May 2006

BattEQ™ Test Results

By Mick Abraham

I've worked with deep cycle batteries since 1984, with particular focus on renewable energy systems. Batteries are widely known to be "The Big Problem" in off grid power systems; they just lose capacity much sooner than we want them to. Many tons of batteries are replaced each year.

In 1997 I introduced the PowerPulse® electronic sulfation dissolver to the alternate energy industry, and I've shipped over 7,000 of those units since that time. That product (and the competing clones which soon followed) became a common battery enhancement, but battery longevity has continued to disappoint. Even my PowerPulse customers are still having battery problems.

In April 2006, I tested a new category of battery health device (sold under the trade name **BattEQ**™) which could be described as a "flying capacitor type charge equalizer". I did the testing in my own shop, with results more dramatic than anything I'd seen before. My results are presented below, but ***this was not a scientifically controlled experiment***. Additional tests are needed.

My own alternate energy system has an 1100 watt solar array, ability to buy backup power from the grid, and a small "fork lift style" lead acid battery with liquid electrolyte. This 24 volt battery was new in 1998, and was originally rated for 385 amp hours at the 20 hour rate. It's been driven hard over the years, and the electrolyte level has gotten too low on several occasions.

I had installed PowerPulse when the battery was new, but the capacity had still degraded seriously over the years. This became obvious whenever we had a utility blackout. Morning sunshine on the solar array would quickly push the battery to the voltage regulation point on my solar charge controller. If not for the longtime PowerPulse deployment, I would have suspected sulfation problems, because of these classic symptoms of reduced capacity.

I've done a number of "equalization charges" on this battery in its lifetime, but shortly after an EQ charge was completed, the cell voltages quickly began to drift apart again. I knew this battery was sick, but I haven't wanted to replace it. So long as the grid is working, our power in the home is reliable even without much of a battery. We've basically been running on solar power during sunny days and buying power from the grid after sunset.

Before I could accurately test the **BattEQ** effect, I first had to build an accurate way to measure battery capacity. My test rig is the subject of another report, but it can force the battery to drive a .69 ohm resistive heat coil. This resistance results in about 35 amps of load on a battery at 24 volts, which represents about a ten hour discharge rate on my battery. When the battery 's "end to end" voltage drops to (a current compensated) 22 volts, the discharge is automatically terminated, and digital metering records the amount of amp hour delivery during that discharge.

I isolated my house battery, and completed a good recharge routine with a grid powered charger from Victron Energy. Next, I connected my capacity testing rig, and measured 89 amp-hours of power delivery before the rig shut down. I recharged the battery using the same method (beginning with about a ten hour rate of charge), and measured 97 amp-hours. These are poor results for this battery.

I recharged again, and noted that the end to end battery voltage was going high early in the charge cycle--that's another sign of low battery capacity. After that recharge, I installed **BattEQ** model LA-400-6V-4 about 1:00 P.M. on April 18th. (Even though the terminals for all twelve cells in my forklift battery are accessible, this **BattEQ** version only has four "channels", and it groups three cells into each channel. It doesn't balance each individual cell, but it instead balances one group of three cells against the other three groups.)

About two hours after installing the device, the voltages on each six volt increment of my pack had converged within .05 volts of each other. I then connected my capacity testing setup, and measured a surprising 225 amp hours of power delivery prior to shutoff. ***This represents about 2.3 times more battery capacity*** with no discernible change other than the **BattEQ** addition.

Recharge behavior for the battery was also different, mostly in the fact that the "end-to-end" battery voltage ramped up more slowly. (This is what we might expect from a discharged battery with bigger capacity than before.) Anecdotally, my Hydrocap™ recombiner caps didn't seem as hot as before, but I didn't attempt to quantify this change.

Subsequent discharge/recharge cycles yielded very similar results, with measured capacity typically in the 228 to 233 amp hour range. This is still well below the original battery rating, so **BattEQ** will not make old batteries work like brand new ones. On the other hand, it took a battery that was "ready for recycling" and brought it back to about 60% of original capacity.

As a footnote, my house battery has had a Vanner Voltmaster™ installed for many years. This device is supposed to balance the two 12 volt halves of the string against each other, but the **BattEQ** delivered a capacity increase on a pack that had approached failure under the Voltmaster management.

I decided to do a second test. The "subjects" were four golf cart batteries that were in terrible shape. They were on hand only because I had not yet turned them in for recycling—they had previously tested so badly before that they were essentially junk. These had never even been pulsed with a sulfate dissolver. Several charge/discharge cycles yielded a maximum capacity of only 13.5 amp hours—from batteries that were originally rated over 200 amp hours. Capacity degradation before installing the equalizer was on the order of 93%.

I installed **BattEQ** and gave it about three hours to "start cooking". I then put the battery back on bulk/absorption charge until the charging current had tapered to six amps. This is the same charging routine that had only yielded 13.5 amp hours of battery capacity before. The taper to six amps (or absorption phase of the charge) took much longer than before, however, which foretold a greater discharge capacity.

Because these are smaller rated batteries, I had to tweak my capacity testing rig to impose a smaller load. By moving a cable tap, I changed the heater resistance to 1.37 ohms, which translates into a 17.5 amp load on a battery at 24 volts. That's about an 11.5 hour discharge rate based on the original battery capacity rating.

My very next measured discharge on this string of golf cart batteries yielded an astonishing 88.3 amp hours. This represented a capacity increase of over 6.5 times versus my earlier tests. I know this is hard to believe, but I saw it with my own eyes. Subsequent cycles clocked out even higher. The measured capacity maxed out around 50% of the original rating, so these batteries are still marginal for continued service. Nevertheless, the balancer restored partial viability to what was previously 240 pounds of trash.

I had to stop my shop testing at this point to respond to a call for help from one of my clients from years ago. I had originally sold them a pack of sixteen Exide brand L-16 batteries--***ten years ago.*** New system users had come and gone, and very little battery maintenance had been practiced. This installation didn't even have a PowerPulse in place. The battery system would only support the electrical loads for about 15 minutes before the inverter shut down due to low voltage.

I had only one **BattEQ** device on hand at the time--my pre-production prototype. I took this to the site, did some hazmat style cleanups and began some simple voltmeter/ammeter tests. One string of four L-16's was behaving even more badly than the others, so I decided to remove this string from the pack. I cross-tied the remaining twelve units, installed the **BattEQ**, then began a normal recharge with generator plus solar power. Using my ammeter, I confirmed that the balancer was still operating below its maximum energy transfer limitation.

In this crisis situation, there was no time for me to test the energy delivery of the battery pack before or after. All I have is anecdotal evidence, but as I write this two months later, ***this system has not shut down a single time since my rescue mission!*** The client was staring at an emergency replacement battery pack cost of over $4,000 parts and labor. Instead they spent less than $500 on parts plus my labor for the trip. They now can wring out another year, or two, or more of remaining battery life before the inevitable replacement. When the eventual replacement does occur, the battery balancer will still be there for the benefit of the new battery.

Here's my explanation for the increased energy delivery: Without the balancer, the weakest battery segments undergo such severe voltage suppression under load that the end-to-end string voltage reaches the low voltage cutoff point *while there is still usable energy available in the stronger segments*. The balancer gives voltage support to the weak segments so they don't falsely cause the discharge to be terminated.

Voltage equalization during discharge therefore has a significant benefit that has not been widely known before, because it's only now that we have an affordable, practical way to achieve that balance. **BattEQ** benefit for older batteries will be greatest if one of the monoblocs is significantly weaker than the other three. If all the L-16's were equally weak, the **BattEQ** effect would be smaller. In my experience, however, equal batteries are the exception rather than the rule.

These are isolated tests and they're far from scientific. Also: I am not an "impartial third party", because I distribute **BattEQ** to the alternate energy industry. Additional testing is needed, both in "laboratory settings" and in the real world.

I encourage interested parties of all stripes to get their hands on some weak batteries, build a capacity measuring rig, and report their **BattEQ** results. Fair testing would exclude mismatched sets, any batteries that had been frozen, those with obviously shorted cells, and those that have been boiled dry. Fair testing also needs reasonable, repeatable methods of recharge with proper regulation.

Renewable energy technicians who build a capacity measuring setup would find this to be a useful tool when responding to the frequent battery related service calls. Those same service calls could also serve as an ideal real world “test bed” for **BattEQ**. An off-grid system could continue running on most of the battery strings in the pack, while one string is isolated from the others (following suitable recharge efforts). The isolated string could be subjected to load testing without **BattEQ** and then with it. The test may need some lag time to give the balancer time in which to work, but in my experiments, the increased capacity was noticeable upon the very first balanced discharge, and within a matter of hours of **BattEQ** deployment.

BattEQ seems to have significant effects on the performance of older batteries. Benefits for the device when deployed on new batteries are harder to measure, because of the need to track data on (at least) two identical new battery systems over a long period of time. However, the benefits that I observed on my old batteries suggest that the balancer is also well advised for new installations. **BattEQ** is not a cure for cancer, but it changed the behavior of my test batteries in important ways. Needless to say, I plan to specify **BattEQ** for all my energy system designs from now on.

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