Subject: **Batteries Lessons Learned**
Sent: 18 Sep 05

After several years of working with 6 and 12 volt batteries at a seldom visited remote site, I have finally learned a few valuable lessons worth sharing. When building and using a battery bank for remote power the following practical general rules would apply.

General Rule: 1) Do not connect a number of 12 volt batteries in parallel to make a long term use battery bank. We found this is a good way to kill off good batteries in short order. Sooner or latter there is enviably one weak cell in the bunch. This week cell will drain the charge of the rest of the good batteries and untimely make them all bad. A weak cell is one that losses it charge rapidly (due to internal leakage) the resulting individual 12 volt battery becomes around 11 volts if allowed to set for a week or so. Excessive internal leakage can be a result of over sulfation in the cell.

Most 12 volt batteries are sealed on the top and do not allow for measurement of individual cell voltage. Using a parallel connection of many 12Volt batteries a bad cell is very difficult to find. One has to charge the parallel combination and then disconnect all batteries and let them set for a few days to a week. The batteries with bad cells will ultimately show up with voltages below 12 volts. In a low tech survival environment where one needs to use the batteries daily this becomes impractical.

A better approach is to use one battery at a time for power. From time to time completely charging it and rotating it out to then use another. Watch the voltage of the ones sitting idle to get an idea how good or bad they are. If you really are on top of it and watching it and need the extra immediate power then go for several in parallel at the most. Try to match up batteries that have the same internal leakage or self discharging rate when doing this. Just don't leave it hooked up this way for the long term.

Bottom line it is better to let a good battery set ideal when charged than to put it in parallel with other 12 volt batteries. The weakest one will pull down all the rest and make the majority go bad before there normal life time is up. Thus the rule --- do not connect 12 volt batteries in parallel to make a long term use battery bank.

Rule: 2) The deeper the discharged state of a battery the shorted the time one should wait to charge it. If one leaves a 12 volt discharged battery (measures below 12 volts) for a month or longer it will not fully charge due to sulfation. This also promotes dead or leaky cells. The longer it is left the less capacity it will have if it holds a change at all. If a battery is partly discharged say it is 30 % discharge then the battery can set for much longer (Say 6 months) before it sulfates very much. Sulfation forms when a cell is discharged. Non-reversible sufation results when the battery sits for too long a time in a partly discharged condition. The sufation crystals become hard and irreversible with time. They then do not go back into solution during charging. The battery is considered to be sulfated.

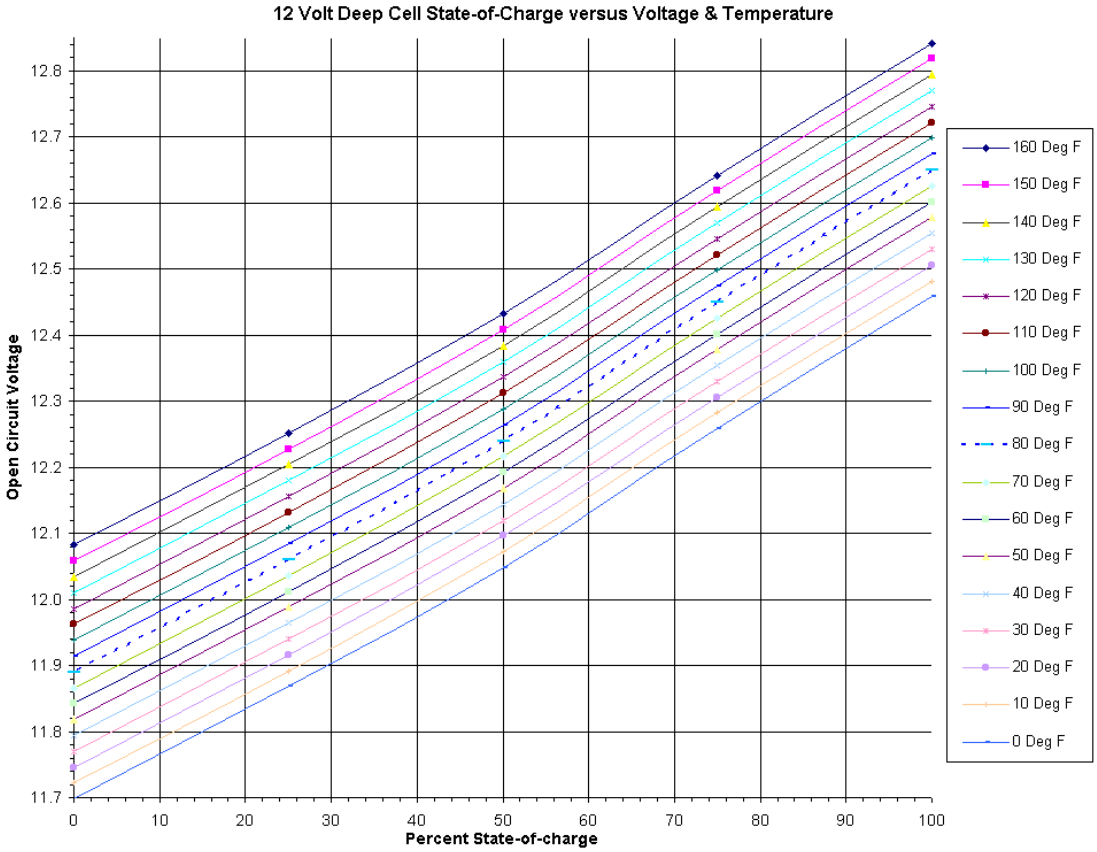
A sulfated battery can sometimes be cured by over charging it for over a week or so at over 15 volts for a 12 volt battery. Due to lack of power this can be hard to do in a primitive survival situation. Another way is to drain the battery acid and put distilled water in the cells. Let it sit for one hour. Charge at about 4 amp rate until hydrometer readings do not change over a period of time. This attempts to redissolve most of the sulfate crystals into solution. Then drain and save this new wash acid. Wash the sediment out of the cell with more distilled water. Replace with new acid if you have it. If in a primitive environment, boil down the wash acid to make it stronger and then combine the original saved acid with the newly created wash acid and continue to slowly boil it down to an amount that will just fit back into the original battery. Use a non-corrosive or glass container to accomplish this. If the specific gravity gets up close to 1.3 then you have enough acid left to do the job.

Rule: 3) If you are making a long term use battery bank use 6 high capacity single 2 volt cells in series to make a single 12 volt battery. Get one extra cell to replace one that may go bad in the future. Chouse an amp-hr rating that matches your charging capability. If you use a wind-mill and only get a small amount of Amp-hours out of your wind don't chouse a high capacity battery bank. You will never keep it charged, the internal leakage will too much.

The advantage of this method is one can from time to time measure the voltage of each of the single cell while in operation. This is done by compare the voltage of each. The one with the consistent lowest voltage is the one most likely to go bad. It will be the one with the greatest internal leakage.

Rule: 4) When using a gasoline generator and a battery charger --- determine you're charging rate in amps and divide that into the amp-hour ratting of the battery to get how many hours you need to run your generator. For example 40 amps divided into 200 amp-hours for a battery = 5 hours for a full charge. From time to time say every month or two over charge the battery bank to balance out the cells. This is called equalization. It insures each cell is fully charged. Cells become unbalanced with respect to state of charge with time if never fully charged, due to different internal leakage rates of each cell.

Rule: 5) Determine your state of charge by measuring voltage for a battery in a resting state. This is a state of not being charged and not discharging and has not been actively being changed for more than 12 hours. Bottom line, wait 12 hours or more after charging and turn off all load and measure the voltage. Using the current temperature and rest voltage of the battery determine the state of charge by use of the attached chart. See http://home1.gte.net/mikelob/Bat_charge1.gif



Do not bother to purchase expensive meters that measure state of charge. They end up from personal experience being more trouble than they are worth. A simple low cost digital volt meter from Harbor Freight will work fine. See http://www.harborfreight.com/

Search for item 90899 for $2.99 or item 30756 for $9.99. Both are a “7 function multi-tester” and will work fine.

Internal leakage and sulfation are the variables that determine useful battery life time that one need to become familiar with and watch for.

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