AUSTRALIAN EV BATTERY PROGRAMME*

D. F. A. KOCH
CSIRO, Division of Mineral Chemistry, Port Melbourne, Victoria (Australia)

Introduction

At present, Australia is 70% self-sufficient in oil, but by the end of the decade this figure is expected to be only 50%. For this reason, the Australian Government established a number of bodies to develop national energy policies and to provide funding for projects associated both with conserving liquid fuels and also encouraging the use of alternative forms of energy. Initially, the National Energy Advisory Council (NEAC) was set up to advise on policy and subsequently the National Energy Research, Development and Demonstration Council (NERDDC) was established to recommend the funding of selected projects from the many proposals received. Both these bodies report directly to the Minister for National Development and Energy in the Federal Government.

NERDDC activities

In the 1978/79 year, NERDDC allocated A $14 M of funds: 31% to the Private Industry Sector, 34% to Tertiary Educational Institutions and 35% to Federal and State Government Instrumentalities. In 1979/80 the funding for projects submitted by the Private Sector was raised to 51% of the total in order to encourage the prospects of commercialization.

NERDDC has identified high priority areas as follows:

Conservation of liquid fuels.

Technology of discovery and exploration and recovery of oil and gas.

Liquid fuel alternatives to petroleum, *e.g.*, methanol, ethanol, oil from coal.

Substitution of other fuels and energy sources, *e.g.*, solar sources.

Improvement in the exploration, production, and utilization of coal.

Electric vehicles and battery technologies.

Remote area applications of solar energy.

*Paper presented at the NERDDC Workshop on Power Sources for Electric Vehicles, Adelaide, August 23 - 25, 1980.

0378-7753/82/0000-0000/$02.75

Environmental effects of coal and uranium mining.
Uranium enrichment.

A number of Standing Committees has been appointed to assess the proposed projects and those considered worthy of support are recommended to the NERDDC Council and thence to the Minister for National Development and Energy. Technical Standing Committee No. 7 (TSC7) examines research projects in the area of the conservation of liquid fuels which covers studies of driving patterns, alternate liquid fuels and electric vehicles. The last named area includes support for the development and demonstration of both electric vehicles and traction batteries.

NERDDC sponsored EV projects

Two research groups are developing electric vehicles in Australia with NERDDC support.

The Electric Vehicle Project at the Flinders University of South Australia is concerned with the conversion to electric power of a Bedford CF350 1-tonne delivery van. Research and development covers a wide scope: from control, motor, and transmission, through to battery and energy storage methods. The drive-line for the van is based on the Modulinear® technology and the motor assembly uses a printed-circuit d.c. motor. The South Australian Department of Mines and Energy is now coordinating the developments required to carry out in-field demonstration trials.

Work at the University of New South Wales has resulted in the conversion of two 1-tonne Bedford CFL vans to an a.c. induction motor drive (IMP) system. Control over the squirrel-cage induction motor is achieved through the use of a programmed microprocessor system. The IMP system was initially developed at the Tasmanian College of Advanced Education. Commercial interests are now involved in developing the microprocessor control system.

Another NERDDC-sponsored project is designed to optimize a mixed drive system and is being carried out at the University of Queensland. Through the development of energy-efficient combinations of internal combustion engine, flywheel and battery storage systems, the project seeks to reduce fuel consumption rates to at least half of those obtainable by conventional power trains.

NERDDC sponsored EV battery projects

For the period 1978/81, up to A$0.5 M was allocated towards EV battery research, mostly in the form of three-year contracts.

The Flinders University of South Australia is receiving support for a project to assess the influence of electrolyte composition on the energy density, cycle life and shelf life of the $Pb-PbO_2$ system. The use of electro-

lytes such as aqueous ammonium sulfate and ammonium sulfate–sulfuric acid mixtures has resulted in an increase in the coulombic capacity of the negative electrode but has had an adverse influence on the positive electrode. A technique has been developed for producing a PbO_2 surface with reproducible properties on smooth lead. The possibility of using circulating lead and lead dioxide slurries in a battery is being examined in a diaphragm cell to estimate the maximum currents obtainable with this system.

Two battery programmes are being funded at the CSIRO Division of Mineral Chemistry. A project entitled "Advanced Batteries for Traction" is aimed at improving the performance of alternative systems to lead/acid which have higher energy densities, *e.g.* Ni/Zn and Li/organic electrolyte systems. Complete cells have been tested using specially constructed zinc electrodes with commercially produced separators and nickel electrodes. Dendritic growth can be minimized by an excess of zinc oxide, and an understanding of the mechanism of shape change is developing. Lithium batteries using organic electrolytes are being studied with special emphasis on the cycle life of the lithium electrode in different electrolytes and the capacity of positive electrode materials such as TiS_2 and V_6O_{13}. As part of this project Murdoch University has been sub-contracted to identify suitable electrolyte/solvent combinations.

The other project receiving NERDDC support at the CSIRO Division of Mineral Chemistry is entitled "Optimization of an Electric Vehicle Lead Battery System". The object of this programme of research is to determine the influence of actual electric vehicle service on the performance of lead/acid traction batteries. The duty cycle of the IMP delivery van (*v.s.*) operating in an urban Australian environment is simulated under electronic control in the laboratory, and a study is being made of the effect of a number of operating parameters on the nature of the electrochemical, crystallographic and morphological processes that limit the capacity and cycle life of the lead–acid battery.

The research supported by NERDDC, which has only been in existence since 1978, has been exclusively mentioned. The Australian lead/acid battery industry has a long history of contributions to the improvement of the lead/acid battery ranging from the use of plastics in commercial battery production to the recent radically different method of construction of plates in the "Pulsar" battery developed by Dunlop Batteries. This latter achievement has resulted in a dramatic decrease in the size and weight of the SLI battery. Although EV batteries for in-plant use (*e.g.*, forklift trucks, underground mine locomotives, etc.) are produced in Australia, research in this area is lacking within the industry. NERDDC is eager to encourage industrial research in traction batteries with particular emphasis on applications where compatability with existing traffic patterns is a requirement.