# Applied Physics Lecture 8

## Chapter 6 Energy Sources

## Voltaic Cell

A cell which produce electrical energy (dc) from its internal chemical reactions. It has two types (a) primary cell and (b) secondary cell

## (a) Primary Cell

It is non rechargeable cell. Its chemical reactions are irreversible.

## (b) Secondary Cell

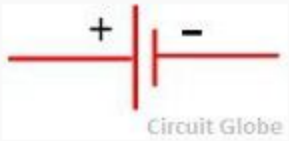
It is rechargeable cell. Its chemical reactions are reversible.

| S No | Primary Cell | Secondary Cell |
|---|---|---|
| 1 | They are low cost | They are expensive |
| 2 | They cannot be recharged again after getting discharged once | They can be recharged again and again. |
| 3 | They can be used only one time | They can be used more than one time |
| 4 | Reactions are irreversible | Reactions are reversible |
| 5 | They can be disposed easily and don't require regular maintenance | They require regular maintenance |
| 6 | Low life time | High life time |
| 7 | They are used in radios, flashlights and wall clocks etc. | They are used in automobiles and inverters. |
| 8 | Examples are carbon-zinc cell, Manganese alkaline cell, Mercury cell, silver oxide cell etc | Examples are Nickel-cadmium cell, Lead-acid cell etc |

## Voltage and Current of a cell

Voltage rating of cell is given by its open circuit voltage (when not connected in the circuit). It depends on the types of materials used.

The capacity of cell is given by amount of current it can supply in a circuit. It depends on condition and size of the electrodes. Larger cell delivers more current than a smaller cell.

| Basis for Comparison | Cell | Battery |
|---|---|---|
| Definition | The single unit device which converts the chemical energy into electrical energy | It is the collection of electrochemical cells which either connects in series or in parallel |
| Symbol |   |   |
| Types | Dry Cell, Wet Cell , Reserve Cell and Fuel Cell. | Primary battery and Secondary battery. |
| Specification | Light and compact | Heavy |
| Power | Supply power for a short time. | Supply power for a long time. |
| Applications | Clocks, lamp, radio, remote control devices etc. | Automobiles, inverter, emergency light etc. |
| Cost | Cheap | Costly |

## Cell life

The time of period during which a cell can be stored on shelf without losing more than 10% of its original capacity. It should be stored in a cool dry paste because heat speed up the chemical reactions inside and results in loss of capacity and drying of paste electrolyte.

## Types of Dry Cell (Book)

(a) Carbon zinc cell (primary or non-rechargeable)

(b) Alkaline cell

- (i)Manganese alkaline (primary)
- (ii) Nickel cadmium (secondary or rechargeable)
- (iii) Mercury cell (primary)
- (iv) Silver oxide cell (primary)

(c) Lead acid cell (secondary and wet cell).

## (a) Carbon Zinc cell

The oldest and most widely used cell. (Do not try to recharge) It is used in flashlight and clocks. Voltage range is 1.4-1.6V for single cell.

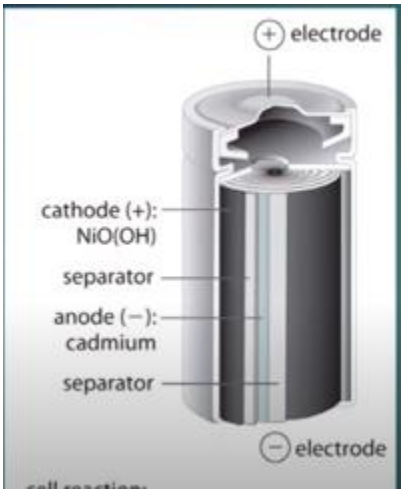

## (i) Manganese Alkaline Cell

It don't possess carbon rod inside. It contains powdered or gel type anode. It is smaller than carbon zinc cell and longer shelf life.

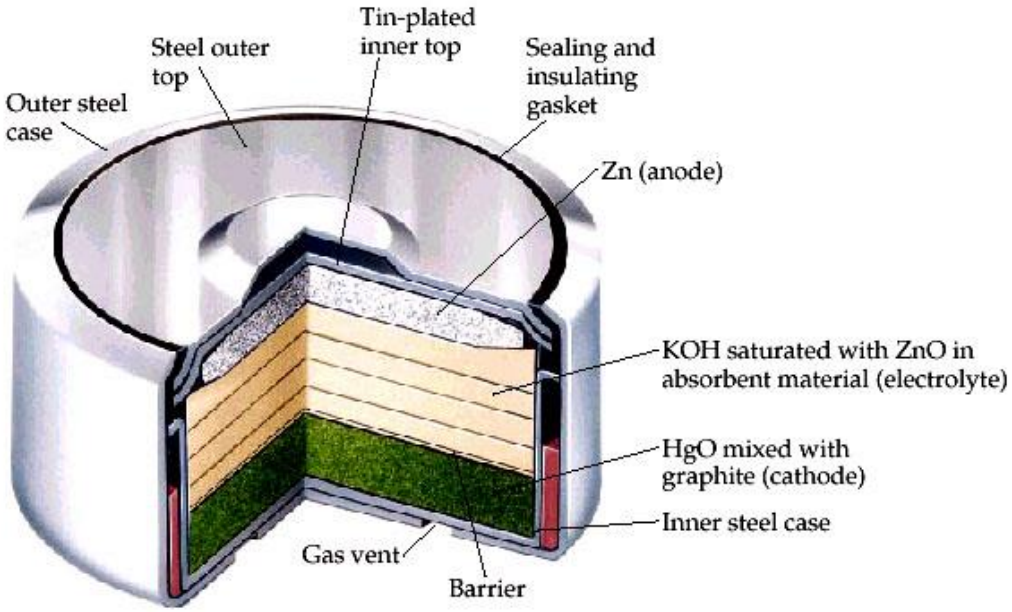
- Anode : Zinc Powder
- Cathode : Manganese dioxide($MnO_2$) powder
- Electrolyte : Potassium hydroxide(KOH)

## (ii) Nickel cadmium cell

Dry cell but rechargeable. Electrolyte is KOH. Voltage is 1.25-1.5V per cell. It has longer life, can be recharged many times, has very low internal resistance and deliver high currents.



## (iii) Mercury cell

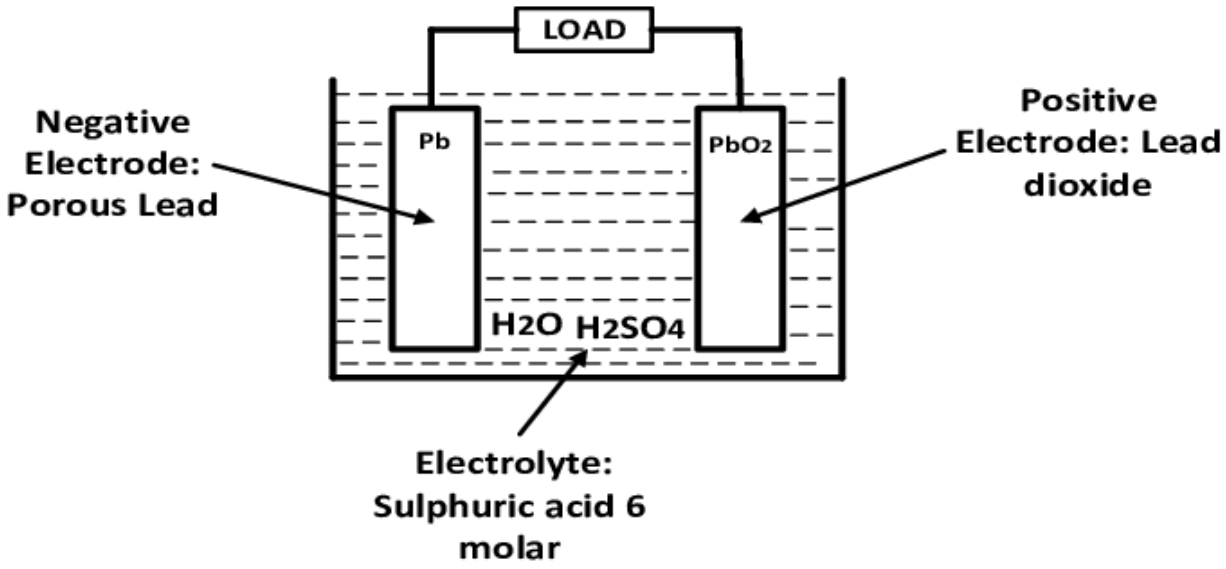



## (iv) Silver oxide cell

Same as mercury cell but silver oxide is used instead mercury.

## (c) Lead acid cell

Its rechargeable and wet cell used in automobile batteries. Its voltage is 2-2.2V per unit cell. For car battery 6 cells are connected in series to give total 12V.





## Battery rating and testing dry cell

Lead acid batteries are usually expressed in ampere hours (Ah) usually for 20hr rate.

It means that a battery which is rated at 100 Ah should deliver 5 A of current continuously for 20 hours and maintain at least 1.75 V per cell. Of course, battery can supply less current for longer time or more current for a shorter time.

The condition of a dry cell or battery can be checked by the terminal voltage developed *when it is connected to a load*. If this voltage is less than 80% of the open-circuit voltage, it should be rejected. The basic reason is that a bad cell has high internal resistance which will become detectable when cell is tested *on load*. Due to normal current flow, there would be a large internal drop and hence terminal voltage would drop by a considerable amount. Such would not be the case when cell is tested on no load.

## Photoelectric Devices (Book)

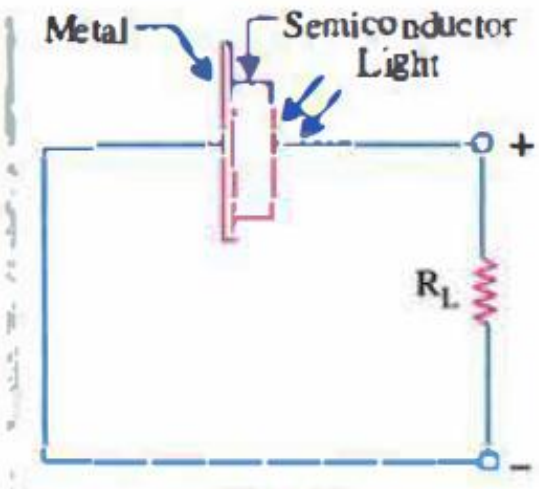
Device that convert light energy into electrical energy

1. Photovoltaic cell

2. Solar cell

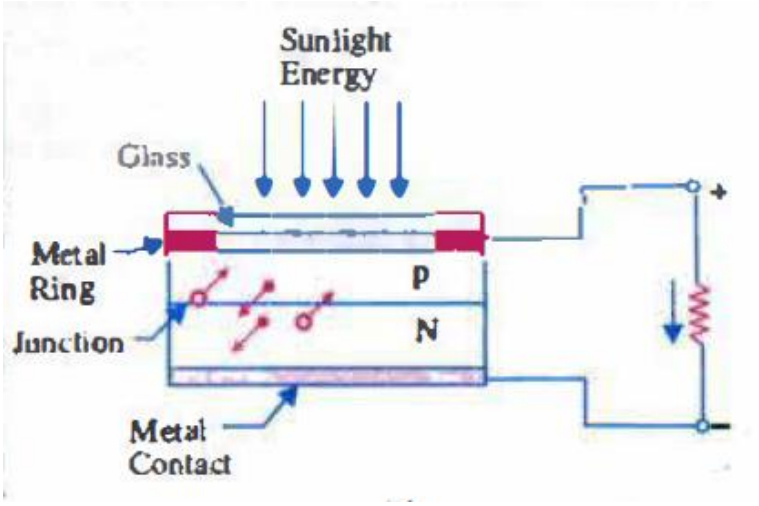
## 1. Photovoltaic cell (for any light)

Light is used to create potential difference which depends on frequency and intensity of light. It contains semiconductor (Si or Ge) attached with metal plate (to provide conducting path). When light falls, electrons and holes are generated and current is obtained. Example is photometer which is used for light detection.



## 2. Solar Cell (specifically sunlight)

It is type of photovoltaic cell where p-n junction is used. As light falls on p-n junction free electrons and holes are generated and produce current. This current is proportional to incident light and surface area available for illumination.




They are used in satellites, also for industrial and domestic purposes. They are smaller in size so large number of cells are required for greater currents.