Maintaining Lead Acid Batteries

As some in the industry once put it, **"Few batteries die a natural death, most are murdered."**

The batteries we are talking about tonight are the lead-acid batteries - the traditional wet cells, gel cells and AGM batteries, standard and deep cycle. For most battery owners, these batteries typically last only a few years. However, they could last much longer, if we knew what happens to these batteries over time and maintained them properly.

Why Batteries Fail

When a lead-acid battery is discharged, a soft lead sulfate material forms on the battery plates. During the battery's recharge, most, but not all, of this material is lifted off the plates and recombined into the battery's electrolyte solution. If, the battery is left in a partial state of discharge for as short as 3 days, the lead sulfate material will begin to harden and crystallize, forming a permanent insulating barrier. As this barrier becomes thicker and thicker, the battery's ability to accept a charge or deliver energy is diminished, resulting in the perception that the battery is no longer usable. The accumulation of such deposits, otherwise known as sulphation, is the most destructive process in the life of any lead-acid battery.

Deep Cycle versus Shallow Cycle (car batteries)

A cycle for batteries is when the battery is discharged and then recharged back to the same level and is referred to as the depth of charge.

A shallow cycle occurs when the battery is discharged to 80 % of its capacity. The plates in shallow cycle batteries (car batteries) are thin, with a broad surface area. This design can deliver a lot of power for a short period of time. These batteries should never be discharged below 80% capacity for optimum life.

Deep Cycles occur when a deep cycle battery is discharged up to 50% of its full charge. Batteries designed for deep cycling are built with thicker plates, which have less overall surface area. Because of the lessened surface area for chemical reaction, these batteries yield just as much power relative for their size, but do so over a longer period of time.

Determining Battery State of Charge

Battery state of charge is determined by reading either terminal voltage or the specific gravity of the electrolyte. Digital voltmeters provide the accuracy to read the voltage in hundreths and are relatively inexpensive and easy to use. The main problem with relying on voltage readings is the high degree of battery voltage variation throughout the day. Battery voltage reacts highly to charging and discharging. As a battery is charged the indicated voltage increases and, as discharging occurs, the indicated voltage decreases.

When using the volt method to determine the charge state of a battery, it is important not to measure the voltage right after the battery has been charged. You must wait several hours after charging, perhaps six hours or so, to allow the battery to rest and shed the residual effects of charging and settle down to its actual state of charge voltage.

How can we determine the state of charge of a battery:

Above 12.7 volts with no-load, the battery is considered to have a 100% charge.

80% charge shows a no-load voltage of 12.46. Ideally, a car battery should never be discharge below this voltage.

50% charge is reached when the no-load voltage is at 12.2 volts. Deep cycle batteries should never be discharged below 50% of its capacity.

As mentioned earlier, as a battery is discharged and recharged, some lead sulfate molecules are left behind on the plates and over time build up, crystallize and harden. As this occurs, the capacity for the battery to recharge, diminishes. This is why most batteries become weaker and weaker over time. In time, a 100amp battery may act as if it were only a 50amp battery or less.

Battery Reconditioning

There are processes designed to remove this lead sulfate buildup from batteries plates to extend their life. One is Equalization, where a battery is subjected to 15 volts or higher for a period of time. While this process will remove a lot of the buildup, it is also hard on the battery.

A newer process for removing sulfate crystals from the battery plates is called Conditioning or **Desulfation.** This process is just at least as effective as Equalization, and perhaps even more effective, at removing sulfate buildup in batteries. It is also gentle to the battery. This process uses a sweeping milliseconds pulse of energy emitted into a battery bank that knocks individual sulfate molecules off the plates. The frequencies at which these pulses are emitted are tuned to excite the structural components of the sulfate crystals. This process enables the trapped sulfate molecules to revert back in to the electrolyte.

This process takes a long time. A normal desulfation cycle takes 24 hours. You may need to repeat this process several times, if the battery has a lot of sulfate buildup in it. Before performing the desulfation process the battery should be charged to is full capacity.

There are numerous devices on the market which can perform desulphation on lead-acid batteries. I personally have a battery charger which has this process built in. Some recommend that batteries should be de-sulfated several times a year to keep them in top condition. Once a year would certainly be appropriate.

I personally have numerous examples where this process has extended the life of a batter by several years. If done properly, you should expect to at least double the “normal” life expectancy of a battery.

Normal Maintenance

In addition, normal maintenance is also required. Keep the battery clean, the electrolytes full (and not over full). Use only distilled water. Keep batteries out of high heat and extremely cold weather. In winter, when

batteries in cars often must remain out in the cold, keep the batteries charged. Don't let the batteries sit for several days or weeks or months at a time without being charged. If a battery is not to be used for a long period of time, it should be float charged continuously or often.

My truck may sit for several weeks without being driven, therefore, I keep a float charger on it at all times, when it is not in use.

Smart Chargers

The best kinds of battery charges are 3 stage chargers, or smart chargers, typically used with boats and RVs. They charge the batteries in three phases:

1) Bulk charge phase (rapidly bringing the battery voltage typically to about 14.3 volts
2) Absorption phase (keeping the voltage at 14.3 volts until the battery is fully charged)
3) Float Phase (keeps the voltage at 13.1-13.4 volts, depending on the battery, to maintain the charged state). Large capacity batteries can usually absorb a slightly higher voltage than can smaller capacity batteries. The specs from the manufacture of the battery will indicate the proper float charge voltage. We are talking about Float charging, not trickle charging. Trickle charging typically maintain the voltage somewhat higher than float charging.

Remember these, "don't go below", charge state thresholds:

80% charge is 12.46 volts no-load - used for car batteries
50% charge is 12.2 volts no-load - used for deep cycle batteries

For 24 volt systems, double these reference voltages.

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