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IMPORTANCE AND PROPER WAY OF MAINTAINING A BATTERY

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Abstract- *Nowadays energy storage is increasingly becoming a hot topic in the debate on how to improve efficiency, reliability and price-competitiveness of electricity services as well as on how to achieve deeper integration of intermittent renewable energies. Battery can play an important role in achieving the target of universal access to clean, reliable and affordable electricity services. Battery is an energy storage device consisting of two or more electrochemical cells that convert stored chemical energy into electrical energy and used as a source of power. As an energy storage device, the use of the battery is increasing day by day such as in automobiles, charger light & fan, IPS, UPS etc. But most of the users are not aware of proper maintenance of batteries. Batteries cannot serve as per capacity and sometimes permanently damage before completing economic lifetime due to the lack of proper maintenance. But if batteries are properly designed and maintained, batteries will improve the system's performance and lead to economic savings over its lifetime. The purpose of this paper is to outline the duties and responsibilities for routine operation and care of batteries so that batteries will serve properly more than its economic lifetime.*

Keywords: Battery, Lifecycle, Energy storage, Maintenance and Charging.

1. INTRODUCTION

The battery is the heart of the electrical system. It is an important energy storage device and is the mostly widely used as secondary storage cell. Without it the automobile engine cannot be started with starting motor. But, it is not only used in automobile fields but also in other fields where electricity storage mechanism is always needed. It is a power storage mechanism which releases a flow of electron through an external circuit. In this system, chemical energy is converted into electrical energy due to reactions occurring between the electrode materials and electrolytic solution or electrolyte. This idea of electro-chemical energy storage began with scientific investigations into electricity. In 1789, while conducting an experiment Luigi Galvani noticed that the legs of frog began to twitch when they came into contact with two different types of material [1]. From this observation, electrochemical cell was developed and after that battery consisting of two or more electrochemical cells was discovered. Then the development of battery has done day by day. Mainly, the developments have taken place in basic material of construction of battery. In present the insulation between positive and negative electrode and outer layers are made of hard rubber, PVC etc. The aqueous electrolyte solution contains in a container which is made of plastics, glass, rubber or PVC. In present days, electrolyte solution has also developed. Nowadays paste type electrolyte such as ammonium chloride is using in some of the batteries instead of liquid acid solution. Those types of batteries are called dry cell battery. But the use of dry cell batteries has not yet spread enough. On the other hand, wet cell batteries have vast application and require more care. So, our main concern is about maintenance of wet cell batteries.

In present days, wet cell batteries are produced commercially by different companies for automobiles and other purposes. They set the life time of the battery according to their uses. The life cycle of the battery depends on not only the quality of battery but also maintenance of battery done by the users. In fact the lifecycle mostly depends upon how properly the battery is maintained. Most of the batteries cannot complete its economic life due to the lack of conscious about the proper maintenance process of battery. If the battery is properly maintained, then the lifecycle as well as service rating of battery will increase from which consumer can be benefited economically. So, the importance of proper maintenance of battery cannot be neglected.

2. IMPORTANCE

Battery is a sensitive electric device. It is essential that batteries are properly maintained to ensure reliability. Under ideal operating and maintenance conditions, this could extend battery life to seven or eight years. It is not unusual to find some batteries to perform this well. If you have problems that develop in fifth or sixth year of the

battery life, it is highly unlikely that major repairs could be justified. It would be wise to consider five to six years as the normal life span. Less than five years could indicate operational abuse or poor maintenance mainly [2]. Furthermore, according to the statics of Hamko Battery Industry Ltd., a battery can serve up to 7-8 years, when maintenance rate is 100%. But it will serve only up to 3-4 years, when the maintenance rate is 50% or average. But, if the maintenance rate is below 50% or the battery is not maintained at all, it will only fulfill its warranty life or not. In figure-2, the histogram, obtained from the statics of Hamko Battery Industry Ltd. represents the importance of maintaining a battery to increase its economic life.

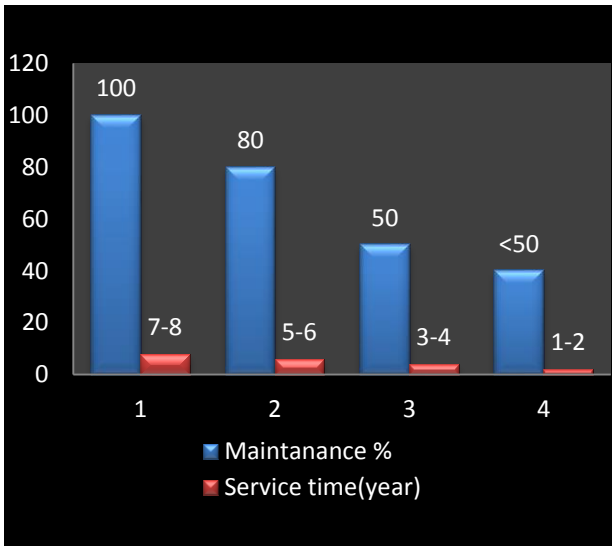

Fig.1: Relation of service time of battery with maintenance rate

There are different problems occurred in the battery due to the lack of maintenance. Undercharging or overcharging problems are commonly occurred due to the lack of proper maintenance of battery. If charging of battery is not handled or maintained properly, it can reduce the battery capacity in day to day activities. Undercharging not only reduces the battery capacity in day to day work activities, but causes abnormal sulfation leading to further reduction of capacity and early cell failure. Overcharging not only creates unnecessary utility expense, but will create high temperatures and over gassing resulting in premature cell failure. Battery problems are also occurred due to the improper watering process. If watering is not done properly in time and battery electrolyte level is allowed to drop substantially, the gas volume inside the battery grows proportionately resulting in an increased amount of flammable gas mixture. Any external or internal spark may result in an oxyhydrogen explosion. Additionally the plates are no longer covered by the electrolyte and may corrode which may cause ultimate failure of the battery. Again, overwatering causes overflow of electrolyte solution. As times goes on water is added and eventually the electrolyte solution becomes more dilute, hence, low gravity readings and a loss of battery capacity. Additionally, external corrosion, and grounds are accelerated, increasing problems with the forklift electronics and to some extent, affecting the longevity of the battery. Furthermore, many battery problems are caused by loose or corroded connections which are the results of lack of proper care of battery. But the proper maintaining of the battery always ensures proper charging, proper watering and proper care of the battery. It keeps the battery free from all problems and ensures long life of the battery. It also keeps the consistency in battery performance. So, the importance of proper battery maintenance is beyond any question.

Fig.2: Battery regularly maintained

Fig.3: Wasted batteries due to lack of maintenance

3. WAY OF MAINTAINING BATTERY

Proper way of battery maintenance means an approach combining preventive with predictive and corrective battery maintenance procedures i.e. there are three ways of maintaining battery:

1. Preventive battery maintenance: It is a procedure of increasing battery reliability by taking action to prevent accelerated deterioration.
2. Predictive battery maintenance: It is a procedure of measuring changes in battery conditions and allowing trend analysis to predict the health and expected economic life of the battery.
3. Corrective battery maintenance: It is a procedure of providing remedies to faults or problems that have been detected.

4. PREVENTIVE BATTERY MAINTENANCE

Preventive battery maintenance process includes watering, ventilation, charging and caring. If those processes are maintained properly, then it can be possible to keep the battery away from all problems or failures.

4.1 Watering

The main reason of battery needs water is loss of electrolyte for which electrolysis is responsible. Other reasons are evaporation from internally generated heat, heavy work load, unavoidable heat, mismatched batteries and charging equipment, use of batteries without a sufficient cool down period. Those reasons can be avoided but need of water due to the loss of electrolyte cannot be avoided. As battery is charged, a small quantity of water in the electrolyte is broken down into hydrogen and oxygen. So, it is necessary to fill up water into the battery after a particular time. Whole watering process is given below:

1. Before starting the charging cycle, each individual cell should be visually checked to assure that the electrolyte level is at least above the separator protector.
2. If the electrolyte level is below the separator protector, sufficient water should be added to bring the level above the protector.
3. Overwatering should be avoided and distilled water must be used.
4. Once electrolyte levels and temperatures are deemed satisfactory, the charging cycle may be initiated.

4.2 Ventilation

Proper ventilation is required for batteries because of gasification. Generated gas during electrolysis in battery should have enough space for escaping. If it is not done, there may be occurred explosion by generated gas. For this purpose, vent cap can be used in battery. It increases safety in poorly-ventilated area. It is advantageous over all other ventilation system. It only provides escape path for harmful and unnecessary gases and helps to prevent steam from escaping. It condenses the steam into water which in turn helps to reduce watering intervals. But vent caps should always be kept tight and gas vent should always be kept opened. Any missing or worn vent plug gaskets should be replaced. The room in which batteries are kept should also have proper ventilation system so that gases have enough space for escaping from the room.

Fig.4: Vent cap of battery

4.3 Charging

The purpose of charging a battery is to put back the energy that has been removed. A battery that is not properly charged will deliver sub-standard performance and display a shorter life span. Overcharging, undercharging and over discharging are always harmful for the battery. The plates suffer greatly when over discharged. Voltage per cell should not be allowed to drop below 1.75 volts [3]. So, proper charging is necessary for standard performance and longer life span of battery. Whole charging process is given below:

1. The battery should not be discharged more than 80% of its A.H. capacity. So, the battery should be charged when the discharge rate is 80% [2].
2. The battery should be charged only after a visual inspection. Never attempt to charge the battery with a damaged case or low electrolyte levels.
3. A state-of-charge test should be performed before charging.
4. Always connect the positive terminal of the battery charger to the positive cell of the battery and the negative terminal of the battery charger to the negative cell of the battery.
5. Unplug the charger or turn it off before disconnecting the terminals at the battery. It should be done when the battery is fully charged.
6. Periodic testing of the battery and charger are necessary.

Table 1: The method of charging batteries that are fully discharged [4]

Reserve Capacity Rating	Slow Charge	Fast Charge
80 minutes or less	15 hours @ 3 amps	2.5 hours @ 20 amps
80 to 125 minutes	21 hours @ 4 amps	3.75 hours @ 20 amps
125 to 170 minutes	22 hours @ 5 amps	5 hours @ 20 amps
170 to 250 minutes	23 hours @ 6 amps	7.5 hours @ 10 amps
Above 250 minutes	24 hours @ 10 amps	6 hours @ 40 amps

4.4 Caring

Daily based cleaning and keeping care of battery is always necessary. In this process, some matter should be considered which are given below:

1. Standard temperature for battery is 80ºF. So, always try to keep the battery temperature near 80ºF [5].
2. Never intentionally allow the electrolyte temperature to exceed 100ºF [3].
3. Keep cells, especially the tops and the battery room clean, dry, and free of electrolyte and corrosion residue.
4. Neutralize spilled electrolyte with soda solution, rinse with water and wipe dry. Do not allow any solution to enter the cells.
5. The terminals should be cleaned and coated with light grease to prevent corrosion [6].

5. PREDICTIVE BATTERY MAINTENANCE

In this process, different tests are conducted to measure changes in battery. Battery testing falls into two categories: performance testing or state-of-health testing.

5.1 Performance Testing

Mainly a full discharge test is used to determine the performance of the battery compared to manufacturers' published performance data, usually in terms of capacity measured in Ah. This requires external load banks, is labor-intensive, and the battery being tested will need to be disconnected from the load. An alternative to full discharge testing is to perform a partial discharge using the system load. This technique involves reducing the load placed on the rectifiers, allowing the entire battery to support the load.

5.2 State of Health Testing

Incorrect float voltage, and temperatures outside of normal operating limits, can soon have a detrimental effect on the state of health of the battery. Various common fault modes such as sulfation or dry out can also quickly degrade the battery state of health. Capacity testing will detect batteries where the state of health has declined to the point of near end of life, but will not indicate how much life is remaining. What we need is a way to measure the state of health with a parameter that changes predictably over the life of a battery. Ohmic testing is a generic term for electrical measurements of state-of-health. Furthermore, state of health testing also includes inspection, removal of surface charge, state-of-charge and load test. Visual inspection indicates different problems e.g. loose generator belt, low electrolyte level, corroded cable or terminal clamps, loose hold-down camps or cable terminals, damaged battery case which are harmful for battery health. Removal of surface charge and state of charge indicates the charging condition of the battery which is directly related to the battery health. The battery has a state-of-charge of 75% or greater or has a good built-in hydrometer indication may be load tested. The voltage on a good battery will not drop below 9.7 volts during the battery load test [4]. This is the indication of good health of battery which is confirmed by the load test.

6. CORRECTIVE BATTERY MAINTENANCE

The predictive and preventive maintenance are an essential part of a complete battery maintenance package but for maximum effectiveness, corrective maintenance should be added to form part of the overall battery maintenance program. Some minor problems can be occurred in battery which in turn may be converted into permanent failures if problems are not solved quickly. These problems are cell failure, cell leakage, loose connection etc. These problems should be solved as early as possible for welfare of battery. Every faulty cell in battery should be replaced time to time. Any leakage occurred in battery should be repaired as early as possible. The loose connection of battery should be tightened. Other problems should also be solved according to manner. Thus the battery will work efficiently again.

7. INSTRUCTIONS OF HAMKO BATTERY INDUSTRY LTD.

Authorities of Hamko Battery Industry Ltd. always provide some instructions for proper maintenance of battery to the users of Hamko battery. These instructions are given below:

7.1 Don'ts

The things that should not be done with the battery are given below:

1. Don't cover the battery with sheets, clothes or any other things.
2. Don't misplace the negative or positive terminal of battery.
3. Don't fill up any acid further in battery.
4. Don't keep any flammable substance near the battery.
5. Don't use rainwater, tap water and water from other sources except distilled or deionized water.
6. Don't keep the battery idle for long terms.

7.2 Do's

The things that should be done with the battery are given below:

1. Do select the battery of accurate capacity rating based on the system load.
2. Do examine the charging state and auto-cut before loading the battery.
3. Do keep the upper surface of battery always dry and clean.
4. Do keep the electrolyte level above separator.
5. Do wash clamp, terminal, trey, battery cell etc. after every ¾ months.
6. Do maintain the servicing of battery after every ½ months regularly.
7. Do add water, if necessary after the battery is fully charged.

8. CONCLUSION

Battery is an electrochemical device to store energy for the further applications according to the demand. It stores the energy by performing some chemical reactions between some chemicals. Day by day it reduces its efficiency and economic life cycle. The reduction will be so fast, if it is not regularly maintained and inspected. It is very important electric device in our day to day life. It is only the reliable electric energy storage source. So, it is very necessary to keep consistency in battery performance. For this reason, it is the most important to ensure the proper maintenance of battery to get required performance from battery for long life cycle.

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