MY TOTAL STATION BATTERY HAS ALZHEIMER'S... And That's a Good Thing!!

By Arthur Dias, B.Sc.

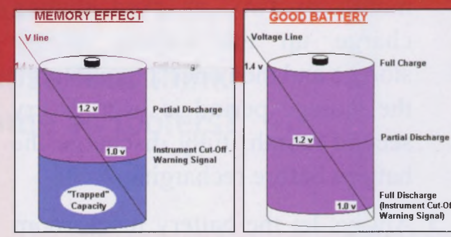
How many times have you heard the phrase, *"My battery pack is holding a memory?"* Being in the battery business, this is something we hear all the time. This term is used to explain the tendency of a rechargeable battery to remember the point up to which it was discharged over several cycles, before full discharge was attained. Subsequently, the battery behaves as if this point is the point of full discharge. This is a generally misunderstood phenomenon and a term often misused to explain various battery problems. There are many scientific and theoretical explanations for why rechargeable batteries behave poorly at times. But in a practical sense, these problems can be analyzed and addressed without having to have a degree in chemical engineering. So, if your battery has "Alzheimer's," based on the explanation above; it's a good thing.

"Memory Effect" is essentially caused when a rechargeable battery is recharged to full capacity, and then used in the field to a point where the battery never reaches full discharge before being placed on recharge again. For argument's sake, let's imagine a battery being a container of sugar, where you fill it up and then use what you need before refilling it again. If you constantly use only the top portion of the container and refill it with new sugar, the remaining portion you have not touched in a while begins to get stale. The same is true for a battery. The remaining charge, that you never allow the instrument to access, over time starts to stagnate.

Initially, the charge in a battery is at a uniform voltage throughout the cells. The voltage begins to drop immediately after removal from the charger. If all the charge in the battery is not consumed before recharging, the portion that is left unused continues to drop in voltage and becomes "stale." Eventually, the voltage in this "stale" portion drops so low that when your instrument is finished gobbling up all the "fresh" charge, it hits this "stale" portion like a brick wall. The instrument is confronted with a sudden drop in voltage, at a level below the "low battery" indicator threshold. The battery cannot power the instrument now without being recharged again.

The only way to recover the performance of the battery is to somehow remove that "stale" charge in the battery and restore a fresh new charge. Unfortunately, some total station manufacturers have designed their instruments and chargers in a way that makes it almost impossible to correct this problem. Chargers with a "discharge" function built in may not work to correct the problem at this point either. The low voltage point of stale charge will also cause the discharge operation to cease prematurely, leaving the stale charge still in the battery. In a case like this, a battery service shop with the proper equipment, can analyse the battery, remove the stale charge and solve the problem.

Trying to live with the problem will only make it worse and can actually ruin the chances of correcting the problem at all. Just like the container of sugar example, eventually this stale part will become so solid and entrenched in the battery that it will permanently ruin that part of the battery and diminish its ability to accept a usable charge again. What also appears to happen is that the portion of the battery that is able to receive a fresh charge now goes through



many rapid cycles and in effect "wears out" that portion of the battery prematurely. You are now left with a container of hard packed stale sugar at the bottom, with the top part of the container so worn out that it can barely contain the new sugar that you keep replenishing it with.

Here are several things that can be done to avoid this problem. Some I am sure you have heard before, but they are still worth repeating.

1. Always fully discharge the battery each time you use it in the field. Number all your batteries and learn the run-time of each one through regular use. If you still carry enough battery power with you for the next day's work, wait and use that all up before recharging again. Always avoid recharging any batteries that have not been fully run down.
2. At the first sign of a sudden decrease in performance, set that battery aside until returning to the office. At the office, put this problem battery back into the instrument and set the instrument on a heavy battery demand operation (like "tracking mode" measuring against a prism). Now run the instrument to the point where it shuts off on its own from lack of battery power. Wait five minutes and repeat the procedure. Repeat this until you feel the instrument has drained as much as possible from the battery. Now put the battery on charge (preferably a slow charge, if your charger has that setting).

3. If storing the instrument away for a week or two, do not recharge the battery until the night before it is needed in the field again.

4. If storing the instrument for a month or two, or even longer, charge up the battery before storage and then once a month until the storage period is over. Every second month, fully discharge the battery before recharging.

5. Always let the battery reach room temperature before recharging. Excessively cold batteries will resist being charged and actually fool auto shut-off chargers into thinking the battery is fully recharged when in reality it is not. When the battery is not allowed to fully recharge over many cycles, you may end up with the same problem as the "memory effect."

Within the last few years, many instrument manufacturers have switched to Nickel-Metal Hydride (NiMH) cells in their battery packs instead of the old industry workhorse, NiCd. The main advantage of NiMH cells is their ability to hold much more charge in the same size cell as the equivalent NiCd and they are more environmentally friendly as well. NiMH cells have also been touted as not having the memory effect problem of the NiCd cells. However, our experience has shown that this is not always the case. Although they may resist the effect from taking hold as easily as NiCds, the same maintenance procedure should be followed…always fully discharge the battery before recharging again. NiMH cells also have one big drawback compared to their NiCd counterparts - their internal resistance is higher.

The internal resistance of a cell will govern how readily it will accept a charge when applied, and how easily it will release that charge while maintaining its voltage when required to do so. Internal resistance also explains why NiMH battery packs sometimes get much warmer during recharge than NiCds. Since internal resistance is a problem that gets worse with the age of the cell for both NiCd and NiMH, designing the instrument and charger to meet these demands is a difficult balancing act with some manufacturers having done a better job at it than others.

A NiMH charger that is designed to charge the battery in a 10 to 14 hour period will always do a better job of topping up the battery than a charger that is designed to do it in 2 to 3 hours. The internal resistance of the battery will always force the charger to apply a higher voltage during recharging to overcome the resistance. This resistance is more pronounced during a fast charge procedure than during a slow charge. Eventually the charger is forced to such a high voltage that it assumes the battery is recharged and shuts off, never recharging the battery to its full potential. As the NiMH battery gets older, the problem gets worse. It is always best, if your field working procedure allows for it, to choose a slow overnight charger cycle. Many OEM chargers for NiMH cells offer both fast and slow charge cycles. Also, chargers that monitor the internal temperature of the battery during a fast charge seem to do the best job of recharging the NiMH batteries quickly.

Another point worth mentioning is the idea of replacing old NiCd cells in a pack with NiMH cells, during a re-cell procedure. This is only recommended if you have just that one battery to run your instrument. You must also be prepared to accept that NiMH cells do not maintain original performance through as many cycles as NiCd cells. But since the NiMH cells start out with the ability to hold much more charge than their NiCd counterparts, the advantages of the NiMH cells are still something worth considering. Unfortunately, your old NiCd charger may never properly recharge the NiMH cells to their full potential because it was not designed for the different requirements of the NiMHs. Even at less than 100% performance, however, the greater capacity of the NiMH cells will generally be realized if that battery is properly maintained from the beginning. In reality though, many users will just add this NiMH battery into a mix of other NiCd batteries being carried into the field for the instrument. Our experience has found that in short order, the NiMH battery will get "lazy" and settle into a performance that is no better than if it had been re-celled using NiCd cells. The advantages of converting to NiMH cells over the original NiCd cells would be lost, not to mention, this "misfit" battery pack now has a diminished life cycle.

The final bit of advice I can give is similar to the advice that we often get from our own doctor: **Batteries stay healthier through regular exercise on a daily basis!**

Arthur Dias is a founding partner of Dias & Dias Electronics and **www.batteryrevival.com.** His company has been repairing battery packs for surveying equipment worldwide for over 11 years.

Sites to See

Microsoft's new Virtual Earth
http://maps.live.com/

Live Search is a free online local search and mapping service that combines road and aerial maps worldwide plus unique bird's eye imagery for select areas. You can also explore the world through maps in 3D view. Use Live Search to learn about, discover, and explore a specific location with the advanced driving directions, traffic information, local listings, and other local search tools.