

Improve Performance of an Energy Storage System

Rishabh Sharma*

Jr. Engineer (Boiler), Thermax India Ltd, Chandigarh, India

Email: *rishabhsharma940@yahoo.com

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Abstract

This paper proposed a battery efficient system to increase the life of the lead acid battery and life cycle cost of the solar lighting system and reduces operational losses, which is directly impacted by the battery. This process reconditions, maintains and rejuvenates “aged, weak and dead” batteries completely safer, faster at fractional cost. It’s completely eco-friendly and reduces carbon foot print. This is not a battery charger but a battery regenerator. It extends minimum 2 times of battery lifespan. It reduces CO₂ greatly after regenerating aged batteries from automotive traction, industry, UPS, hybrid car, electric vehicles and smart grid. It does maintain functioning batteries in a new condition and also a new incredible space invention that extends the life of batteries. This excellent performance for correct restoration with pulsed charging and discharging. By using this about 70% of lead acid batteries fail prematurely because of a build-up of lead sulphate on the plates of lead acid batteries or impurities on others. This build up causes the battery to become unstable at approximately 1/3rd of its natural life. Battery life maximize solution dissolves this build up restoring the battery to full capacity based on cutting edge technology. The main cause of the batteries dying is sulfation. The sulfating builds up on the battery electrodes preventing it from properly charging.

Keywords: lead acid battery, eco-friendly, battery, Energy Storage System

INTRODUCTION

In India alone, there are above 152 Battery manufacturers manufacturing all kinds of Lead Acid batteries. These manufacturers are selling approximately 180 million batteries every year with 36 months to 60 months warranty period. Every year approximately 36 million batteries are going as scrap as an average in every district three lakh batteries are going to scrap which has approximately 120 crore rupees value per year. We can reduce this economical loss by Refurbishing / Extending the life

of the batteries with the help of the Battery Life Maximizer Technology. With New or Old batteries, just use it and it will prevent it from getting old and wearing out soon. The main cause of the batteries dying is sulfation. The sulfation builds-up on the battery electrodes preventing it from properly charging. Battery Life Maximizer will completely dissolve the sulfation while charging, as well as forms protective coating for Electrodes. The coating will further protect the battery from sulfation enabling the battery to last longer.

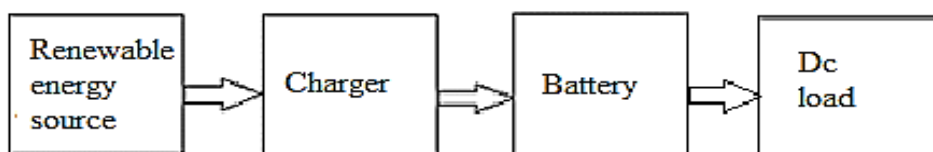


Figure 1: Block diagram for energy storage system.

BATTERY

Battery is a type of device which consisting one or more electrochemical cell with external connections which is provided to connected with electrical power devices such as lights, smartphones and electric cars. Whenever a battery is supplying electric current, its positive terminal is cathode and its negative terminal is anode [1]. The terminal marked negative is a source of electrons that when connected to an external circuit will flow energy to an external devices. When a battery is connected to an external circuit, electrolytes are able to move as an ions within, allowing the chemical reaction to be completed at the separate terminals and so deliver energy to external circuit. Batteries can be classified into two types that is primary cell and secondary cell. Primary cell cannot be recharged and chemical process cannot be reversible. Secondary cell can be recharged and chemical process can be reversed. The Lead Acid battery is made up of different separator plates, lead plates and lead oxides plates (assorted other elements are using to changed density, porosity, hardness etc.) with a 35% sulphuric acid and 65% water solution [2]. This solution is said to be electrolyte which is responsible for a chemical reaction that generate electrons. When a battery become discharged the electrolytes dilutes very quickly and the sulphur accumulated on the lead plates. As the battery is recharged then process reverses back and came into play, the sulphur dissolves into the electrolytes.

Lead Acid Battery

Lead acid battery was invented in 1859 and is the oldest type of rechargeable battery. Despite of having a very low energy to weight ratio and very low energy to volume ratio, its ability to supply high surge current means that the cells have a relatively large power to weight ratio. The low cost of motor vehicles along with its

features, is responsible to makes it attractive for use in to the high current, needed by starter of automobile motors. Even after they are more inexpensive relatively to newer technologies, they are widely used even when there is no importance of surge current and densities of design is providing high energy [3]. The lead-acidic cells used in automobile batteries are wet cells. Lead acid battery delivers short burst of high power, to start the engine. Battery is most important part which is responsible to supplies power to the starter and ignition system for the starting of engine. Battery acts as a voltage stabilizer in the electrical system.

Battery Life Maximizer

An electronic digital device plus chemical solvent that reconditions, maintains, and rejuvenates “aged, weak and dead” batteries. It does maintain functioning batteries in a like new condition, extending the life of the batteries. It is a new incredible invention that extends the life of the batteries. About 70% of lead acid batteries fail prematurely because of a build-up of lead sulfate on the plates of lead acid battery or impurities on others. This buildup causes the battery to become unusable at approximately one-third of its natural life. “Battery Life Maximizer Solution” dissolves this buildup, restoring the battery to full capacity based on cutting-edge technology (Intelligent Charger and Chemical Solvent). “Battery Life Maximizer Solution” solves the battery's problem of the build up on their plates, impurities that accumulates in a crystal form that is very much inert. We will first identify whether a given battery can be refurbished or not. Intelligent Charger is used to loosen the chemical bonding by applying current pulses. By the help of using control technology, this transfer electrical energy to every lead sulfate crystals to energizing them and due to this the necessary conversion back to lead taken place, lead oxides, sulfuric acid

in case of lead acid battery. Adding Chemical solvent to de-sulphate the battery [4]. This action gradually restores the battery back to its original chemical condition allowing the battery to store and release charge again.

BATTERY REJUVANATION PROCESS DOCUMENT

It consists of three phases:

- Identification Phase: In this phase the battery will be qualified whether it can be refurbished or not.
- Rejuvenation Phase: In this phase, the battery will be refurbished.
- Testing and Qualification Phase: In this phase, the refurbished battery will be tested & verified.

Identification Phase

- Observe the voltage reading.
- Observe the current reading.
- Charge the battery for couple of hours and keep it for some-time to settle down the ions.
- Observe the voltage readings, if the battery can hold more than or equal to 10.5 Volts, continue with next step else reject the piece.

Testing Phase

Testing is done to ensure the supported equipment is adequately backed up or not. To prevent the unexpected failures by tracking the batteries health. To forewarn/predict death. To locate weak cells and faulty intercell connector. Testing is done to know the capacity and condition of the battery [5]. To check the level of charging of the battery. To know whether the battery given is aged, weak and dead batteries.

Qualification Test

- Observe the voltage readings and continue the test if it reads 12.5 Volts and above.
- Apply the proper load as per the battery current capacity.

- Load should be appropriate to draw 10% of the battery current.
- Note down the timings of start of the test.
- Observe the voltage readings under load condition.
- Stop the load test when voltage reading is at 10.5 Volts and note down the timings.
- Duration of the test is the backup time of the battery under test.

High Rate Discharge Test

- Observe the voltage readings and continue the test if it reads 12.5 Volts and above.
- Apply the proper load as per the battery current capacity.
- Load should be 3 times the maximum current capacity of the battery.
- Note down the timings of start of HRD (High rate discharge) test.
- Observe the voltage readings under load condition for 15 seconds.
- If the battery cranks 3 times the rated current, then the battery is qualified else it is rejected.

Battery Voltage Testing

- The testing of battery voltage with the help of voltmeter is a simple method by which we can determine the state of charge of any battery.
- The voltage of any battery is not responsible to show whether battery could be perform satisfactorily or not. but instead of this the technician can be easily observe more about the condition of battery's than a simple visual inspection. A battery which is "appear fine" may not be fine.
- This test is can be called as an open circuit battery voltage test because it is executed with an open circuit-in which no current is flowing and there is no load applying on the battery.

Battery Drain Test

If battery is draining overnight, you need to perform a battery drain test

- Remove -ve terminal.
- Hook DVOM or test light in series with the post/terminal.
- With everything off, no light on/voltage reading.
- If light is on or getting voltage reading, battery will be drained.
- Separate the circuit by pull out one fuse at a time.

Voltage Test

- Quick check to find if terminals needs cleaning.
- Measure voltage drop across post to terminal.
- Crank the engine (disable Fuel/ignition).
- While cranking, if reading over 0.5V indicates terminal cleaning maximum 15 seconds.

Load Testing

- One of the most accurate tests to determine the condition of any battery is the load test.
- Most automotive starting and charging testers use a carbon pile to create an electrical load on the battery.
- The amount of the load is determined by the original capacity of the battery being tested. The capacity is measured in cold-cranking amperes, which is the number of amperes that a battery can supply at 0°F or (- 18°C) for 30 seconds. An older type of battery rating is called the ampere-hour rating.
- The proper Electric load to be used to test a battery is one-half of the CCA rating or three times the Ampere hour rating, with a minimum of a 250 ampere load.

Rejuvenation Phase

- Apply the proper proportional mixture of rejuvenating solution and distilled water as per the requirement.

- Rest the batteries in cool place up to 24 hours for reconditioning.
- Charge the battery as per the current rating capacity.
- Observe the Voltage and current readings.
- Discharge the battery and repeat few charge and discharge cycles.

FAILURE MODES OF BATTERY

Gassing

Gassing is generally due to overcharging. This leads to loss of the active chemicals but in many cases this can also be dangerous. In some cells the released gases may be explosive [6]. Lead acid cells for instance give off oxygen and hydrogen when overcharged.

Overheating

Overheating is always a problem and is a contributing factor in nearly all cell failures. It has many causes and it can lead to irreversible changes to the chemicals used in the cells, gassing, and expansion of the materials, swelling and distortion of the cell casing [7]. Electrolytes are particularly vulnerable to heat, breaking down at temperatures as low as 70°C. Such temperatures can be reached in the interior of a parked car, possibly exceeding the recommended maximum temperature of Lithium ion batteries used in devices such as laptops left in the vehicle.

Preventing a cell from overheating is the best way of extending its life.

Thermal Testing

The rate at which a chemical reaction taken place doubles for each and every 10°C increase in temperature. The current flow through a cell causes its temperature to rise. As the temperature rises the electro-chemical action speeds up and at the same time the impedance of the cell is reduced leading to even higher currents and higher temperatures which could be

eventually lead to demolition of the cell unless precautions are taken.

Improve Self Discharge

The changing crystal structure of the active chemicals as noted above can cause the electrodes to swell increasing the pressure on the separator and, as a consequence, increasing the self discharge of the cell. As with all chemical reactions this increases with temperature. Unfortunately these changes are not usually reversible.

Lessen Capacity

This is one another outcome of cell ageing and crystal widening [8]. It is sometimes recoverable through reconditioning the cell by subjecting the cell to one or more deep discharges.

Sulphation

As the lead acid battery become discharges, lead sulphate crystals will be accumulated on the plates as a part of the normal chemical reaction which came into the results in the flow of electrons (at the same time, the sulphuric acid electrolyte is being converted to water). And During charging, the chemical reaction is reversed back and the lead sulphate crystals of lead acid battery become accumulated on lead of the negative electrode and lead oxides on the positive electrode. However, if the battery is not fully charged, or is in use but not reaching the condition of fully charged state, the crystals of lead sulphate will become harden and will not reverse back to lead or lead oxides during charging state. This effects will occur more rapidly at high temperatures.

Once this happens, the capacity of the battery will be reduced.

ADVANTAGES

Refurbishment of batteries makes its cost lower than other batteries. It is portable, compact and light. Easy operation and

easy learning is done. Carbon foot print problem is reduced. Refurbishment of old batteries is the main advantage of our paper.

CONCLUSION

The refurbished batteries consumes lower cost than normal recycling of batteries or purchasing of new batteries. They are eco-friendly. Battery efficiency of refurbished batteries is better than normal batteries.

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