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Battery expert comments on DIY NiCd battery pack replacement strategies

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Readers had a variety of suggestions for the **best way to upgrade/replace/recycle** the old NiCd battery pack from a still-usable Makita drill.

I asked the folks at battery pack designer **Nexergy** to read your comments and respond, specifically to the comments addressed the pros and cons of replacing the NiCd cells with NiMH cells. Here are some excellent suggestions from **Chris Turner, director of battery technology at Nexergy** – and make sure you read all the way to the end and click on the link to find out more about Nickel Zinc “green” replacement cells for NiCd.

To some degree, Nickel Metal Hydride (NiMH) is interchangeable with Nickel Cadmium (NiCd) — with caveats. The issues related to replacing NiCd with NiMH are the charge methods, the discharge characteristics (specifically rate capability) and then the effect of both on cycle life.

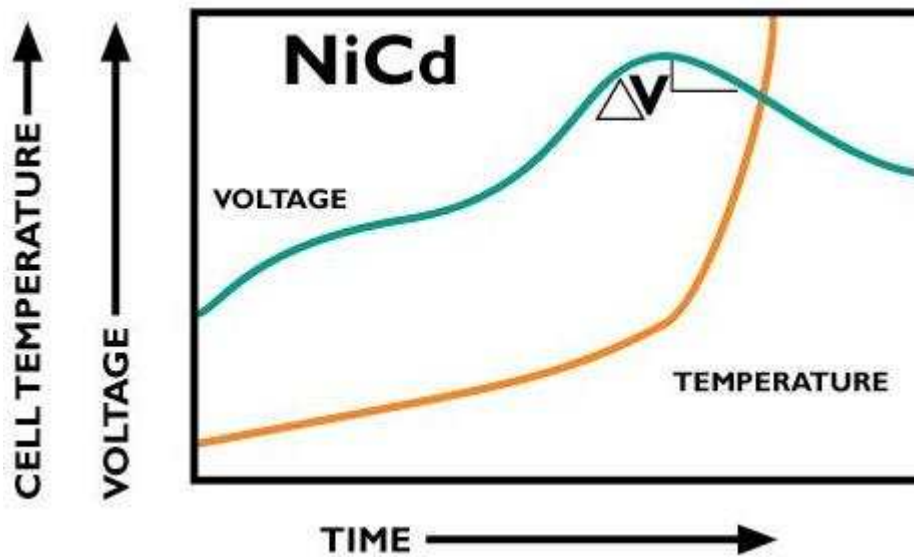
The rate capability is perhaps the most pertinent question. Consider the specs of one of the leading manufacturers of NiCd and NiMH. The NiMH AA-cell has an impedance of 25milliohms, while the NiCd Sub-C has an impedance of 6 milliohms. While NiMH AAs could show an initial improvement over the older, well-spent NiCd battery — particularly if using more AAs (in parallel), as one reader implied — they are not inherently lower in terms of impedance.

While the impedance is a factor, another important issue is the cell's ability to transfer the ions quickly and keep up the electrochemical reactions at the rate demanded by the device. The NiCd Sub-Cs were designed for just this task (thinner and higher surface area electrodes, more conductive electrolyte, etc). They can support the rates necessary for power tools without stress or damage to the cell's system.

The NiMH AA-cells found on retail shelves are optimized for energy density (capacity). They suffer from lower cycle life compared with the original equipment-type cells. The cycle life of a NiCd Sub-C is three to five times that of a retail-type NiMH AA-cell. With the additional “abuse” of discharging at high rates, the life of the common NiMH cell is significantly shortened and ultimately disappointing.

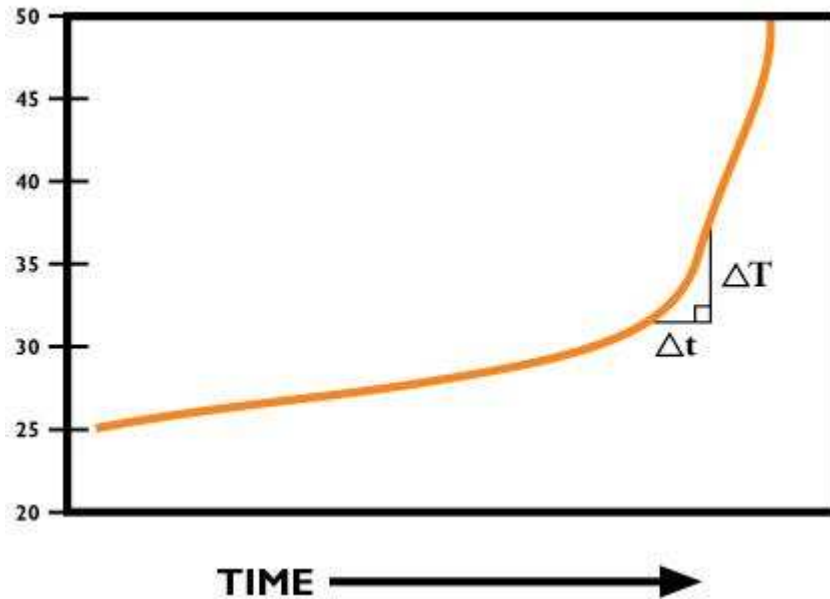
There is a power-tool class of NiMH cells available today. However, these cells are typically available direct only to a battery pack manufacturer or device OEM and are not the type typically found in a retail store. (High-rate-capable NiMH cells may be available from Internet battery wholesale sites. The buyer should verify that those available are the high-rate NiMH cells.)

Of particular concern regarding charge methods is that of charge termination. Both NiCd and NiMH can be charged with constant current, and both have a similar rise in voltage and temperature as they approach full charge, although the NiMH voltage peak is less pronounced than the NiCd peak.



The most common method for terminating charge for NiCd is typically referred to as Negative Delta V. You try to capture the point at which the voltage comes down from its peak by a prescribed amount (usually 5-10mV/cell). Because of NiCd's tolerance for overcharge, older versions of chargers may employ a timed charge using a C/10 charge rate for 16 hours or simply a low-rate float charge indefinitely.

The recommended method for charging NiMH is the dT/dt method (change in temperature with respect to time) that is typically set to 1-2degC rise per minute, at which point the charge is terminated.



Going beyond this point is considered overcharging NiMH. While NiMH can accept some overcharge, going to a Negative Delta V termination will typically cause faster degradation and reduction in cycle life (again going in the wrong direction). As one of your readers pointed out, purchasing a NiMH charger would be recommended. As all of us at Nexergy can tell you, there are practical concerns in terms of assembling the battery pack. Not too many people have resistance welders at home to weld tabs from cell to cell to get the low-resistance welds you need for a supplying a high-discharge rate. Our recommendation is to visit your local Batteries Plus or similar outlet and ask if it carries a NiMH replacement for your battery and appropriate charger. Some locations may also have the capability to take your old battery and replace it with the appropriate NiMH cells. (If nothing else, it is just plain fun to go into a store that sells nothing but batteries.)

A "green" technology that should be available soon to do-it-yourself-minded folks is the Sub C cells utilizing Nickel Zinc commercialized by PowerGenix. These are replacements for the NiCd Sub-C cells that were designed for these high-rate applications. For more information, go to:

<http://www.powergenix.com/docs/powergenix-specs-c.pdf>