

RESEARCH, DEVELOPMENT AND DEMONSTRATION OF LEAD-ACID BATTERIES FOR ELECTRIC VEHICLE PROPULSION

ELTRA Corporation, C&D/Prestolite, EV Group, Plymouth Meeting, PA 19462 (U.S.A.)

The objective of this program is the development and demonstration of improved state-of-the-art and advanced lead-acid batteries suitable for application to electric vehicle propulsion. The final goal is a practical lead-acid electric vehicle battery which meets the technical, economic, and ecological goals, and which is acceptable for installation and demonstration in electric vehicles.

The work was initiated in April 1978. Since the beginning of the program, a complete product package has been generated for the initial ISOA design which includes a full set of engineering drawings, bill of materials, process specifications, and analytical and fabrications procedures. The ISOA design was reviewed with ANL in July 1978.

An electric vehicle battery pilot line capable of producing 10 000, 96 volt batteries per year was designed and installed. Commissioning of this line is in the final stages.

Several groups of ISOA modules based on the ELTRA design were constructed. One of the versions has been submitted to NBTL for testing and evaluation.

A facility for the automatic testing of electric vehicle modules was designed and placed in operation. Test procedures for evaluating vehicle modules and batteries were written.

A comprehensive advanced battery development program was formalized in a series of experiments, each addressing areas of lead-acid battery technology where potential weaknesses may exist or where avenues of performance improvement appear promising. The advanced program is being conducted in parallel with the ISOA program. The objective is therefore twofold: (1) to verify the design of the ISOA battery, and (2) to improve performance to meet the program's advanced battery goals, especially with regard to energy density and cycle life.

Special reports were prepared covering materials' availability, safety, recyclability and environmental impact matters associated with the manufacture of electric vehicle lead-acid batteries. The C&D Batteries' Quality System Program Policy Manual was submitted to ANL for review and was accepted. A QA plan was also submitted for their review and acceptance.

The major challenge is to attain this program's advanced battery goals for both capacity and cycle life simultaneously. Although deep-cycling, motive-power batteries with cast lead-calcium grids have been successfully marketed by ELTRA's industrial battery division, the performance of the expanded-metal in high energy-density plates under a high discharge rate condition remains to be demonstrated. A key feature of ELTRA's program is to transfer the benefits that accrue from the continuous expanded metal process used in automotive battery production to the manufacture of electric vehicle

batteries. We have addressed the challenge by employing a cell design that is not limited by the positive plate, in order to prolong its life. Reserve capacity fall-off with increasing cycle life has not been observed with initial electric-vehicle modules as compared with automotive batteries with similar construction. Thus, this approach appears feasible.

Future work will be to:

(a) Complete commissioning of the electric vehicle pilot line. Sufficient electric vehicle ISOA modules and batteries will be produced to establish production quality, unit costs and production and electrical production confidence levels.

(b) Expand the electric vehicle module and battery testing facilities to provide more testing circuits for the additional R&D and battery production programs.

(c) Continue the advanced battery R&D program with particular focus on increasing energy density and cycle life.

Recent publications

- 1 C. J. Venuto, Lead-acid developments, in collected program visual aids of *Second Annu. Battery and Electrochem. Technol. Conf., June 5 - 7, 1978, Arlington, Virginia*, sponsored by the U.S. Department of Energy Storage Systems, published May, 1978.
- 2 R. M. Meighan, Rationale for use of expanded grids in battery plates, paper presented at the *Fall Meeting of the Electrochemical Society, Pittsburgh, Pennsylvania, Oct. 15 - 20, 1978. Extended Abstracts of 154th Meeting*, No. 101, p. 269.
- 3 C. W. Fleischmann, Electric vehicle battery development, *SAE Tech. Paper Ser. No. 790158, presented to the Society of Automotive Engineers' Congress and Exposition, Cobo Hall, Detroit, Michigan, Feb. 26 - Mar. 2, 1979.*
- 4 D. P. Boden, C. W. Fleischmann and J. P. Badger, Development of expanded metal grids for electric vehicle propulsion, *ACS/CSJ Chemical Congress, Honolulu, April 1 - 6, 1979, Paper No. INDE 99.*

RESEARCH, DEVELOPMENT AND DEMONSTRATION OF LEAD-ACID BATTERIES FOR ELECTRIC VEHICLE PROPULSION

ESB Technology Company, 19 W. College Ave., Yardley, PA 19067 (U.S.A.)

The contract has been divided into two phases, namely, development of Improved State of the Art (ISOA) and Advanced Lead-Acid Batteries. Key technical goals are:

	ISOA	ADVANCED
Specific energy W h/kg @ 3 h rate	40	60
Specific power (W/kg)	100	150
Life cycles @ 80% depth of discharge	800	1000
Volume price \$/kW h	50	40