Advanced Battery Studies

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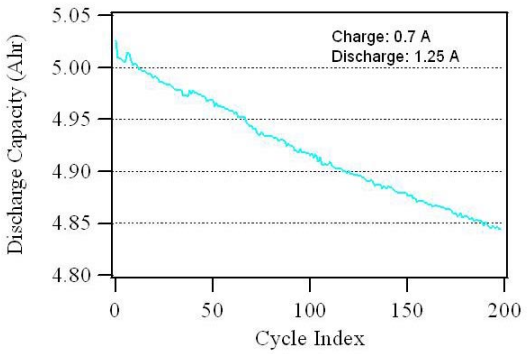
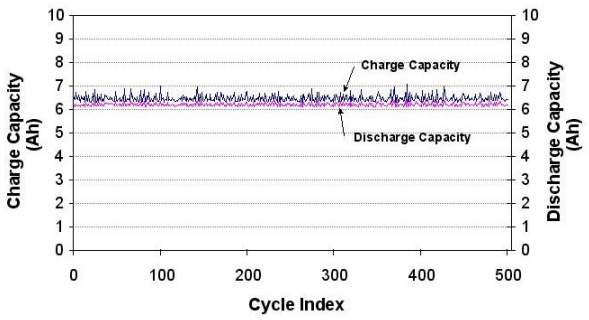
The Johnson Space Center (JSC) Battery group has an advanced battery and cell studies program that includes testing of state-of-the-art commercial off-the-shelf (COTS) battery chemistries. Each year, a few battery cells are chosen from different manufacturers for study to determine their performance and safety characteristics. The data obtained are added to a database that can be accessed when the requirement for power systems is needed. These studies also constitute methods of understanding not only the attributes of the cells but the issues encountered that will help improve the battery design. The cells tested in fiscal year 04 were mostly of Li-ion polymer type cells and two NiMH cells. An update to the testing on COTS alkaline cells was also performed.

The Li-ion polymer cells under test were Kokam, Emerging Power, GlobTek, Valence, and SKC. Of the cells tested, minor issues observed included cell-tab breakages, capacity retention during storage, and swelling under vacuum conditions. On the other hand, cells from SKC exhibited excellent shelf-life capabilities and provided capacities that were above the manufacturer's specification even after 18 months of storage. Testing included cycle life studies under various rates of charge and discharge, performance at different temperatures, internal resistance measurements, performance under vacuum conditions, and burst pressure test of the pouch cells. It was observed that the capacity retention was most marked for restrained cells than for unrestrained pouch cells.

The NiMH cells studied were from SAFT (8.5 Ah) and Panasonic (6.5 Ah). The Panasonic NiMH cells are currently being used in the Honda and Toyota hybrid vehicles. The cells were subjected to life cycle, thermal, vent, and burst pressure and effective internal resistance tests. A significant observation on the Panasonic cells was that, at the end of 500 cycles, the capacity of the cells under test increased by 4.3% for the constant current charge protocol and by 1.7% for the burp



Life cycle test on SKC 5.0 Ah Li-ion polymer cells.

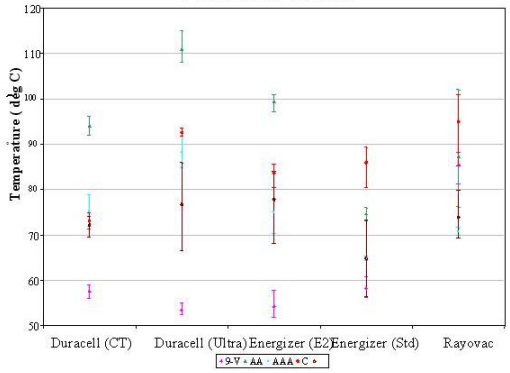


Capacity change for the Panasonic 6.5 Ah NiMH cell with a burp charge method.

charge protocol, proving that 500 cycles did not affect the cycle life of the cells in a significant manner.

The alkaline cells obtained from different manufacturers varied in size from AA to 9V sizes and were subjected to discharges at various rates, external short circuits, over-discharge, heat-to-vent, and vibration. The temperatures obtained during an

external short circuit test were as high as 110 C for AA alkaline cells. This led to changes in the requirements for noncritical batteries that, in the past, included the use of up to six alkaline cells of any size in series or parallel configurations. The change reflects a limitation on the number of cells that can be used in a parallel configuration for it to fall under a noncritical battery category.



Temperatures recorded for external short circuit tests on various alkaline cells.