

## RESEARCH, DEVELOPMENT AND DEMONSTRATION OF A NICKEL-ZINC BATTERY FOR ELECTRIC VEHICLE PROPULSION

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The objective of this effort is to develop improved Ni/Zn batteries and to verify their performance by demonstration in electric vehicles. Key technical goals for 1979 are an energy density of 65 W h/kg, a peak power density of 130 W/kg, and a cycle life of 200 cycles. The first phase of this R&D work concentrated on (1) defining the major life limiting factors, including zinc shape change, dendrite propagation, and separator decay; (2) production of high-performance and cost-effective polymer-bound nickel electrodes; (3) sealed-cell operation; (4) charging and charge control.

A zinc electrode produced earlier in this program was used as a base for further improvements. This electrode exhibited an area reduction of 48% due to shape change at the 100th cycle. About 6 months into the program, a Zn electrode containing  $\text{Fe}_2\text{O}_3$  as an additive was tested in 20 A h Ni/Zn cells. The  $\text{Fe}_2\text{O}_3$ -containing electrode displayed an area reduction of 46% after 211 cycles. We are continuing our investigation on this and other additives which not only minimize shape change, but also favor highly adherent mossy type deposits.

The technology of polymer-bound nickel electrodes, which contain graphite as the conductive diluent, has reached an advanced stage. Electrodes produced in a semicontinuous manufacturing operation have displayed a capacity of 4.6 A h/in.<sup>3</sup>. The graphite loss due to oxidation and emulsion formation in KOH amounted to 8% after 1140 cycles in a 20 A h Ni/Cd cell.

A separator study is underway centered around the development of crosslinked PVA and cast inorganic/organic composites. These have shown very low electrical resistance (*e.g.*, 20 m $\Omega$  per sq. in.). The composites are highly stable in KOH.

In Phase II of our study, we are incorporating the advances made in component technology into EV type cells. In conjunction with this program, two full-size EV batteries were fabricated. One was installed in a Jet Industries Van Model 500 and is undergoing tests at ERC. Another was delivered to JPL as part of the Upgraded Demonstration Vehicle Program. Attainment of high cycle life without any sacrifice in energy density is still the subject of detailed investigation.

A coulometric type charge controller which functions also as a state-of-charge meter was developed and successfully tested with an EV battery.

Major R&D activities planned for 1980 include: (1) improvement of nickel utilization and reduction or elimination of cobalt in the polymer-bonded nickel electrode; (2) accelerated development of highly-stable, high-conductivity separators; (3) continued development of sealed-cell operation.