SNS COLLEGE OF TECHNOLOGY

Vazhiamyampalayam,Coimbatore-35

(An Autonomous institution)

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DEPARTMENT OF CHEMISTRY

COURSE NAME : 19CHB101- CHEMISTRY FOR ENGINEERS

I YEAR / II SEMESTER

UNIT : 1. MODERN BATTERIES

TOPIC : 3. Lead Acid batteries

SECONDARY BATTERY

In these cells, the electrode reaction can be reversed by passing an external electrical energy. Hence, they can be recharged by passing electric current through them and can be used again

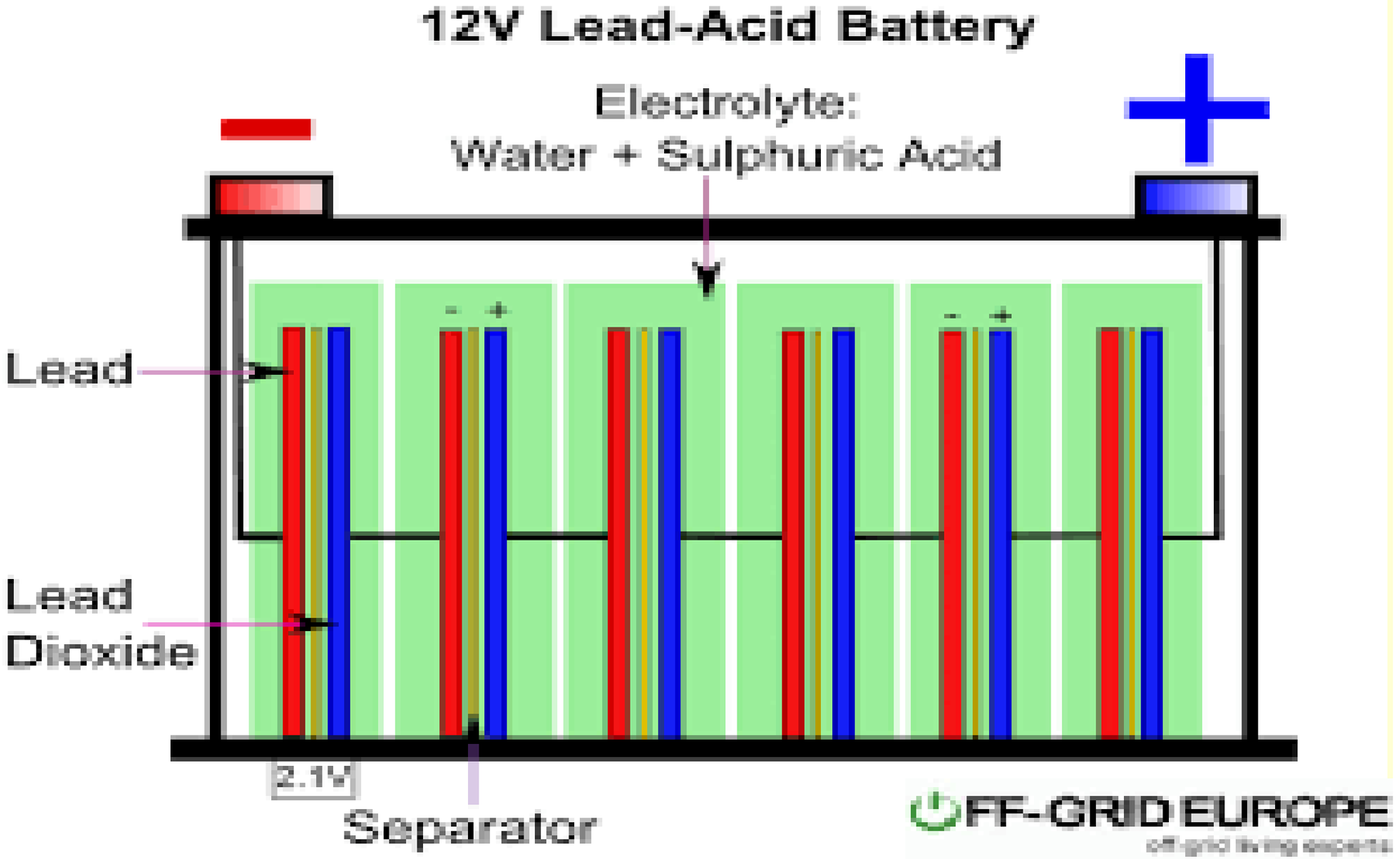
and again. They are also called as storage cells or accumulators.

Examples: Lead acid storage cell, Nickel – Cadmium cell, etc.

LEAD ACID BATTERY

- **Lead acid battery (or) Lead storage cell (or) Lead accumulator (or) Acid storage cell**

Lead acid battery can be operated both as a voltaic and electrolytic cell. When it acts as a voltaic cell, it supplies electrical energy and run down. When it is recharged, it acts as an electrolytic cell. Thus, it is rechargeable.


12V Lead-Acid Battery
Electrolyte:
Water + Sulphuric Acid
Lead
Lead
Dioxide
2.1V
Separator
OFF-GRID EUROPE

Construction

A lead storage battery consists of 3 to 6 voltaic cells connected in series. In each cell, lead acts as anode and lead dioxide (PbO_2) acts as cathode .

Various plates are separated from the adjacent one by insulator like rubber.

Anodes and cathodes are immersed in 20 to 21 % dil. H2SO4 having a density of 1.3 gm/ml. The cell representation is given below.

$$Pb \mid PbSO_4 \parallel H2SO_{4(L)} \mid PbO_2 \mid Pb$$

Working (Discharging)

When the storage cell is supplying electricity, lead is oxidized to Pb2+ ions and PbSO4 is formed at anode. At cathode, PbO2 gains the liberated electrons and gets reduced to Pb2+ and PbSO4
is formed.

At anode:

$$Pb\ (s) \longrightarrow Pb^{2+}_{(l)} + 2e^-$$

$$Pb^{2+}_{(l)} + SO_4^{2-} \longrightarrow PbSO_{4(S)}$$

$$Pb(s) + SO^{2-}_{4\ (l)} \longrightarrow PbSO_4(s) + 2e^- \text{ .....(1)}$$

At cathode:

$$PbO_{2(s)} + 2e^- + 4H^+_{(l)} \longrightarrow Pb^{2+}_{(l)} + 2H_2O$$

$$Pb^{2+}_{(l)} + SO^{2-}_{4\,(l)} \longrightarrow PbSO_{4(s)}$$

$$PbO_{2\,(s)} + 4H^+_{(l)} + SO^{2-}_{(l)} + 2e^- \longrightarrow PbSO_{4\,(s)} + 2H_2O(s) \quad .....(2)$$

Overall cell reaction during (discharging) use (1) + (2)

$$Pb + PbO_2 + 2H_2SO_4 \longrightarrow 2PbSO_{4(S)} + 2H_2O + \text{Energy}$$

At the time of discharging process, $PbSO_4$ is deposited at both the electrodes and H_2SO_4 is consumed. As a result, the concentration of H_2SO_4 decreases gradually.

Recharging

The cell is recha rged when the density of H2SO4 becomes below 1.2 gm/ml. It can be done by applying an external electricity across the electrodes. The following reaction will take place during recharging process :

At anode : $PbSO_4(s) + 2e^- \longrightarrow Pb(s) + SO^{2-}_{4\,(l)}$

At cathode: $2PbSO_{4(S)} + 2H_2O \longrightarrow PbO2(s) + 4H^+\,(l) + SO^{2-}4\,(l) + 2e^-$

Overall Reaction

$$2PbSO_{4(S)} + 2H_2O + \text{Energy} \xrightarrow{\text{charging}} Pb + PbO_2 + 4H_2SO_4$$

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$$Pb + PbO_2 + 4H_2SO_4 \xrightarrow{\text{discharging}} 2PbSO_{4(S)} + 2H_2O + \text{Energy}$$

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Overall Reaction

$$2PbSO_{4(S)} + 2H_2O + \text{Energy} \xrightarrow{\text{charging}} Pb + PbO_2 + 4H_2SO_4$$

Net Reaction :

$$Pb + PbO_2 + 4H_2SO_4 \xrightarrow{\text{discharging}} 2PbSO_{4(S)} + 2H_2O + \text{Energy}$$

Hence, the recharging involves exactly the reverse process of the normal cell reaction.

Note:

Decrease in density Decrease in density of dil. H_2SO_4 can be measured with the help of hydrometer.

Uses

It is used in automobiles such as cars, buses, etc.

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

Advantages of lead acid battery

It can be constructed easily.
It produces high voltage.
It acts as effectively even at low temperature.
Self-discharge is very low when compared to all other batteries.

Disadvantages

Recycling of this battery causes environmental pollution.
Mechanical strain and normal pumping reduces battery capacity.

REFERENCES

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THANK YOU