Class – X

Subject – Chemistry

Chapter -- 6

Electrolysis

Electrolysis is introduced by Michael Faraday in 19th century.

Electro- by electricity

Lysis - to separate

It is very useful commercially for separation of elements from their naturally occurring ores using electricity.

Some Important Terms:

1. Conductors: The substance which allow the electric current pass through them are called conductors.

2. Non-Conductors: The substance which does not allow the passage of electricity through them, are called NON CONDUCTORES.
   Ex. Glasses, wood, non-metals.

3. Electrolytes: These are binary compounds of metals & non-metals, which are dissociation aqueous solution.
   Ex. NaCl → Na+ + Cl-

Electrolytes are good conductors in aqueous or in molten state but NOT in solid state.

4. Non-Electrolytes: Compounds do NOT conduct electric current at all whether in solid state or in aqueous solution.
   Ex. Kerosene, Glucose etc.
   Types of electric conductance:

Metallic Conductance	Electrolytic Conductance
1. Passage of current by movement of electrons in metallic lattice.	Passage of current by movement of IONS in molten or in aqueous solution.

2. Metals are good conductor in solid as well as in liquid state.	It is the property of ionic compound.
3. Metallic conductance decreases with increase in temperature.	Electrolytic conductance increases with increase in temperature.
4. This is a Physical Process; NO CHEMICAL change takes place.	This is a Chemical Process.
Ex. Cu, Ag, Au etc.	Ex. NaCl(aqueous)

Classification of electrolyte:

Electrolysis classify into two categories on the basis of conductivity and ability to dissociate into ions.

1. Strong Electrolytes: The electrolytes which are completely dissociates in aqueous solution. Degree of dissociation is 100%.
   Ex. NaCl, KCl etc.
2. Weak Electrolytes: The electrolytes which are partially dissociates in aqueous solution. Degree of dissociation is about 5%.
   Ex. Organic acids.

Difference between Strong Electrolytes and Weak Electrolytes:

Strong Electrolytes	Weak Electrolytes
1. Electrolytes which allow large amount of electricity to flow through them.	Electrolytes which pass very small amount of electricity through them.
2. These are completely dissociated in aqueous and molten solution.	Electrolytes which are partially dissociates in aqueous solution.
3. These are good conductor of electricity.	These are poor conductors of electricity.
Ex. HCl, NaCl, NaOH, KOH etc.	Ex. CH3COOH, NH4OH, HgCl2 etc.

Cell: A cell is a device which convert chemical energy into electrical energy and vice-versa.
Constriction of cell: It is device in which electrodes are dipped in salt solution of suitable electrolyte.

Types of Cell:

1. Electrochemical Cell: It is a device by which we convert Chemical energy to Electrical energy.
2. Electrolytic Cell: It is a device by which we convert Electrical energy to Chemical energy.

It is also used for production of active metals from their salt solution.
In cell there is two types of electrodes, i.e. Anode and Cathode.
At Anode oxidation takes place.
At Cathode reduction takes place.

Oxidation: Removal of electrons from an atom is referred as oxidation.

$Na \longrightarrow Na^+ + e^-$

Reduction: Gaining of electrons by an atom is referred as reduction.

$Cl + e^- \longrightarrow Cl^-$

Mechanism and Characteristics of Electrolysis:
When electric current is passed an aqueous solution, ions of electrolytes start migrating towards respective electrode.
Cation takes electron from Cathode and undergo the process of Reduction
Anion transfer electron to anode and undergo the process of Oxidation.

1. **Electrolysis of molten sodium Chloride:**

$2NaCl \xrightarrow{\text{electrolysis}} 2Na(s) + Cl2(g)$

Mechanism:

At cathode: $Na^+ + e^- \longrightarrow Na(s)$ (cation moves towards cathode)

At anode: $Cl^- \longrightarrow Cl2(g) + e^-$ (anion moves towards anode)

2. **Electrolysis of molten lead bromide:**

$PbBr2 \xrightarrow{\text{electolysis}} Pb(s) + Br2(g)$

Mechanism:

At cathode: $Pb^{+2} + 2e^- \longrightarrow Pb(s)$ (cation moves towards cathode)

At anode : $2Br^- \longrightarrow Br2(g)$ (anion moves towards cathode)

3. **Electrolysis of acidified water:**

$2\ H_2O$ ---------(H_2SO_4)--------→ $H_2O + H_2(g) + O_2(g)$

H_2O ---------→ $H^+ + OH^-$

H_2SO_4 -----→ $2H^+ + SO_4^{2-}$

Mechanism :

At cathode: $2H^+ + 2e^-$ ----→ $H_2(g)$

At anode: Their two anions which can be moves toward anode. There is OH^- is preferentially discharge over sulphate ion.

$2OH^-$ ----------→ $H_2O + ½\ O_2(g)$

4. **Electrolysis of aqueous copper sulphate:** When electrodes are made of copper metal

$CuSO_4$ ----------→ $Cu^{+2} + SO_4^{2-}$

H_2O ----------→ $H^+ + OH^-$

At cathode:

Copper ion deposited preferentially over hydrogen ion because of copper ions are placed below hydrogen ions in electrochemical series.

$Cu^{+2} + 2e^-$ ----------→ $Cu(s)$

At anode:

At anode neither OH^- nor SO_4^{2-} deposited because anode is made of copper i.e. why concentration of Cu^{+2} ion is more so copper is undergoes ionisation.

Cu ----------→ $Cu^{+2} + 2e^-$

Application of electrolysis:

1. Electroplating of metals

Electroplating: The electrolytic process involving the deposition of a superior metal (e.g., nickel, silver, gold) on the surface of an inferior metal (e.g., iron, copper, etc) or on an article made of it is called electroplating.

2. Electrorefining of metals

Electrorefining is the process by which n impure metal containing different types of impurities is purified electrolytically to obtain the

metal in the pure form.

3. Extraction of metals [Electrometallurgy]:

The extraction of metals by using an electrolytic process is called electrometallurgy.