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High Energy Density Gel Polymer Battery for Military Applications

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The use of lithium ion polymer rechargeable batteries (LiPBs) is expected to expand rapidly due to their unique properties such as high energy density, good safety characteristics, and flexibility in the design of the battery [1]. Ultralife has been working on the Bellcore type polymer battery since 1994. However, several technical hurdles such as swelling and high self-discharge rates prevented Ultralife from commercializing this product. Recently, Ultralife has modified the traditional Bellcore technology and incorporated a gel polymer electrolyte and new cell design. The new gel polymer cells will be assembled into the BB-XX90 battery packs to evaluate the electric performance and safety features.

Gel polymer electrolytes play a major role in the improvement of safety and design flexibility when compared to liquid electrolyte systems [2]. However, most LiPBs with gel polymer electrolytes suffer from high-rate and low-temperature performance flaws due to the decreased conductivity of the gel polymer electrolyte [3]. Ultralife is in the process of designing and developing a new lithium ion polymer rechargeable battery for use in military applications. Today's military batteries must meet stringent requirements, possess high energy density, and perform well in a variety of environments. One of the most challenging performance issues for a lithium ion polymer rechargeable battery is its performance while enduring desert-like high and very low temperatures. Cell design and electrolyte formulation directly affect cell performance characteristics such as long-term cycle life, low and high temperature capabilities, and impedance growth.

Cells (34mm x 106mm x 102mm, w x l x h) were prepared using the commercial $LiCoO_2$/MCMB chemistry. Celgard 2320 separator was used for our experiments and the cells were manufactured using a special folding configuration. The cells made with the new gel polymer electrolytes exhibit excellent properties such as energy density (195 Wh/kg , 430 Wh/L), high/low temperature performance, long-term cycling ability (Fig. 1), safety features, and rate capability. The desert cycle results are shown in Table 1. The details of all of the above results, as well as safety assessments, will be discussed.

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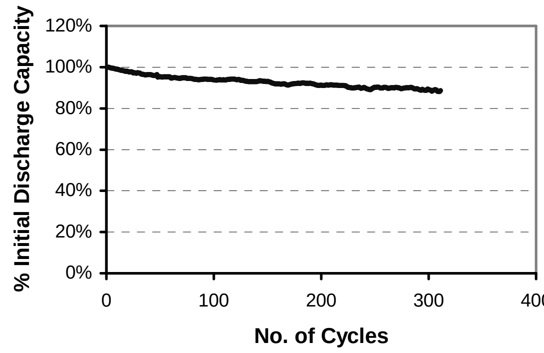

Figure 1. Long term cycling at 1C rate of a typical Ultralife lithium ion polymer rechargeable cell.

Table 1. Low temperature and desert cycle performance data for typical gel polymer cells.

Low Temperature			
	Discharge Capacity/claimed capacity (0.2C)		
Electrolyte	**-20 deg. C**	**-30 deg. C**	**-40 deg. C**
Liquid	69%	30.90%	2.40%
Gel Polymer	79.80%	55.30%	5.10%
Desert Cycle Test Results (28 days)			
Electrolyte	**Standard Loss**	**IR C**	**IR C/5**
Liquid	24.0%	50%	15.5%
Gel Polymer	26.0%	45.50%	18.5%