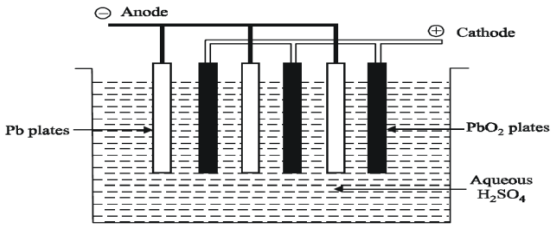
Lead storage cell or lead accumulator or acid storage cell

A lead acid storage cell is a secondary battery, which can operate both as a voltaic cell and as an electrolytic cell. When it acts as a voltaic cell, it supplies electrical energy and becomes "run down". When it is recharged, the cell operates as an electrolytic cell.



A lead-acid storage battery consists of a number of (3to 6) voltaic cells connected in series to get 6 to 12 V battery. In each cell, the anode is made of lead. The cathode is made of lead dioxide PbO_2 or a grid made of lead, packed with PbO_2.

A number of lead plates (anodes) are connected in parallel and a number of PbO_2 plates (cathodes) are also connected in parallel. Various plates are separated from the adjacent ones by insulators like rubber or glass fibre. The entire combinations is then immersed in dil. H_2SO_4 (38% by mass) having a density of 1.30 gm/ml.

The cell may be represented as;

$Pb|\ PbSO_4\ ||H_2SO_{4(aq)}|\ PbO_2|\ Pb$

Working(Discharging)

When the lead-acid storage battery operates, the following reaction occurs.

***At Anode*:**

Lead is oxidized to Pb^{2+} ions, which further combines with SO^{2-} forms insoluble $PbSO_4$.

$$Pb_{(s)} + SO^{2-}_{4(aq)} \underset{\text{charging}}{\overset{\text{dicharging}}{\rightleftharpoons}} PbSO_4 + 2e^-$$

***At Cathode*:**

PbO_2 is reduced to Pb^{2+} ions, which further combines with SO_4^{2-} forms insoluble $PbSO_4$.

$$PbO_{2\,(s)} + 4H^+ + SO_4^{2-} + 2e^- \underset{\text{charging}}{\overset{\text{discharging}}{\rightleftharpoons}} PbSO_{4\,(s)} + 2H_2O$$

Overall cell reaction during use (Discharging)

$$Cd_{(s)} + NiO_{2\,(s)} + 2H_2O \underset{\text{charging}}{\overset{\text{dicharging}}{\rightleftharpoons}} Cd(OH)_{2\,(s)} + Ni(OH)_{2\,(s)} + \text{Energy}.$$

From the above cell reactions it is clear that, there is no formation of gaseous products, the products $Cd(OH)_2$ and $Ni(OH)_2$ adhere well to the surfaces. This can be reconverted by recharging the cell.

Recharging the Battery

The recharging process is similar to lead storage battery. When the current is passed in the opposite direction, the electrode reaction gets reversed. Cd gets deposited on anode and NiO_2 on the cathode.

The net reaction during charging is

$$2PbSO_{4(s)} + 2H_2O + Energy \underset{discharging}{\overset{charging}{\rightleftharpoons}} Pb_{(s)} + PbO_{2\,(s)} + 2H_2SO_{4\,(eq)}$$

Advantages of Lead - Acid Batteries

i) It is made easily.

(ii) It produces very high current.

(iii)The self-discharging rate is low when compared to other rechargeable batteries.

(iv)It also acts effectively at low temperature.

Disadvantages of Lead - Acid Batteries

(i) Recycling of this battery causes environmental hazards.

(ii) Mechanical strain and normal bumping reduces battery capacity.

Uses

1. Lead storage cell is used to supply current mainly in automobiles such as cars, buses, trucks, etc.

2. It is also used in gas engine ignition, telephone exchanges, hospitals, power stations, etc.,