carbon based air electrode structure are planned further to clarify and identify the means and methods for upgrading the performance and life of future electrodes.

Recent publications

1 E. S. Buzzelli, Iron–air battery development program — Interim report, June 1976 - June 1977, *Report No. COO/7949-1, November 1978.*
2 W. A. Bryant, C. T. Liu and E. S. Buzzelli, Iron–air battery characteristics, *28th Power Sources Symp., June 12 - 15, 1978, Atlantic City, NJ.*
3 E. S. Buzzelli, C. T. Liu and W. A. Bryant, Iron–air batteries for electric vehicles, *13th Intersoc. Energy Conversion Engineering Conf., August 20 - 25, 1978, San Diego, CA.*
4 C. T. Liu, Wet-proofing of air electrodes for use in alkaline electrolytes, *154th National Meeting Electrochem. Soc., Oct. 15 - 20, 1978, Pittsburgh, PA.*
5 E. S. Buzzelli, Iron–air batteries for electric vehicles, *154th National Meeting Electrochem. Soc., Oct, 15 - 20, 1978, Pittsburgh, PA.*
6 W. A. Bryant and G. D. Leap, Electrochemical half cell performance of sponge iron electrodes, *154th National Meeting Electrochem. Soc., Oct. 15 - 20, 1978, Pittsburgh, PA.*
7 E. S. Buzzelli and W. A. Bryant, Fe–Air, *Metal–Air Batteries Project Workshop, DOE, April 10 - 11, 1979, Washington, DC.*
8 E. S. Buzzelli, W. A. Bryant and C. T. Liu, Iron–air battery development, Interim Report, June 1977 - June 1978, draft in review.

REACTIVE METAL–AIR BATTERIES FOR AUTOMOTIVE PROPULSION

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The objective of this 15-month contract is to develop potential battery systems for use in automotive propulsion application. The systems to be evaluated include the alkaline lithium–water–air and alkaline aluminum–water–air batteries. The lithium–water–air development program will result in the design, construction, and demonstration of a 500 cm^2 cell, followed by the construction of a six-cell power module. The aluminum–water–air assessment program will reveal critical system parameters through laboratory and subscale cell testing with subsequent design, construction, and evaluation of a 1000 cm^2 cell.

During fiscal year 1978 - 79 a program is being conducted to examine the operational characteristics and determine the technical feasibility of the lithium–water–air and aluminum–water–air battery systems as applied to automotive propulsion power sources. The effort is concentrated in three areas: (1) design, construction, and evaluation of a 500 cm^2 lithium–water–air cell with subsequent expansion to a six-cell module; (2) design, construction, and evaluation of the operational characteristics of a subscale (50 cm^2)

aluminum–water–air cell, with associated laboratory studies of anode behavior; (3) design, construction and evaluation of a 1000 cm^2 aluminum–water–air cell as a prototype for an automotive propulsion system.

Evaluation of the lithium–water–air cell revealed several problem areas: (1) the anode/cathode separator produces a large pressure drop across the electrode face; (2) most air cathodes cannot meet the requirements of large pressure differential, high electrolyte flow rate, ambient temperature operation, and high current density; (3) the inefficiency of the air cathode is manifest in uneven current distribution on the anode with subsequent decrease in power and overall efficiency; (4) electrolyte flow distribution is critical to the efficiency of the lithium anode.

The high electrolyte pressure drop has been resolved by modifications in the dimensions of the separator and thus the extreme conditions faced by the cathode have been reduced. Air cathodes are now available which possess the required durability and electroactivity. These more efficient air cathodes will eliminate the uneven current distribution and increase the efficiency of the anode.

In the last quarter of 1979, cathodes specifically developed for this application will be tested in an improved 200 W, 500 cm^2 cell and a six-cell, 1.2 kW, module will be fabricated and tested.

Under the aluminum–water–air program electrochemical evaluation of the behavior of a variety of candidate aluminum alloys has been conducted. From this evaluation a small group was chosen for testing in the subscale cell under typical system operating conditions.

A subscale cell has been used to generate data for a parametric analysis of the aluminum–water–air cell and to reveal optimum operational conditions. The optimized system includes a very active aluminum alloy in an electrolyte comprised of 6M NaOH, 1M $Al(OH)_3$, and 0.05M Na_2SnO_3. The $Al(OH)_3$ and Na_2SnO_3 both serve to reduce the corrosion rate of the alloy, $Al(OH)_3$ is the dissolution product of the alloy. The performance of the system has been shown to be unaffected by electrolyte flow rate over a wide range. A nonrestrictive flow channel/separator is employed between the anode and cathode. A constant electrode separation is required to minimize *IR* losses. The operational temperature of the cell is 55 - 65 °C. Problem areas which have been investigated include uneven flow distribution, and cathode performance. The problem of flow distribution was resolved by design changes, and the cathode performance is being improved by formulation and sintering modification.

The aluminum–water–air subscale cell has been operated at a peak power density of 0.378 W/cm^2 at 425 mA/cm^2 and exhibits a nominal operating voltage of 1.3 V at 0.23 W/cm^2 and 175 mA/cm^2. In the last quarter of 1979 and in 1980, a 1000 cm^2 aluminum–water–air cell will be developed under the follow-on-contract beginning in July. This prototype cell will be evaluated and, from the test results, a 2000 cm^2 cell module will be designed. This design will be used for subsequent development of an operational multicell module in 1980.