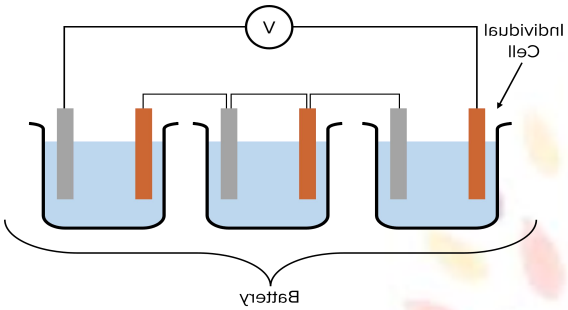
UNIT -3

ENERGY SOURCES

Batteries: It is a device consisting of two or more galvanic cells connected in series or parallel or both,which converts chemical energy into electrical energy through redox reaction



Primary components of Battery:

Primary components of a battery:The primary components of battery are anode,cathode and electrolyte.

Anode:Oxidation takes place

Cathode:Reduction takes place

Electrolyte:A chemical solution that separates the anode and cathode.

Classification of batteries:

Primary Batteries

Secondary Batteries

Reserve Batteries

PRIMARY BATTERIES:

- These are non rechargable cells
- The electrode reactions cannot be reversed by passing external electricity
- Will be used for a single time and discarded after the use
- Once the reactants are converted in to products by generating electrical energy they become dead

- R → P+ Electrical energy
- They cause huge pollution.
- Ex: Dry cell, Zn Air Battery

SECONDARY BATTERIES:

- These are rechargable cells
- The electrode reactions will be reversed by passing external electricity
- R → P+E.
- Here the products interacts with the external energy and convert in to reactants.
- Will be used many times.
- They cause the pollution but less when compared to primary batteries
- They are also known as storage batteries
- Ex: Li ion battery

RESERVE BATTERIES:

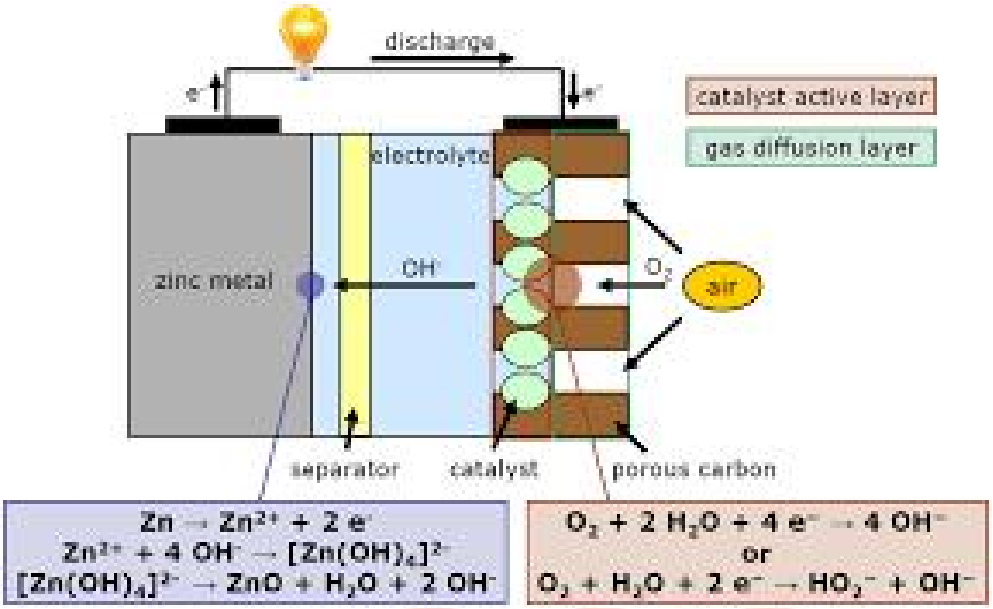
Reserve battery: In this battery, one of the components is stored separately and used whenever required.

Ex: Mg-AgCl battery where battery is activated by the addition of water. It is used in missiles and military weapon system.

Main components Zinc Air Battery :

- ❖ Anode:Zn metal
- ❖ Cathode:Porous carbon plate
- ❖ Electrolyte:KOH
- ➢ The entry of moisture at the cathode is prevented by giving Teflon coating at cathode.

Construction of Zinc Air Battery:



Working:

Cell Reactions:

Anode:Zn+2OH

- The zinc metal reacts with oxygen gas to give electricity according to the following discharge reactions.
- Zn +2OH - → ZnO + H 2 O + 2e- (anode reaction) , Oxidation
- ½ O 2 + H 2 O + 2e - → 2 (OH) - (cathode) , Reduction

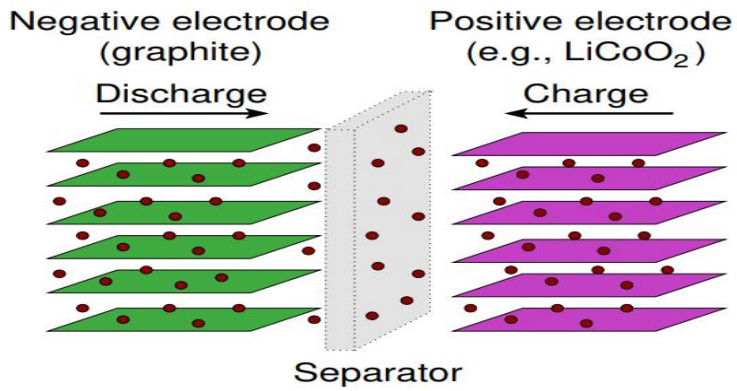
Zn + 1 / 2 O 2 → ZnO (cell) .

emf: 1.4 volts

APPLICATIONS:

- Zn-air batteries are used in watches and hearing aids
- Rechargeable Zn-air batteries have the potential for large-grid scale energy storage systems, electric cars, flexible electronic devices such as small drones.
- In Military Transistors and voice transmitters

Construction of Li ion battery:



Main components of li ion battery :

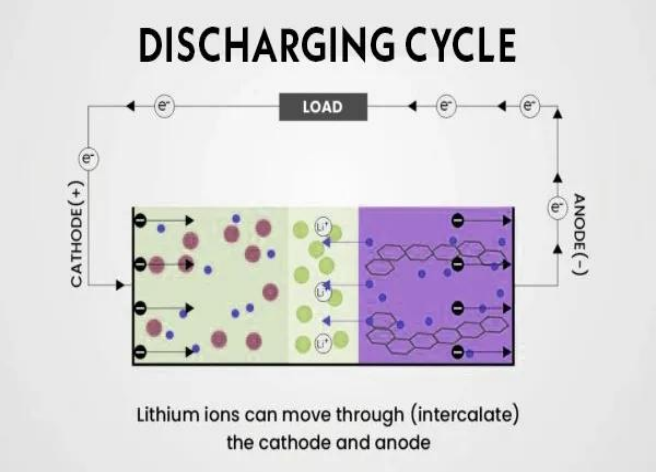
- ❖ Anode(-):Graphite{fully lithiated graphite} LiC6
- ❖ Cathode(+):cobalt dioxide LiCoO2
- ❖ Electrolyte:Organic solvents like ethylene carbonate

- ❖ Working principle of Lithium-ion Battery based on **electrochemical reaction.**
- ❖ Inside a lithium-ion battery, **oxidation-reduction (Redox)** reactions take place which sustain the charging and discharging cycle.

Discharging cycle: During this cycle, **lithium ions** form from the ionization of lithium atoms in the anode.**Oxidation reaction** takes place:

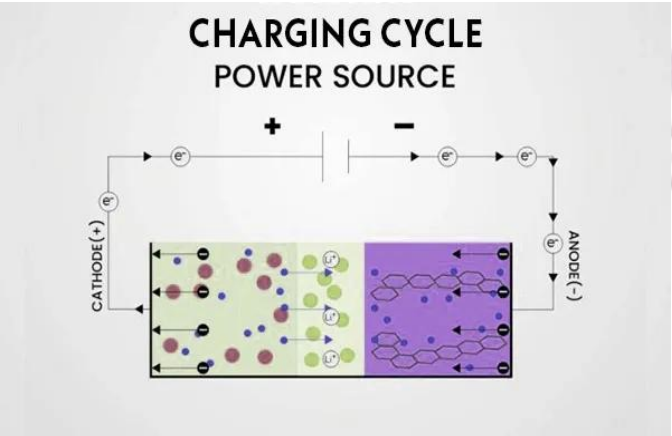
$$LiC6 \rightarrow C6 + Li^{+} + e^{-}$$

- The lithium ions move from the anode and pass through the electrolyte until they reach the cathode, where they recombine with their electrons and electrically neutralise.
- The lithium ions are small enough to be able to move through a **micro-permeable separator** between the anode and cathode.
- **Li-ion batteries** are capable of having a very **high voltage** and **charge storage** per unit mass and unit volume owing to the small size of lithium.



Charging cycle:

- **During the charging cycle,** the process is exactly the opposite of the discharging cycle.
- The lithium ions return to the anode from the cathode and electrons are transferred from the anode to the cathode.
- Lithium ions flow from the cathode to the anode, and electrons flow from the **anode to the cathode,** as the battery is charging.
- There is a **steady flow of electrons** as long as lithium ions are making their way from one electrode to the next.
- **Reduction** takes place at the cathode -***CoO2 + Li+ + e-*** → ***LiCoO2*** (Cobalt oxide combines with lithium ions to form lithium-cobalt oxide (LiCoO2)



Applications:

- The versatility and performance characteristics of lithium-ion batteries make them a preferred choice in a wide range of applications, such as **aerospace, electric vehicles, electronics industries, etc.**

Portable electronic devices: Lithium-ion batteries are predominantly used in various portable electronic devices such as **smartphones** and **laptops** etc.

High-end application: It can also be employed to power electrical systems for aerospace applications and submarines.

FUEL CELLS

- A fuel cell is a electrochemical cell ,which converts the chemical energy into electrical energy
  from fuel with out combuston. It converts the energy of the fuel directly into electricity.
- In these cells,reactants,products and electrolytes pass through the cell.
- Fuel Oxygen Oxidation products + Electricity
  Examples: Hydrogen-oxygen fuel cell,Methyl alcohol(Methanol)-oxygen fuel cell .

ADVANTAGES OF FUEL CELLS

- Fuel cells are efficient (75%) and take less time for operation.
- It is pollution free technique.
- It produces electric current directly from the reaction of a fuel and an oxidiser.
- It produces drinking water.
- Disadvantages of Fuel cells
- Fuel cells can not store electric energy as other cells do.
- Electrodes are expensive and have short life time.
- Storage and handling of hydrogen gas is dangerous.

Difference Between Battery And Fuel Cell

Batteries	Fuel cells
A Battery is a device Cantaing one or more electrochemical cells that convert chemical energy into electrical energy	A fuel cell is a device that can converts the chemical energy into electrical energy
Battery stores chemical Energy	Fuel Cells do not stores chemical Energy
They Can be Recharged	They Can not be Recharged
Products remain in the cell	Products removed from the cell
Harmful Waste Products are Not Formed	Harmful Waste Products are Formed
Efficency is Less	Efficency is More
Chemical changes occur in batteries	No changes occur in chemical

DIRECT METHONOL FUEL CELL:

A direct methanol Fuel cell is a type of cell that generates electricity by directly oxidizing liquid methanol with oxygen. DMFCs use a readily available liquid fuel, which specify storage and storage and transport.

The fuel cells are composed of an anode made of pt/pd where methanol is oxidized, a proton exchange membrane that allows protons to pass through and a cathode where protons and oxygen combine to form water.

At anode : $CH_3OH + H_2O \rightarrow CO_2 + 6\ H^+ + 6e^-$

At cathode : $1/2O_2 + 2\ H^+ + 2e^- \rightarrow 3/2O_2 + 3\ H_2O$

Overall reaction: $CH_3OH + 1/2O_2 \rightarrow CO_2 + 2H_2O$

WORKING:

At the anode, a methanol water mixture is passed and methanol reacts with oxygen in presence of a catalyst to produce carbon dioxide, protons and electrons.

The protons pass through the proton exchange membrane to the cathode. The electrons travel through an external circuit producing an electric current.

At cathode, protons, electrons and oxygen react to form water.

ADVANTAGES :

1. Methanol fuel cells are stable at all environmental conditions.
2. Fuel cells are efficient and take less time for operation
3. Easy to transport.
4. It is pollution free technique
5. Methanol poses less risk to aquatic plants, animals and human beings than gasoline.
6. Fuel cells are eco friendly.
7. It produces drinking water.

DISADVANTAGES :

1. Fuel cells can not store electric energy as other cells do
2. Electrodes are very expensive and short life time.
3. Storage and handeling of hydrogen gas is dangerous.

APPLICATIONS : The major application of methyl alcohol-oxygen fuel cells is a fuel for fuel cell motor vehicles .