16. HOW CAN I REVIVE A SULFATED BATTERY?

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Introduction:

People kill more deep cycle batteries with poor charging practices, than die of old age! During the normal discharge process, soft lead sulfate crystals are formed in the pores and on the surfaces of the positive and negative plates inside a lead-acid battery. When a battery is left in a discharged condition, continually undercharged, or the electrolyte level is below the top of the plates, some of the soft lead sulfate re-crystallizes into hard lead sulfate. It cannot be reconverted during subsequent recharging. This creation of hard crystals is commonly called permanent **"sulfation"**. It accounts for approximately 85% of the deep cycle lead-acid battery failures. The longer sulfation occurs, the larger and harder the lead sulfate crystals become. *The positive plates will be light brown and the negative plates will be dull, off white.* These crystals lessen a battery's capacity and ability to be recharged. This is because deep cycle batteries are typically used for short periods, vacations, weekend trips, etc, and then are stored the rest of the year to slowly self discharge. Car batteries are normally used several times a month, so sulfation rarely becomes a problem. As a consequence of parasitic load and natural self-discharge, permanent sulfation occurs as the lead-acid battery discharges while in long term storage. *(Parasitic load is the constant electrical load present on a battery while it is installed in a vehicle even when the power is turned off. The load is from the continuous operation of appliances, such as a clock, security system, maintenance of radio station presets, etc.)* While disconnecting the negative battery cable will eliminate the parasitic load, it has no effect on the natural self-discharge of a car battery. Self-discharge is accelerated by temperature. Thus, sulfation

can be a huge problem for lead-acid batteries not being used, sitting on a dealer's shelf, or in a parked vehicle, especially in HOT temperatures. Car and deep cycle lead-acid batteries are perishable!

Section 1: How can I tell if my batttery has permanent sulfation?

Chances are that your battery has some permanent sulfation, if it exhibits one or more of the following conditions:

- If your wet Standard (Sb/Sb) or wet Low Maintenance (Sb/Ca) battery has been not been recharged for over three months, especially if the storage area was warm or hot. (Six months for wet Maintenance Free (Ca/Ca) or one year for VRLA AGM or Gel Cell.)
- While recharging, the ammeter does not drop to within 2% (C/50) of the AH capacity of the battery within twice the capacity divided by the charging rate in hours and the battery is warm or hot. For example, if you have a 50 AH battery and a ten amp charger, the battery should be fully charged within 10 hours (2 x 50 AH/10 amps = 10 hours).
- If the temperature compensated absorption charging voltage is correct and the battery is gassing excessively.
- Poor performance.
- If the battery will not take or "hold" a charge.

Section 2: How do I prevent permanent sulfation?

The best way to prevent sulfation is to keep a lead-acid battery fully charged because lead sulfate does not form. This can be accomplished three ways. The best solution is to use a charger that is capable of delivering a continuous "float" charge at the battery manufacturer's recommended float or maintenance voltage for a fully charged battery. 12-volt batteries, depending on the battery type, usually have fixed float voltages between 13.2 VDC and 13.8 VDC, measured at 80° F (26.7° C) with an accurate (.5% or better) digital

voltmeter. Based on the battery type you are using, charging can best be accomplished with a microprocessor controlled, three stage (for AGM or Gel Cell batteries) or four stage (for wet batteries) "smart" charger or by voltage-regulated float charger to "float" or maintain fully a charged battery. A cheap, unregulated "trickle" charger or manual two stage charger can overcharge a battery and destroy it.

A second and less desirable method is to periodically recharge the battery when the State-of-Charge drops to 80% or below. Maintaining a high State-of-Charge (SoC) tends to prevent irreversible sulfation. The recharge frequency is dependent on the parasitic load, temperature, the battery's condition, and plate formulation (battery type). Temperature matters! Lower temperatures slow down electro chemical reactions and higher temperatures speed them up. A battery stored at 95° F (35° C) will self-discharge twice as fast than one stored at 75° F (23.9° C).

A third technique is to use a regulated solar panel or wind or water generator designed to float charge the battery. This is a popular solution when AC power is unavailable for charging.

Section 3: How do I recover sulfated batteries?

Here are three methods to try to recover permanently sulfated batteries:

3.1 Light Sulfation

Check the electrolyte levels and apply a constant current at 2% of the battery's RC or 1% of the AH capacity rating for 48 to 120 hours at 14.4 VDC or more, depending on the electrolyte temperature and capacity of the battery. Cycle (discharge to 50% and recharge) the battery a couple of times and test its capacity. You might have to increase the voltage in order to break down the hard lead sulfate crystals. If the battery gets above 125° F (51.7° C) then stop charging and allow the battery to cool down before continuing.

3.2. Heavy Sulfation

Replace the old electrolyte with distilled, deionized or demineralized water, let stand for one hour, apply a constant current at four amps at 13.8 VDC until there is no additional rise in specific gravity, remove the electrolyte, wash the sediment out, replace with fresh electrolyte (battery acid), and recharge. If the specific gravity exceeds 1.300, then remove the new electrolyte, wash the sediment out, and start over from the beginning with distilled water. You might have to increase the voltage in order to break down the hard lead sulfate crystals. If the battery gets above 125° F (51.7° C) then stop charging and allow the battery to cool down before continuing. Cycle (discharge to 50% and recharge) the battery a couple of times and test capacity. The sulfate crystals are more soluble in water than in electrolyte. As these crystals are dissolved, the sulfate is converted back into sulfuric acid and the specific gravity rises. This procedure will only work with some batteries.

3.3. Desulfators

Use a desulfator also known as a pulse charger. A list of some of the desulfator or pulse charger manufacturers is available on the *Battery References Links List*. Despite manufacturer's claims, some battery experts feel that desulfators and pulse chargers do not work any better at removing permanent sulfation than do constant voltage chargers.

Section 4: Where can I find additional information on sulfation?

The jury is still out, but here are some articles on Sulfation, Desulfation and Desulfators by Alistair Couper,

Lead Acid Battery Desulfation Pulse Generator, *http://www.shaka.com/~kalepa/desulf.htm.*

Some Technical Details on Lead Acid Batteries: The Chemistry of Sulfation, and Why Pulsing Helps, http://www.flex.com/~kalepa/technotes.htm

and

Desulfator Frequently Asked Questions.

http://www.shaka.com/~kalepa/faq.htm

From:
http://www.rpc.com.au/products/batteries/car-deepcycle/carfaq16.htm

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