



SNS COLLEGE OF TECHNOLOGY

(An Autonomous Institution)

COIMBATORE-35.



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DEPARTMENT OF AUTOMOBILE ENGINEERING

COURSE NAME : 19AUB204 – AUTOMOTIVE ELECTRICAL AND ELECTRONICS ENGINEERING

II YEAR / IV SEMESTER

Unit 1 – Electrical System

Topic : Principle and Construction of Lead Acid Battery



LEAD ACID BATTERY



- ❖ Lead-acid batteries are one of the oldest and most commonly used types of rechargeable batteries.
- ❖ They are widely employed in automotive applications, backup power supplies, and various other stationary and portable power applications.





COMPONENTS



- ❖ **Lead Plates:** The main components of a lead-acid battery are the positive and negative lead plates. These plates are usually made of lead dioxide (PbO_2) for the positive plates and sponge lead (Pb) for the negative plates. The lead plates are typically grid-like structures to maximize surface area.
- ❖ **Electrolyte:** The electrolyte in a lead-acid battery is usually a diluted sulfuric acid (H_2SO_4) solution. It serves as a medium for ion exchange between the positive and negative plates during charging and discharging. The electrolyte is critical for the chemical reactions that occur within the battery.



COMPONENTS



- ❖ **Separator:** Separators are porous materials placed between the positive and negative plates to prevent short circuits while allowing the electrolyte to flow freely. Traditionally, separators in lead-acid batteries are made of microporous materials like rubber or polyethylene.
- ❖ **Battery Container:** The container holds all the components of the battery together. It's typically made of plastic or hard rubber and designed to withstand the corrosive effects of the electrolyte.



COMPONENTS



- ❖ **Terminal:** Terminals are the points on the battery where external connections are made. They are usually made of lead and serve as the points for attaching electrical conductors to the battery.
- ❖ **Vent Caps:** Lead-acid batteries often have vent caps to allow the release of gases produced during charging. These caps help regulate internal pressure and prevent the buildup of excessive gas within the battery.
- ❖ **Battery Case/Cover:** The case or cover encloses the entire battery assembly, providing protection and support to the internal components. It also helps in preventing electrolyte leakage.



CONSTRUCTION



- ❖ The lead plates are typically stacked alternately with separators and immersed in the electrolyte within the battery container.
- ❖ The container is then sealed with a cover, and terminals are attached to the lead plates.
- ❖ Vent caps are installed to allow for gas venting, and the battery undergoes testing to ensure proper functioning before being packaged for distribution.



WORKING OF LEAD ACID BATTERY - CHARGING



- ❖ When an external voltage source, such as an alternator in a vehicle or a charger in an electrical system, is connected to a lead-acid battery, the battery enters the charging mode.
- ❖ During charging, electrical energy from the external source is supplied to the battery.
- ❖ This electrical energy causes a chemical reaction at the electrodes (lead plates) and in the electrolyte.
- ❖ At the negative electrode (the lead plate connected to the negative terminal of the battery), lead sulfate (PbSO_4) is converted into metallic lead (Pb) and sulfate ions (SO_4^{2-}).



WORKING OF LEAD ACID BATTERY - CHARGING



- ❖ This reaction occurs as follows: $\text{PbSO}_4 + 2\text{e}^- \rightarrow \text{Pb} + \text{SO}_4^{2-}$
- ❖ At the positive electrode (the lead dioxide-coated plate connected to the positive terminal of the battery), lead dioxide (PbO_2) reacts with sulfate ions from the electrolyte to form lead sulfate and release oxygen. This reaction is represented as:
$$\text{PbO}_2 + \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{PbSO}_4 + 2\text{H}_2\text{O}$$
- ❖ Overall, the charging process converts lead sulfate on both electrodes back into lead and lead dioxide, effectively reversing the discharge process.



WORKING OF LEAD ACID BATTERY – DISCHARGING



- ❖ When a load is connected to the battery (such as a car's electrical system or an electronic device), the battery begins to discharge.
- ❖ During discharging, the chemical energy stored in the battery is converted into electrical energy to power the connected load.
- ❖ At the negative electrode, lead (Pb) reacts with sulfate ions (SO_4^{2-}) from the electrolyte to form lead sulfate (PbSO_4) and release electrons.
- ❖ This reaction is represented as: $\text{Pb} + \text{SO}_4^{2-} \rightarrow \text{PbSO}_4 + 2\text{e}^-$



WORKING OF LEAD ACID BATTERY – DISCHARGING



- ❖ At the positive electrode, lead dioxide (PbO₂) reacts with sulfuric acid (H₂SO₄) from the electrolyte and electrons from the external circuit to form lead sulfate (PbSO₄) and water.
- ❖ This reaction is represented as: $\text{PbO}_2 + \text{SO}_4^{2-} + 4\text{H}^+ + 2\text{e}^- \rightarrow \text{PbSO}_4 + 2\text{H}_2\text{O}$
- ❖ As the battery discharges, the lead plates gradually become coated with lead sulfate, and the concentration of sulfuric acid in the electrolyte decreases.



OVERALL REACTION



- ❖ At the positive electrode, lead dioxide (PbO₂) reacts with sulfuric acid (H₂SO₄) from the electrolyte and electrons from the external circuit to form lead sulfate (PbSO₄) and water.
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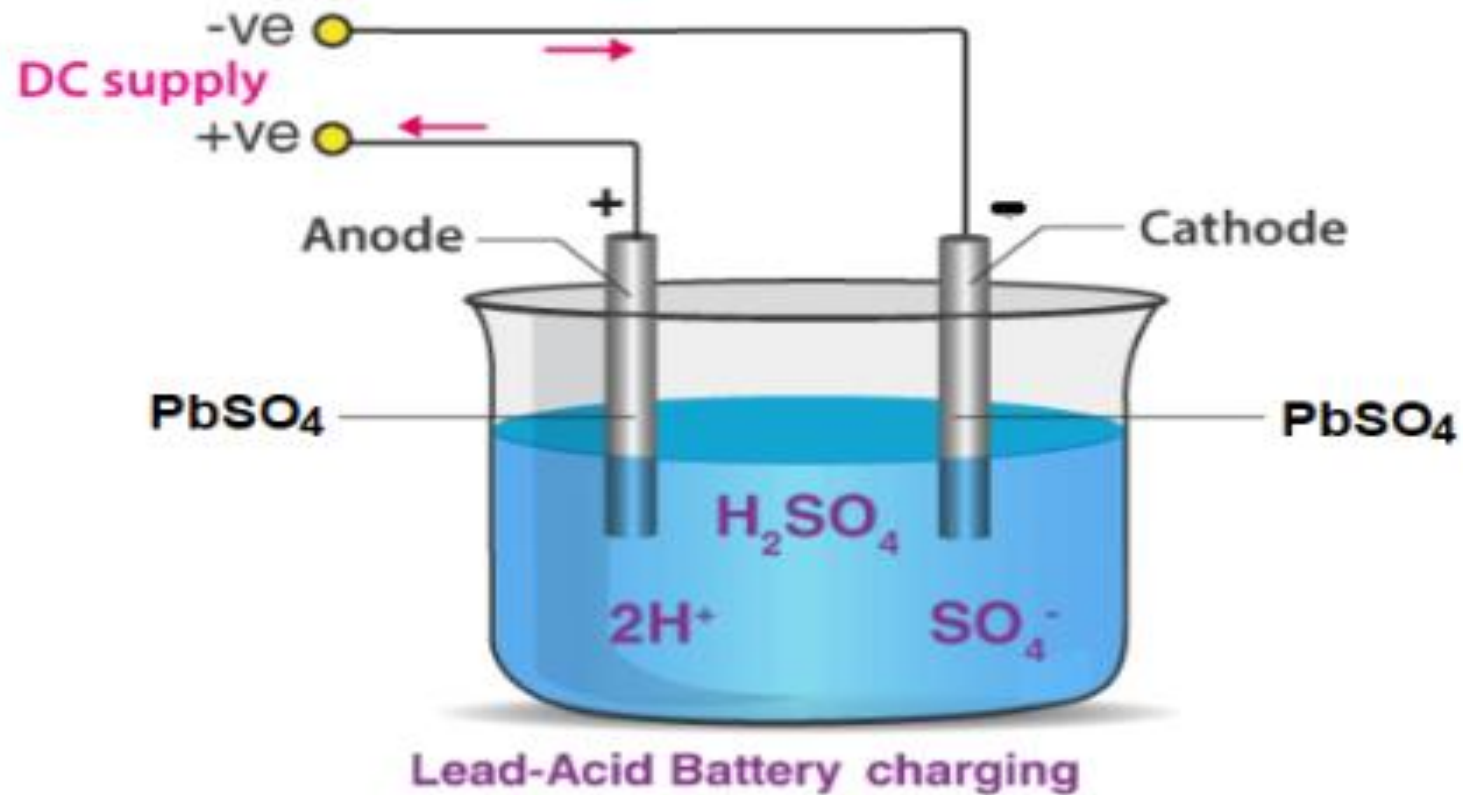


OVERALL REACTION





OVERALL REACTION





APPLICATIONS



- ❖ Automobile
- ❖ UPS
- ❖ Telecommunication
- ❖ Renewable energy sources



THANK YOU !!!