

# Proposal for The Design of Automobiles Batteries production line

Mohamed Nasser El-sayed  
Military Technical College

Maj.Gen. ( R ) Metwally Mohamed Elsayed Moussa , metwallymoussa50@gmail.com

**Abstract** The objective of this work is to present a proposal for automobile batteries production line on a land area of 4000 m<sup>2</sup> with better characteristics.. Due to the huge number of vehicles in our daily life, batteries which convert chemical energy into electric energy with low cost and high efficiency are produced. The typical new lead-acid battery contains 60 to 80 percent recycled lead and plastic. During the recycling process, a battery is separated into three distinct components. The lead is smelted and refined to be used in new batteries. The plastic case is recovered and its material cleaned, and molded into new battery cases. The used acid is even recycled for reuse. Three main stages of lead-acid battery recycling are : battery treatment , smelting and refining .

## I. INTRODUCTION

The battery is a device that simply stores energy in the form of chemical energy and supplies in the form of electrical energy for your need when & where you require in the convenient way. The capacity of the battery depends on the amount of lead dioxide on the positive plate; sulfuric acid present in the battery; and, the amount of spongy lead on the negative plate.

There are many types of batteries such as :  
Lead acid battery, lithium battery, dry battery , liquid battery , etc.

### A. lead acid batteries

The lead battery is manufactured by using lead alloy ingots and lead oxide It comprises two chemically dissimilar leads based plates immersed in sulphuric acid solution. The positive plate is made up of lead dioxide PbO<sub>2</sub> and the negative plate with pure lead.

### B. Construction of Lead Acid Battery

- 1- Container:** The container of the lead acid battery is made of glass, lead lined wood, ebonite, the hard rubber of bituminous compound, ceramic materials or moulded plastics and are seated at the top to avoid the discharge of electrolyte.
- 2- Plate:** The plate of the lead-acid cell is of diverse design and they all consist some form of a grid which is made up of lead and the active material. The grid is essential for

conducting the electric current and for distributing the current equally on the active material.

**3- Active Material:** The material in a cell, which takes active participation in a chemical reaction (absorption or evolution of electrical energy) during charging or discharging, is called the active material of the cell. The active elements of the lead acid are:

Lead peroxide (PbO<sub>2</sub>) - Sponge lead - Dilute Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>)

**4- Separators:** The separators are thin sheets of non-conducting material made up of chemically treated Leadwood, porous rubbers, or mats of glass fiber and are placed between the positive and negative to insulate them from each other.

**5- Battery Terminals:** A battery has two terminals the positive and the negative. The positive terminal with a diameter of 17.5 mm at the top is slightly larger than the negative terminal which is 16 mm in diameter.

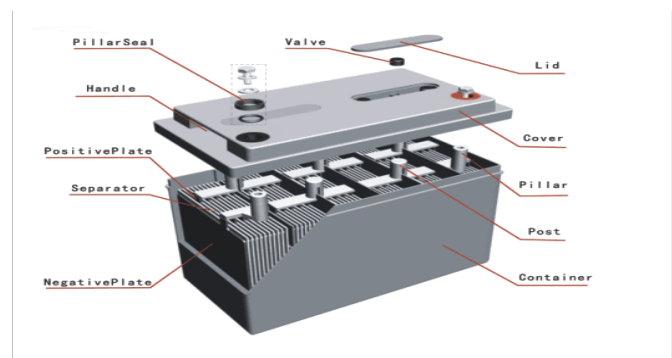


Figure 1 Battery Construction.

### C. Lead-acid battery maintenance rules:

- 1) Watering is the most neglected maintenance feature of flooded lead-acid batteries. Less water creates oxidation in plates and decreases the lifespan of the battery. Add distilled or ionized water when needed.
- 2) Check for the vents.
- 3) Recharge lead-acid batteries after each use. A long period without recharging provides sulfating in the plates.
- 4) Do not freeze the battery or charge it more than 49-degree centigrade.

5th IUGRC International Undergraduate Research Conference,  
Military Technical College, Cairo, Egypt, Aug 9<sup>th</sup> -12<sup>th</sup>, 2021.

- 5) Do not deep discharge the battery less than 1.7V per cell.
- 6) To store a lead acid battery, it needs to be completely charged then the electrolyte needs to be drained.

**D. Applications of lead-acid battery:**

Wet cell stand-by (stationary) batteries designed for deep discharge are commonly used in large backup power supplies for telephone and computer centers, grid energy storage, and off-grid household electric power systems. Lead-acid batteries are used in emergency lighting and to power sump pumps in case of power failure.

Traction (propulsion) batteries are used in golf carts and other battery electric vehicles. Large lead-acid batteries are also used to power the electric motors in diesel-electric (conventional) submarines when submerged, and are used as emergency power on nuclear submarines as well. Valve-regulated lead-acid batteries cannot spill their electrolyte. They are used in back-up power supplies for alarm and smaller computer systems (particularly in uninterruptible power supplies; UPS)an for electric scooters, electric wheelchairs, electrified bicycles, marine applications, battery electric vehicles or micro hybrid vehicles.

**II- Manufacturing steps of lead acid batteries:**

The Manufacturing processes can be divided into several stages like Oxide and grid production process, pasting and curing, assembly process, formation, filling, charge-discharge process, final assembly, inspection and dispatch

**A) Oxide and Grid Production Process:**

Lead oxide is obtained by masses of lead from melting furnaces either by Milling or Barton Pot process methods.



Figure 2. Lead Oxide Production

**B) Pasting and Curing:**

Manufacturers consider the pasting material as a trade secret, and therefore not reveal this to public. However, this paste material in general is made with oxide of lead, red lead, litharge, water and dilutes sulphuric acid.

5th IUGRC International Undergraduate Research Conference, Military Technical College, Cairo, Egypt, Aug 9<sup>th</sup> –12<sup>th</sup>, 2021.



Figure 3. Battery Plates After Pasting and Curing

**C) Assembling the Elements:**

This step involves the formation of positive and negative plate stacks, insertion of separators, inter-cell connector and plate burning.

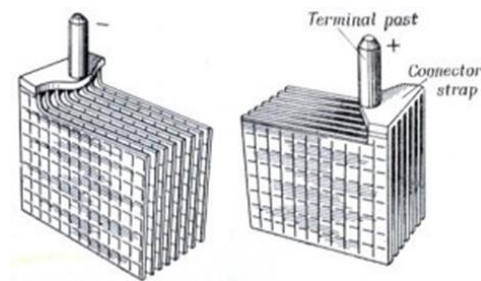


Figure 4. Battery Plates Stacking

**D) Filling and Formation:**

After the assembling, battery jar is filled with required amount of electrolyte through a filling or vent tube. Then, it is ready for initial charging.



Figure 5. Filling Battery with Electrolyte

**E) Charging and Discharging:**

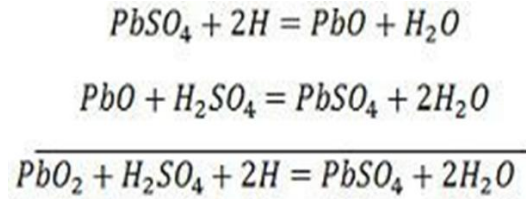
After the formation, batteries are subjected to high-rate discharge test for short duration to rule out any defects before sending them out to the final charge.



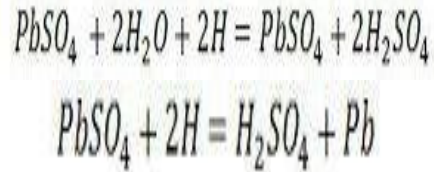
Figure 6. Charging and Discharging Process

If the DC source of supply is disconnected and if the voltmeter connects between the electrodes, it will show the potential difference between them. If wire connects the electrodes, then current will flow from the positive plate to the negative plate through external circuit i.e. the cell is capable of supplying electrical energy.

**A- Chemical Action During Discharging:**

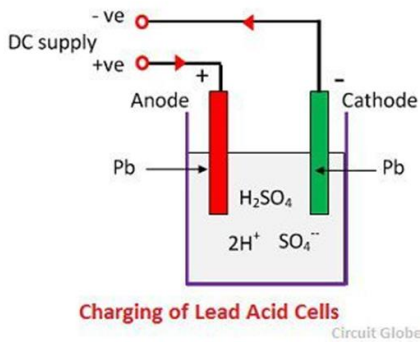


**B- Chemical Action During Recharging:**



**III. Working principle of lead acid battery:-**

When the sulfuric acid dissolves, its molecules break up into positive hydrogen ions (2H+) and sulphate negative ions (SO4-) and move freely. If the two electrodes are immersed in solutions and connected to DC supply, then the hydrogen ions being positively charged and moved towards the electrodes and connected to the negative terminal of the supply. The SO4- ions being negatively charged moved towards the electrodes connected to the positive terminal of the supply main (i.e., anode).



(Figure 7)

Each hydrogen ion takes one electron from the cathode, and each sulphates ions takes the two negative ions from the anodes and react with water and form sulfuric and hydrogen acid.

The oxygen, which produced from the above equation react with lead oxide and form lead peroxide (PbO2.) Thus, during charging the lead cathode remain as lead, but lead anode gets converted into lead peroxide, chocolate in colour.

**IV- BASIC MACHINE TOOLS**

**A-**

First machine.



Figure 8. Container casting machine

Second machine



Figure 9. Terminals assembly machine

Third Machine.



Figure 10. Acid filling machine

Fourth Machine



Figure 11. Battery assembly machine

Fifth Machine.

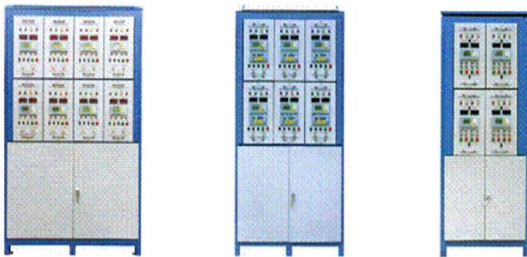


Figure 12. Battery charging machine

B- Battery testing machine.

5th IUGRC International Undergraduate Research Conference,  
Military Technical College, Cairo, Egypt, Aug 9<sup>th</sup> –12<sup>th</sup>, 2021.

CLIMA can provide all kinds of test machine for battery, including UBT microprocessor multifunction testing machine, Microprocessor high rate discharge testing machine, Microprocessor cycle life tester, Aluminum foil sealing machine, Medium vella battery fully automatic three function testing machine, medium VRLA battery Automatic numeric control short circuit testing machine, battery wrapping machine, Bunding machine.



( Figure 13)

Automatic Lead Acid Car Battery Assembly Line

FOB Reference Price: Get Latest Price

\$100,000.00 - \$150,000.00 / Plant | 1 Plant/Plants  
(Min.Order)

## V. Line safety

Fire safety of factories include preventive and protective measures to be taken to eliminate the causes and sources of fire, and if a fire starts, prevent its disastrous action in the personnel, and ensure protection of building, equipment's, machines, etc.

### In the factory :

- 1- Always keep your workplace clean to protect yourself and other from injury.
- 2- Do not leave tools or parts on the floor where you or somebody else may trip over them.
- 3- Immediately clean up any spilled fuel, oil to prevent yourself or others from slipping on the floor.
- 4- Be careful when handling heavy objects.

## VI. Cost

The main goal is to estimate the cost of some main items in order to get an approximate value of total cost.

A- Land cost :

The net area =4000m<sup>2</sup> square meter costs about 600 L.E

Landcost=4000\*600=2,400,000 L.E

**B- Cost of administration building .**

- 1- Construction  
The total cost of administration construction =210.000 L.E
- 2- Air condition  
Each condition cost about 6000 L.E  
Total of air condition=7000\*5= 35,000 L.E
- 3- Furnishing
  - For first manager Furnishing cost about 5000 L.E
  - For 3 engineering managers Furnishing cost about 4000 L.E
  - For employers the office cost 2500 for Furnishing
  - For security Furnishing cost about 1000 L.E
  - For 2 security office cost 1000\*2=2000 L.E
  - For reception Furnishing cost about 2000 L.E
  - Total cost of Furnishing = 16.500 L.E

**Conclusion**

**From the current study the following can be drawn :**

**1- Main application of Battery we:**

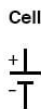
- a- Starting, light and ignition for car, Tractor, Mine vehicle and Mobile machinery shop.
- b- Starting and ignition for the diesel motor or gasoline motor
- c- It can be used as power for car, Tractor, Mine vehicle and Mobile machinery shop.

**2- The materials used in Battery production are:**

- a- contains the cells is made of nickel-plated steel.
- b- layered paper or a porous synthetic material.
- c- an asphalt or epoxy sealant and steel.
- d- brass nail

**3- The construction of Battery is :**

consisting of one long line and one short line, parallel to each other, with connecting wires:

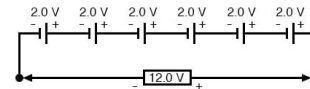


The symbol for a battery is nothing more than a couple of cell symbols stacked in series:

Battery



As was stated before, the voltage produced by any particular kind of cell is determined strictly by the chemistry of that cell type. The size of the cell is irrelevant to its voltage. To obtain greater voltage than the output of a single cell, multiple cells must be connected in series. The total voltage of a battery is the sum of all cell voltages. A typical automotive lead-acid battery has six cells, for a nominal voltage output of 6 x 2.0 or 12.0 volts:



The cells in an automotive battery are contained within the same hard rubber housing, connected together with thick, lead bars instead of wires. The electrodes and electrolyte solutions for each cell are contained in separate, partitioned sections of the battery case. In large batteries, the electrodes commonly take the shape of thin metal grids or plates and are often referred to as *plates* instead of electrodes.

For the sake of convenience, battery symbols are usually limited to four lines, alternating long/short, although the real battery it represents may have many more cells than that. On occasion, however, you might come across a symbol for a battery with unusually high voltage, intentionally drawn with extra lines. The lines, of course, are representative of the individual cell plates:

**4- The manufacturing steps are:**

- a- Oxide and Grid Production Process.
- b- Pasting and Curing.
- c- Assembling the Elements.
- d- Filling and Formation.
- e- Charging and Discharging.

**5- Basic machine tools :**

- a- Container casting machine.
- b- Terminals assembly machine.
- c- Acid filling machine.
- d- Battery assembly machine.
- e- Battery charging machine.
- f- X-ray inspection machine.

**REFERENCES**

- [1] “Rechargeable Batteries” [www.primeproducts.in](http://www.primeproducts.in)
- [2] “Recycling Used Lead Acid Batteries” Ing. Sophie van den Berg MSc. Partner in Development Consultant Solid Waste Management & Recycling , (<http://www.partnerindevelopment.nl>)
- [3] “Emission Estimation Techniques for Lead Concentrating, Smelting and Refining”, Environment Australia – National Pollutant Inventory.
- [4] “Controlling Lead exposures in the Construction Industry: Engineering and Work Practice Controls” – Occupation Safety and Health Administration, USA
- [5] “Metal Manufacturing, Refining and Finishing works” – Department of the Environment Industry Profile.
- [6] Vest, H., Fundamentals of the Recycling of Lead-Acid Batteries, GATE information service GTZ, 2002