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NEAR-TERM BATTERY SUPPORT

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The objective of this program is: (1) to provide a facility for testing cells and batteries at various stages of development in accordance with contractural requirements with DOE battery developers, (2) to provide a centralized and independent facility for characterizing, quantifying, and comparing the performance of various brands and types of batteries under the same operating conditions, (3) to verify performance of batteries under simulated operating conditions prior to application demonstrations, (4) to provide data for battery analysis and modeling, (5) to perform charging studies, (6) to provide battery support research on topics of fundamental interest to battery developers, and (7) to provide organizational and logistic support to the National Battery Advisory Committee (*ad hoc*).

During 1978 the National Battery Test Laboratory (NBTL) became operational to accommodate the testing program in support of the Near-Term Battery Development Program. Testing activity for the period from January 1978 through June 1979 included:

Developer	System	Number of cells
ERC	Ni/Zn	19
Gould	Ni/Zn	12
Yardney	Ni/Zn	16
ESB	Lead–acid	12
Globe–Union/GE	Lead–acid	6
Globe–Union	Lead–acid	5

Ranges of results obtained for the above tests were as follows:

System	Specific energy (W h/kg)	Energetic efficiency (%)	Cycle life (cycles)
Lead–acid	35 - 41	72 - 87	32 - TBD
Ni/Zn	32, 62, 64	73 - 80	14 - 120

Two significant phenomena were discovered in Ni/Zn modules during the course of this testing program, one was a pseudo-memory effect and the other was an observation that the temperature rise at a given rate of discharge appears to be proportional to the specific energy of the module. The pseudo-memory effect relates the prevailing maximum capacity available from a Ni/Zn battery at any given time to the capacity that was previously utilized. In practice, the maximum capacity of the module may not be achievable for several cycles following a series of shallow discharges.

Simplified simulated driving profiles were also developed and have been applied in the testing of lead–acid and Ni/Zn cells and modules.

The work being carried out by the Near-Term Battery Support Research Group is directed primarily toward research projects of fundamental interest and application to the development of ambient temperature batteries. The work carried out during 1978 and the first half of 1979 included the following mathematical modeling and experimental studies:

(A) The potential distribution over two dimensional rectilinear electrodes was modeled and extended to model three dimensional cell systems. This latter work included the determination of the three dimensional variations in electrode reaction rate as a function of factors such as electrode configuration, component conductivity and electrode porosity. As a continuation of the earlier thermal modeling studies of lead–acid batteries, the thermal behavior of nickel/zinc batteries was calculated.

(B) Experimental studies on the passivation behavior of zinc electrodes was carried out to determine the effects of changes in electrolyte composition and electrode orientation. Studies are being done on a novel simulated porous electrode. (It consists of several layers of perforated sheet metal which are insulated from one another.) The results indicate a very shallow reaction zone for the zinc electrode (of the order of 80% of the reaction taking place within the first 0.1 mm depth).

(C) A third area which is now being studied is the effect of periodic current reversal or interruption, during the overcharge period, upon SbH_3 and AsH_3 generation in lead–acid batteries.

The services of MERADCOM, Ft. Belvoir, Virginia, were procured to initiate studies to provide a quantitative assessment of the impact of thyristor and transistor battery chopper operation on battery performance, and to determine the physical impact of pulsed loads on the internal components of electric vehicle batteries. X-ray diffraction and microscopic examination of the active material of lead–acid battery plates after cycling, with and without high current pulsed discharges, indicated that pulsing might be responsible for a definitive accumulative and detrimental effect seen in the pulsed positive plates, and that it might also slightly change the negative plates in a manner that could have a beneficial effect.

The testing capability of NBTL will be expanded to provide for 36 cell/module and eight (8) full size electric-vehicle battery pack test stations. In addition, cooling and heating chambers will be installed to allow battery testing over a range of temperatures. A more sophisticated simulated driving profile system will be implemented. Studies will continue on potential distribution, modeling and experiments for multidimensional electrodes, the thermal behavior of nickel/zinc batteries, the passivation behavior of zinc electrodes, the effects of periodic current reversal during overcharge upon SbH_3 and AsH_3 generation in lead–acid batteries, and other projects in response to needs expressed by battery developers.

Recent publications

From last reporting period

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