19CH201 - ENGINEERING CHEMISTRY

UNIT-1 - ELECTROCHEMISTRY

1.1. Introduction – Electro Chemistry

Electrochemistry

Electrochemistry is a branch of chemistry, which deals with the chemical applications of electricity. Electrochemistry deals with the chemical reactions produced by passing electric current through an electrolyte or the production of electric current through chemical reactions.

Conductors

A substance or material that allows electric current to pass through it is called a conductor. The ability of a material to conduct electric current is called conductance.

Examples: All metals, graphite, fused salts, aqueous solutions of acids, bases, etc.,

Non-Conductors (or) Insulators

Materials which do not conduct electric current are called non-conductors or insulators.

Examples: Plastics, wood, most of the non metals, etc.,

Types of Conductors

The conductors are broadly classified into two types as follows.

1.Metallic conductors (or) Electronic conductors

Metallic conductors are solid substances, which conduct electric current due to the movement of electrons from one end to another end. The conduction decreases with increase of temperature.

Ex: All metals, graphite.

2.Electrolytic Conductors

Electrolytic conductors conduct electric current due to the movement

of ions in solution or in fused state. The conduction increases with increase of temperature.

Ex: Acids, bases, electrovalent substances.

CELL

A cell is a device consisting two half cell. Each half cell consists of an electrode dipped in an electrolytic solution. The two half cells are connected through one wire.

TYPES OF CELLS

The followings are two types of cells.

1.Electrolytic cells.

2.Electrochemical cells (or) voltaic cells (or) galvanic cells.

ELECTROLYTIC CELLS

Electrolytic cells are cells in which electrical energy is used to bring about the chemical reaction.

Electrolysis, electroplating, etc.,

ELECTROCHEMICAL CELLS(or) GALVANIC CELLS

Electrochemical cells are entirely different from electrolytic cells. The cells used for electrolysis (where electrical energy is converted to chemical energy) are called electrolytic cells, whereas in electrochemical cells, chemical energy is converted to electrical energy.

Galvanic cells are electrochemical cells in which the electrons, transferred due to redox reaction, are converted to electrical energy.

Daniel cell (Fig 1.7)

Cell device (Construction)

Daniel cell consists of a zinc electrode dipped in 1 M $ZnSO_4$ solution and a copper electrode dipped in 1 M $CuSO_4$ solution. Each electrode is known as a half cell. The two solutions are inter connected by a salt bridge and the two electrodes are connected by a wire through the

voltmeter.

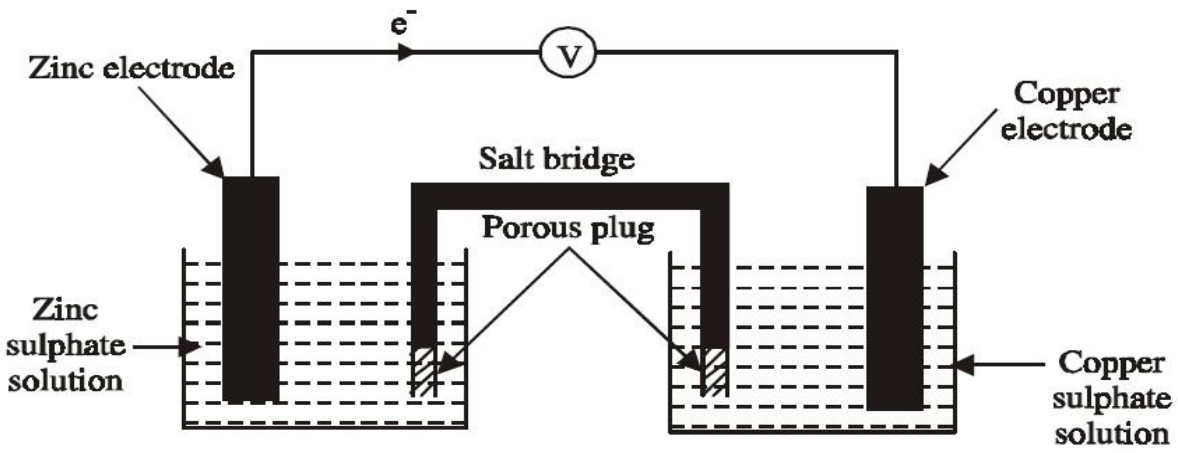

Fig. 1.7 Daniel cell

Reactions occurring in the cell

At anode: Oxidation takes place in the zinc electrode by the liberation of electrons, so this electrode is called negative electrode or anode.

At cathode: Reduction takes place in the copper electrode by the acceptance of electrons, so this electrode is called the positive electrode or cathode.

$$Zn \longrightarrow Zn^{2+} + 2e^{-} \text{ (at anode)}$$

$$Cu^{2+} + 2e^{-} \longrightarrow Cu \text{ (at cathode)}$$

$$Cu^{2+} + Zn \rightleftharpoons Zn^{2+} + Cu \text{ (net cell reaction)}$$

The electrons liberated by the oxidation reaction flow through the external wire and are consumed by the copper ions at the cathode.

Salt bridge

It consists of a U-tube containing saturated solution of KCl or $NaNO_3$ in agar-agar gel. It connects the two half cells of the galvanic cells.

Functions of salt bridge

(i) It eliminates liquid junction potential.

(ii) It provides the electrical continuity between the two half cells.

Conditions for a cell to act as standard cell

The conditions for an electrochemical cell to act as a standard cell are

(i) The e.m.f of the cell is reproductive.

(ii) The temperature-coefficient of e.m.f (change in e.m.f with temperature) should be very low.