acid is also used as mordant for basic dyes.

Generally the fabric is dipped in a mordant and then in a solution of dye. The dye coat thus formed is insoluble and does not fade on washing.

E.g. Alizarin and Anthraquinone dyes.

Questions

Part - A

1. Define paint.
2. Give examples for heat resistant paint.
3. What is Varnish?
4. What is the function of the drier in paint?
5. What are Fire-retardant paints?
6. Define Dyes.

Part - B

1. What are the components present in the paint. Explain their functions.
2. How is oil varnish prepared ?
3. Write a short note on special paints.
4. write short notes on Dyes.

SEMESTER- I

PRACTICAL- I

VOLUMETRIC ANALYSIS

The method to determine the exact amount of the substance in a given sample is termed as quantitative analysis volumetric analysis is a branch of quantitative analysis involving accurate measurement of volumes of reacting solutions. The volumetric analysis is very much in use due to simplicity rapidity accuracy and wide applicability.

The reacting substances are taken in the form of solutions and made to react. The concentration of one solution is determined using another suitable solution whose concentration is accurately known. A known volume of one solution is measured with a pipette and taken in a conical flask. The other solution is taken in a burette and run into the first solution till the chemical reaction is just complete. The volume of the second solution is read from the burette and the two volumes are compared.

Various terms used in volumetric analysis are given below:

Titration

The process of adding one solution from the burette to another in the conical flask in order to complete the chemical reaction is termed titration.

Endpoint

It is the exact stage at which chemical reaction involved in the titration is just complete

Indicator

It is a substance which will show the end point of the reaction by change of colour. For example phenolphthalein and methyl orange are indicators used in acid alkali titrations. Potassium permanganate itself acts as an indicator in potassium permanganate titrations.

Acidimetry and Alkalimetry Titration:

Acidimentry refers to the titration of alkali with a standard acid and alkalimetry refers to the titration of an acid with a standard alkali.

Titration-II : Potassium permanganate Vs ferrous sulphate

S.No	Volume Ferrous sulphate (ml)	Burette reading (ml)		Solume of Potassium permanganate (ml)	Indicator
		initial	final		

Concordant value=

Calculation:

Volume of ferrous sulphate (V_1) = 20 ml

Normality of ferrous sulphate (N_1) = ?

Volume of Potassium permanganate (V_2) =

Normality of Potassium permanganate (N_2) =

By the principle of volumetric analysis, $V_1N_1 = V_2N_2$

$\therefore$ Normality of ferrous sulphate = ____________ N

$$\therefore N_1 = \frac{V_2N_2}{V_1} = \frac{X}{20} = ------N$$

Amount of ferrous sulphate present in 500 ml of the given solution = Equivalent mass x Normality of ferrous sulphate x 500/1000 = ---------g

SHORT PROCEDURE

Description	Titration I	Titration II
Burettesolution	Potassium permanganate	Potassium permanganate
Pipette solution	Ferrous ammonium sulphate	Ferrous sulphate
Reagents added	One test tube of dilute sulphuric acid	One test tube of dilute sulphuric acid
Indicator	self	self
End point	Appearance of pale permanent pink colour	Appearance of pale permanent pink colour
Equivalent mass of Ferrous sulphate = 278		

SEMESTER II

UNIT I

ENVIRONMENTAL CHEMISTRY

1.1. AIR POLLUTION

1.1.1 Introduction

In recent days, everyone speaks about pollution. We are all facing huge risks due to pollution. The air we breathe, the water we drink, and the place where we live and work in may be full of toxic substances. The adverse effects of these pollutants may affect the future generation also.

Pollution may be defined as the excessive discharge or addition of unwanted and undesirable foreign matters into the environment that causes huge damage to human, plants and animal life.

Environment includes air, water and land. The unwanted foreign matters are called pollutants.

1.1.2 Causes of Pollution

The following are the main causes of pollution.

1. Huge increase in population.
2. Rapid Industrialization.
3 Rapid urbanization
4. Uncontrolled exploitation of nature.
5. Radio activity.
6. Volcanic eruptions etc.

To understand the magnitude of pollution problems it may be classified into three as follows:

1. Air pollution
2. Water pollution
3. Land pollution.

litter. Another common by product of land fill is gas (Methane & CO_2) which can create odour problems, kill surface vegetation etc.,

Land fill operation

Modern land fill contain a series of three dimensional control cells. The wastes dumped in the appropriate cells can be covered by a layer of soil at the end of each day. Below the wastes dumped in the cell, a double liner system is provided to prevent the leachates from polluting the soil and ground water beneath the site. The upper liner must be flexible-membrane lining made of plastic or rubber. A properly designed and well-managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials.

Landfill operation

(2) Incineration:

Burning of solid wastes such as wood wastes, cloth wastes can be carried out by burning them into charcoal and ash. A number of hazardous wastes incinerators are available.

Organic wastes are disposed by combustion and are converted into residue and gaseous products. This process reduces the volumes of solid wastes to 20 – 30 percent of original volume. Incineration and other high temperature waste treatment described as "thermal treatment" .Incinerators convert wastes into heat, gas, steam and ash.

Incineration plant

(3) Recycling

Recycling is a process of converting used materials (waste) into new products to prevent wastage of potentially useful materials, to reduce the consumption of fresh raw materials, to reduce energy usage, to reduce air pollution (from incineration) and water pollution (from landfilling). This reduces the need for "conventional" waste disposal methods and there by lower greenhouse gas emissions. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, Recycle" waste.

Steel crushed and baled for recycling

Recycling refers to the collection and reuse of waste materials. "Materials for recycling may be collected from general waste and

(1) Peat:

It is the first stage of formation of coal from wood. It is brown, fibrous jelly-like mass. It contains 80-90% moisture. The composition of peat is C=57%; H=6%; O=35% Ash=2.5%. The calorific value of peat is 5400kcal/kg. It is a low –grade fuel due to high water content. It is used as a fertilizer and packing material.

(2) Lignite:

Lignite is immature form of coal. It contains 20-60% moisture. Air –dried Lignite contains C=60-70% O=20%. It burns with a long smoky flame. The calorific value of lignite is 6500-7100 kcal/kg.

Uses:

1.It is used as a domestic fuel.
2.It is used as a boiler fuel for steam raising.
3.It is used in the manufacture of producer gas.

(3) Bituminous Coal:

It is a high quality fuel. Its moisture content is 4%. Its composition is C=83%. O=10%, H=5% and N=2%. Its calorific value is 8500 kcal/kg.

Uses:

1. It is used in metallurgy.
2. It is used in steam raising.
3. It is used for making coal gas.
4. It is also used for domestic heating.

(4) Anthracite Coal:

It is the superior form of coal. it contains C=92-98%, O=3%, H=3% and N=0.7%. It burns without smoke. It's calorific value is 8700 \kcal/kg

Uses:

1. It is used for steam raising and house hold purposes.
2. It is used for direct burning in boilers and in metallurgy.
3. It is used in thermal power plant.
4. It is used in coal tar distillation.
5. It is used in glass furnaces.

UNIT – III

EXTRACTION OF METAL , POWDER METALLURGY, ALLOYS AND ABRASIVES

3.1. EXTRACTION OF METALS

3.1.1 Introduction

Metallurgy deals with extraction of a metal in its pure form from its ore. The stages involved in extracting a metal from its ore are

1. Crushing and grinding of ore
2. Concentration of ore by Physical methods
3. Conversion of concentrated ore into its oxide by chemical reactions
4. Conversion of metal oxide into metal by reduction and
5. Purification of metal by suitable method.

In this lesson we are going to study the metallurgy of two important metals namely Titanium (Ti) and Tungsten (W) which are mainly used to prepare hard steel varieties.

31.2 Titanium (Ti)

(1) The main ores of Titanium are

1. Rutile – TiO_2
2. Ilmenite – $FeTiO_3$

(2) Extraction

Stage I: The ores of Titanium (Rutile and Ilmenite) is converted into titanium tetra chloride ($TiCl_4$) by heating them at 900ºC with carbon in a current of Chlorine.

$$TiO_2 + C + Cl_2 \xrightarrow{900^0 c} TiCl_4 + CO_2$$

Stage II: The vapours of $TiCl_4$ are collected and condensed to get $TiCl_4$ liquid. $TiCl_4$ liquid, which boils at 136ºC, is purified by distillation.

Stage III: $TiCl_4$ is then reduced with sodium metal in argon atmosphere to get titanium.

$$TiCl_4 + 4Na \longrightarrow Ti + 4NaCl$$

The metal thus obtained is washed with 3% nitric acid to remove impurities.

Stage IV: Finally the metal is purified by Van Arkel method. In this method impure Titanium is heated with iodine vapours to get Titanium tetra iodide vapours. These vapours are taken to a different chamber and passed over a heated tungsten wire at 140ºC. TiI_4 decomposes to give pure Titanium.

$$Ti + I_2 \longrightarrow TiI_4$$

$$TiI_4 \xrightarrow{140°C} Ti + I_2$$

(3) Conversion Of Ilmenite Ore Into Titanium Oxide

The ilmenite ore is treated with concentrated sulphuric acid to get a mixture of Titanium suphate and ferrous sulphate. This mixture is digested with excess of water. Iron goes into solution as ferrous sulphate. Titanium sulphate undergoes hydrolysis to form titanium hydroxide precipitate.

$TiO(OH)_2$ on heating gives titanium oxide.

$$Ti(SO_4)_2 + 3H_2O \longrightarrow TiO(OH)_2 \downarrow$$

(4) Properties

$$TiO(OH)_2 \longrightarrow TiO_2$$

Titanium is a shining white metal. It has low density and high melting point. It is a good conductor of heat and electricity.

(5) Uses

1. Titanium has better corrosion resistance and is much lighter in mass when compare to stainless steel. It is therefore used in aircrafts, gas turbine engines, marine equipments etc.
2. It is also used for hardening steel.
3. TiO_2 is used as a semi-precious artificial gem. It is the ninth most abundant element present in the earth crust.

(4) uses

1. The chief minerals of Tungsten present about 10^{-4} % in the lithosphere.
2. Tungsten is mainly used for preparing special type of steels. It is also used for making filaments of electric bulbs, pinpoints, strings for musical instruments etc.,
3. Steel containing 14-22% tungsten and 3-5% Chromium forms a high-speed tool steel material, since it retains its hardness even at very high temperature. It is also used as anti cathode in X-ray tubes.
4. Tungsten is also used for making surgical instruments, spark coils, gramophone needles, Voltage regulators, telegraphic keys, contact points etc.,Tungsten carbide is used to prepare very hard alloys.
5. Sodium tungstate is used for making fireproof fabrics. It is also used as a mordant in dyeing.
6. WO_3 is used as yellow pigment.

Summary:

In this lesson extraction of titanium and tungsten and their properties and uses are discussed.

QUESTIONS

Part – A

1. Name the ores of Titanium
2. List the uses of Titanium
3. Name the ore of Tungsten
4. List the uses of Tungsten.
5. How is tungsten ore concentrated?
6. How is Titanium tetra chloride prepared from titanium ore?
7. How is $TiCl_4$ reduced to get titanium?
8. How is tungsten obtained from tungstic acid?

Part – B

1. Explain how tungsten is obtained from its ore in pure form.
2. Explain the extraction of Titanium from its ore.
3. Describe Van Arkel method of purification of Titanium.

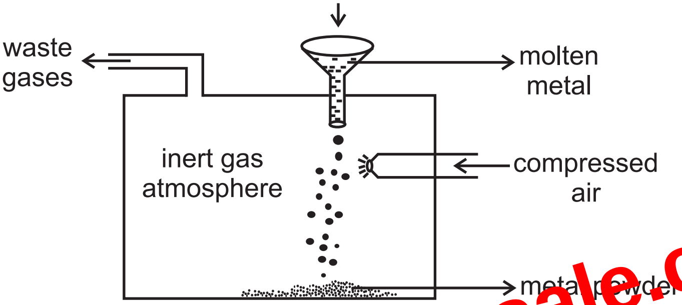
TEST YOUR UNDERSTANDINGS

1. What are the alloys prepared using titanium?
2. What are the alloys prepared using tungsten?

Powders of metals like Iron, Tungsten, Nickel, Copper can be prepared by this method.

2) Atomization Method

A molten metal is forced through an orifice. A compressed stream of air is passed over the metal. The liquid metal is broken and sprayed into minute droplets. The droplets are cooled and condensed to get metal powder. To avoid oxidation of metal powder, inert gas is used instead of air. Powders of low melting metals metals like Zinc, Lead and Tin are produced by this method.



3.2.3 Applications Of Powder Metallurgy

- This technology is successfully employed to make compact complicated geometrical shapes.
- Used for making metal bearings embedded with graphite powder.
- Even dense ductile sheets of highly brittle metals like Tungsten and Molybdenum can be produced by this method.
- Wear resisting cutting tools with Cobalt and Nickel metal powder and Carbides of Tungsten and Molybdenum can be produced by this method.
- This method is used to make special electrical contacts containing a current and heat conducting metal mixture.
- This method is used to prepare filaments for bulbs. (Tungsten filament)
- Used to make diamond impregnated cutting tools.
- Used to prepare magnetic materials.

Summary:

In this lesson importance of powder metallury and methods of production of metal powder are discussed.

Types of Brass:

Dutch metal:

It contains 80% copper and 20% Zinc. It has golden yellow colour. It is suitable for all drawing and forming operations. Used for making cheap jewellery, musical instruments, battery cap, flexible hoses, tube, nameplates etc.

German silver:

It contains 50% Copper, 30% Nickel and 20% Zinc. It has very high corrosion resistance. Used for making coins, ornaments and decorative materials.

Cartridge Brass:

It contains 70% copper and 30% Zinc. It has high tensile strength and ductility. It is used for making condenser tubes, brass sheets etc.

Bronze:

Bronze is an alloy of Copper and Tin.

Types of Bronze

Gun Metal:

It contains 88% Copper, 10% Tin and 2% Zinc. It is very strong and tough. It can even withstand explosion. It is mainly used for making bearings, coins, and hydraulic fittings and in foundry works.

Coinage Bronze or common bronze

It contains 89 to 92% copper and 11 to 8% tin. It is soft, ductile and durable. It is used in pumps, valves, wires, flanges, utensils, coins and statues.

(2) Nickel alloys

Nichrome:

It contains 60% Nickel, 12% chromium, 2% Manganese, 26% iron. It is a chemical and heat resistant material. It has a very high melting point and high electrical resistance. It is used in making resistance coils, heating elements in stoves, electric irons, and toasters.

Locanel:

It contains approximately 80% Nickel, 14% chromium and 6% iron. It is very ductile in nature. It is a good corrosion-resistant material. It retains

3.4.4 IMPORTANT NATURAL ABRASIVES

(1) DIAMOND

- It is the hardest substance in the world.
- It is the purest form of carbon.
- It is a natural hard non-siliceous abrasive.
- Its hardness in Moh's scale is 10.

In diamond each carbon atom is connected to four other carbon atoms by covalent bonds throughout the crystal. This explains the extreme hardness of diamond. It is used for cutting, grinding and polishing purposes. It is mainly used in rock drilling.

(2) CORUNDUM

- It is a natural hard non-siliceous abrasive.
- It is fused aluminium oxide.
- It is obtained by fusing the ore of aluminium called Bauxite.
- It is mainly used in grinding wheels.
- It is specially used for grinding paper pulp.
- Its hardness in Moh's scale is 9.

(3) EMERY

- It is a mixture of corundum (Al_2O_3) and magnetite (Fe_3O_4).
- The presence of magnetite decreases the hardness of corundum.
- It is mainly used for scratching and rubbing surfaces.
- It is also a natural hard non-siliceous abrasive.
- Its hardness in Moh's scale is 7 to 9.

(4) GARNET

- Garnets are tri-silicates of alumina, magnesia and ferrous oxide.
- They are natural hard siliceous abrasives.
- In Moh's scale their hardness is 6.5.
- They are not as hard as emery.
- They are mainly used for making abrasive cloth and paper.

3.4.5 ARTIFICIAL ABRASIVE

(1)Silicon carbide (SiC):

It is also called as Carborundum. In hardness, it is almost equivalent to diamond.

Preparation:

Silicon Carbide is prepared by fusing a mixture of Silica (sand) and Carbon (coke) with some salt and sawdust in an electric arc furnace at 2500°C.

$$SiO_2 + 3C \xrightarrow{2500^0 C} SiC + 2CO$$

Salt and saw dust is added to infuse air into the product so that it can be broken into pieces easily. The product obtained is first washed with strong acid followed by strong base to remove basic and acidic impurities Finally it is washed with water.

Silicon Carbide is chemically inert. It is also a good refractory material. It is used for making grinding wheels, which are used to grind glass, granite, carbides, rubber, chilled iron, etc.

(2) BORON CARBIDE

It is harder than silicon carbide. It is also called as NORBIDE. It is obtained by heating Coke with Boron Oxide (B_2O_3) at 2500°C in electric arc furnace.

$$2B_2O_3 + 7C \xrightarrow{2500^0 C} B_4C + 6CO\uparrow$$

It is chemically inert and used for cutting steel, tungsten carbide and other hard materials.

SUMMARY:

In this lesson hardness of abrasives, classification and their applications are discussed.

QUESTIONS

Part – A

1. What are abrasives?
2. Why is carbon the hardest material in the world?
3. What are the main uses of emery?
4. What is carborundum?
5. What is the commercial name of Boron Carbide?

4.1.3 Advantageous Properties of the composites over metals, polymers and ceramics

The important advantages of composites over the common bulk materials are as follows:

1. Higher specific strength.
2. Lower specific gravity.
3. Higher specific stiffness.
4. Lower electrical conductivity.
5. Better corrosion and oxidation resistance.
6. Can be fabricated easily.
7. They are tough having good impact and thermal shock resistance.

4.1.4 Constituents of Composites

Two essential constituents of composites are

1. Matrix Phase is the continuous body constituent which encloses the composite and give it its bulk form. Matrix phase may be metal, ceramics (or) polymers.

Composites using these matrix are known as metal matrix composites (MMC).

Ceramic Matrix Composites (CMC)
Polymer Matrix Composites (PMC)

Functions of Matrix Phase

It binds the dispersed phase together acts as a medium to transmit and distribute an externally applied load to the dispersed phase.

It protects the dispersed phase from chemical action and keep in proper position and orientation during application of loads prevents propagation of brittle cracks due to its plasticity and softness.

Dispersed Phase is the structural constituent which determines the internal structure of composite. Important dispersed phases of composites are

I. Fibre ii. Particulates

4.1.5. Types of Composites

(1) Fibre reinforced composites involve 3 components namely filament, a polymer matrix and a bonding agent.

The fibre reinforced composites posses superior properties like higher yield strength, fatigue life. The fibres prevent slip and crack propogation and inhibit it, there by increasing mechanical properties.

Some types of fibre reinforced composites are described below:

a. **Glass fibre** - reinforced polymer composites employ glass fibres for improving the characteristics of especially polymeric matrices containing nylons, polyesters etc. These composites posses lower densities higher tensile strengths and impact resistance and resistance to corrosion and chemicals.

Applications: Automobile parts, storage tanks transportation industries, plastic pipes etc.,

b. **Carbon fibre - reinforced polymer** composites are employed in situations requiring excellent resistance to corrosion, lighter density retention of properties even at high temperatures.
Applications : Structural components of aircraft, sport materials.

c. **Alumina and / (or) carbon fibre** reinforced metal composites have improved specific strength, stiffness, abrasion resistance and dimensional stability.

Applications: (i) Matrix - Aluminium alloy reinforced with Al_2O_3 or carbon fibre used in components of automobile engines

(ii) Matrix - Ni and Co based alloy reinforcement with Al_2O_3 (or) tungsten used in components of turbine engines.

(2) **Particulate composites** are made by dispersing particles of varying size and shape of one materials in a matrix of another material.

Ceramic bonded with metals called cermets are refractory material these are metal carbides dispersed in alloys are used as cutting tools for hardened steel.

Cermets are three types

a. Carbide based cermets: WC (carbide) and Co (matrix) cermet is quite hard used in wire-drawing dies, valves etc.

(2) Semi – solid Lubricants
  - (a) Greases
  - (b) Vaseline's

(3) Liquid Lubricants
  - (a) Vegetable oils – eg: palm oil & castor oil
  - (b) Animal oils - eg: Whale oil & lard oil
  - (c) Mineral oils – eg: petroleum fractions.
  - (d) Blended oils or compounded oils – Eg: Mineral oils with various additives to induce desired properties.
  - (e) Synthetic oils – eg: Silicones.

4.4.4. Solid Lubricants

The most widely used solid Lubricants are Graphite and Molybdenum disulphide.

Solid Lubricants are used in the following areas.

- (a) For heavy machinery working as a crude job at very high loads.
- (b) When the operating temperature or load is very high.
- (c) Where a liquid or semisolid lubricant film cannot be maintained.

(1)Graphite:

Graphite has a layered structure of carbon atoms. The carbon atoms are joined together by strong covalent bonds. The adjacent layers are held together by the weak Vander walls force. Thus they forms a net work of hexagons.

Graphite is soapy to touch, non-inflammable and not oxidized in air below 375° c.

When it is incorporated as lubricant between uneven surfaces, it makes the surface more even, Further the particles slide easily over each other as the surfaces of the machinery are in motion.

Graphite can be used as a dry powder or as a colloidal dispersion.

A dispersion of graphite in water is called aqua dag and that in oil is called oil dag.

Uses

It is used as a lubricant in IC engines, air compressors, lathes, food stuff industry, railway-track joints, general machine job works, etc.

Blended Oils

They are mixtures of vegetable oils and Petroleum products. They show improved properties. Different oils are suitably mixed depending on the requirement. They are synthetic lubricants.

Summary:

In this lesson purpose of lubrication, properties and types of lubricants are discussed.

Questions:

Part A

1. What is Lubricant?
2. What is grease?
3. Give two examples for solid lubricants.

Part B

1. What are the Characteristics of the lubricants?
2. Write a short note on solid lubricants.
3. What are the classification of lubricants? Give an example each.
4. Write a note on liquid lubricants.

TEST YOUR UNDERSTANDING

1. What types of lubricants are used for transformers.?
2. Why does graphite act as a good lubricant on the surface of the motion?

$$nCH_2{=}CH_2 \longrightarrow -(-CH_2\text{-}CH_2\text{-})n-$$

Ethylene Polyethylene

Other examples: Polyvinyl chloride (PVC), Polystyrene, etc.

5.1.4 Condensation Polymerisation

These types of polymers are formed by reaction between small molecules with elimination of molecules like H_2O, H_2S, NH_3, etc.

Example: Formation of Phenol-formaldehyde resin. It is formed by the reaction between phenol and formaldehyde.

$$C_6H_5OH + HCHO \longrightarrow -(-\overset{\overset{OH}{|}}{C_6H_4}\text{-}CH_2\text{-})_n-$$

Phenol Formaldehyde Phenol-formaldehyde

Other examples: Urea-formaldehyde resin, Nylon 6:6 etc.

5.1.5 Types of Plastics

Plastics are classified into two types:

1. Thermoplastics and
2. Thermosetting plastics.

Thermoplastics:

They are the resins which soften on heating and set on cooling. Therefore, they can be remoulded any number of times and used.

Example: Polythene, PVC, Nylon, etc.

Thermosetting plastics:

They are the resins which set on heating and cannot be resoftened. Hence, their scrap cannot be reused.

Examples: Phenol-formaldehyde resin (Bakelite), urea-formaldehyde resin, etc.

5.1.6 Differences between thermoplastics and thermosetting plastics

The differences between two types of plastics arise mainly due to the difference in their chemical structure.

Glass fibres, Metallic oxides like ZnO, PbO etc, and Metallic powders like Al, Cu, Pb, etc.

5.1.11 Advantages of filled plastics

Fillers modify properties of basic polymer. They improve thermal stability, mechanical strength, hardness, desired finish and water resistance.

Specific fillers are added to give special characters.

For example,

1. Fillers like carborundum, quartz and mica are added to improve hardness of polymers.
2. Fillers like asbestos is added to give heat and corrosion resistance to polymers.
3. Fillers like barium sulphate makes the polymers resisting X-rays.

The percentage of fillers used can be up to 50%.

5.1.12 Applications of filled plastics

1. Addition of carbon block about 40% increases tensile strength of natural rubber which is used in automobile tyres.
2. Addition of china clay increases the electrical insulation property of PVC.
3. Fibrous fillers like wood flour, short length synthetic fibres, cotton floc, etc. are added to thermosetting plastics like phenol-formaldehyde resin, melamine-urea resin to improve the impact resistance.
4. In textiles for making shutters filled polymer is used with nylon as polymer.
5. In electrical and electronic industries, filled polymers are used for making exhaust fans, computer tapes, insulators, wire and cable insulation, switch gear parts, spools etc.(using polypropylene, PET, nylon and SAN as base polymers).
6. In consumer goods like doors, windows, hinges, chairs, camera housing, etc (Polypropylene, ABS are used as base polymers).
7. In defence for making nose cones, pistol grips and riffle bullets, filled polymers like polystyrene, nylon, etc are used.

5.2.6 Reclaimed rubber

Rubber obtained from waste rubber articles such as worn out tyres, tubes, gaskets, hoses, foot wears, etc, is called reclaimed rubber.

The process of reclamation of rubber is carried out as follows.

1. The waste is cut into small pieces and powdered by using a 'cracker'.
2. Then iron impurities, if any present, is removed by using electromagnetic separator.
3. The purified waste is digested with caustic soda solution at 200°C under pressure for 8 to 15 hours in 'steam jacked autoclaves'. This process hydrolyses the fibres present in the waste rubber.
4. After the removal of fibres, reclaiming agents like petroleum or coal tar based oils and softeners are added.
5. Sulphur gets removed as sodium sulphide and rubber gets devulcanised.
6. The rubber is thoroughly washed with water spray and dried in hot air driers.
7. Finally, the reclaimed rubber is mixed with small portions of reinforcing agents like clay, carbon block etc.

5.2.7 Properties of Reclaimed Rubber

1. Reclaimed rubber has less tensile strength, low elasticity and possesses very low wear resistance when compared to natural rubber.
2. However, it is much cheaper and has uniform composition.
3. It has better ageing property.
4. It is quite easy for fabrication.

5.2.8 Uses

Reclaimed rubber is used for the manufacture of tyres, tubes, automobile floor mats, belts, hoses, battery containers, mountings, shoes, etc.

Summary

In this lesson, extraction of natural rubber from Latex, defects of natural rubber, compounding of rubber, vulcanization, different synthetic rubbers, their preparation and uses, special rubbers like Neoprene, Thiokol etc. and reclaimed rubber are discussed.

B. WET REACTIONS

S.NO	EXPERIMENT	OBSERVATION	INFERENCE
6.	ACTION OF Dil. HCl To a pinch of the salt taken in a test tube dilute hydrochloric acid is added	No characteristic gas is evolved	Absence of Carbonate
7.	ACTION OF CONC. SULPHURIC ACID To a little of the substance taken in a test tube a few drops of conc. Sulphuric acid is added and warmed	No characteristic reaction	Absence of chloride and nitrate
8.	ACTION OF CONC.H_2SO_4 AND COPPER TURNINGS To a small amount of the given salt conc. H_2SO_4 and copper turnings are added and heated.	No brown vapours	Absence of Nitrate
9.	ACTIONOF CONC. H_2SO_4 AND MnO_2 To a little of the given salt, conc. H_2SO_4 and MnO_2 are added & warmed	No characteristic change	Absence of chloride
10.	CHROMYL CHLORIDE TEST To a small amount of the given salt conc. H_2SO_4 and $K_2Cr_2O_7$ are added and warmed	No characteristic change	Absence of chloride

C.REACTIONS USING SODIUM CARBONATE EXTRACT

Preparation of Sodium Carbonate Extract:

A mixture of 1part of the given salt and 3parts of solid sodium carbonate is boiled with distilled water and filtered. The filtrate is called sodium carbonate extract.

S.NO	EXPERIMENT	OBSERVATION	INFERENCE
12.	BARIUM CHLORIDE TEST A little of the extract is acidified with dil. HCl and $BaCl_2$ solution is added	A white precipitate insoluble in Conc. HCl is obtained	Sulphate is confirmed

c.250 ml	35 nos
d.100 ml	5nos
16. Glass Rods 15cm	100 nos
17. Watch Glass 3”	35 nos
18. Wash Bottle (Polythene) 1000ml	35 nos
19. Nickel Spatula	10 nos
20. Kipps Apparatus	1 no
21. Burner Nipple	30 nos
22. Bunsen Burner for gas connection	30 nos
23. Wire Gauge with asbestos center	15 nos
24. Plastic Buckets (15 lts)	10 nos
25. Tripod Stand (Iron)	30 nos
26. Filter Paper Round sheets	1000 nos
27. Burette stand	35 nos
28. Standard flask 100 ml	35 nos
29. Pipette 10ml	5 nos.

FIRST AID FOR ACCIDENTS IN CHEMISTRY LABORATORIES

Accident	First Aid Treatment
1. **Fire** **(a)** Inflammable liquids, gases on fire	(I) Pour water carefully, except when sodium, potassium, oil or spirit is on fire. (ii) Throw large quantities of sand if sodium, etc. is on fire. (iii) Throw a mixture of sand and sod, bicarbonate if oil or spirit is on fire. (iv) If any liquid or flask has caught fire, cover the mouth of the vessel with a damp cloth or duster. (v) Cover with a piece of blanket or thick cloth or card-board.
(b) Burning of clothes	Lay the person on the floor, burning parts of cloth upwards and cover with a blanket. Never throw water on the person; otherwise it will cause serious boils on the body.
2. **Cuts**	Remove the visible glass pieces, etc. if any from the affected part. Stop bleeding by one of the following methods (i) By applying pressure at the place of injury. (ii) By washing with alum or $FeCl_3$ solution. (iii) By applying a little spirit or dettol on the skin and cover with a piece of leucoplast.
3. **Burns** (a) By dry heat (i.e., flame, steam, hot object, etc.)	(i) Avoid handling the affected area as far as possible. Do not break the blisters. For minor burns apply burnol and sarson oil (mustard oil). (ii) Cover the affected part with lint or linen saturated with carron oil (a mixture of linseed oil and lime water in equal amounts) or with cold cream, etc. and bandage tightly.
(b) By corrosive acids	(i) If conc. H_2SO_4 falls on skin, wipe it with cotton. (ii) Wash with plenty of cold water, then with dilute $NaHCO_3$ solution (t in 88) and again with water. If burning persists wipe the skin with cotton wool and apply burnol and sarson oil.
(c) By corrosive alkalis	Wash immediately with excess of water, then with dilute acetic acid or lemon juice and apply burnol or sarson oil dressing.

Accident	First Aid Treatment
(d) By bromine	(i) Wash with petrol or alcohol and then rub glycerin. Finally smear with burnol. (ii) Wash with dil. Na_2CO_3 solution (1:10); then with alcohol and picric acid and apply oil dressing.
(e) By sodium	Remove sticking sodium piece by a forceps. Wash with excess of water. Apply burnol or cover with gauze a=soaked in olive oil.
4. **Eye Injuries**	
(a) By acid	Wash with excess of water, then with 3% $NaHCO_3$ and then with excess of water, forcibly opening the eyes. If necessary, drop castor oil (mobile oil) into the eyes, cover with cotton wool and bandage lightly.
(b) By alkalis	Wash well with 2% boric acid solution; the fest as in (a).
(c) By bromine or chlorine vapour	Wash with dil. $NaHCO_3$ solution and then bring near the eyes a cloth or sponge soaked in alcohol or alcohol +ether mixture. Do not allow the liquid to enter the eyes.
(d) By foreign particles	Wash it by sprinkling water into the eyes. Open the eye carefully and remove the particle by means of cotton wool or clean handkerchief. Wash again with water. Then put a drop olive or castor oil in the eyes and keep closed.
5. **Damage to Clothes**	
(a) By acids	Apply $(NH_4)_2CO_3$ solution or dilute ammonia and wash well with water.
(b) By alkalis	Apply lemon juice or dil, acetic acid, wash well with plenty of water.
6. **Poisoning**	
(a) Strong acid	Give plenty of water. Then give 2 tablespoons of lime water or milk of magnesia.
(b) Caustic alkalis	Give plenty of water. Then give orange or lemon juice.
(c) Salts of heavy metal or copper sulphate	Give milk or white of an egg.
(d) Mercury salts	Immediately give a tablespoon of common salt or zinc sulphate in a tumbler of warm water.