

PULSE DISCHARGE STUDIES FOR LEAD-ACID BATTERIES

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The effects of high current pulses caused by electric vehicle (EV) controllers on battery energy, life and microstructure are being investigated. A watt-hour meter with Hall-effect transducers, designed specifically for EV pulsed waveforms, demonstrated an error less than ± 0.5 percent, from d.c. to 333 Hertz with current peaks to 300 amperes.

The only battery type to date was the ESB Ray-O-Vac EV106. All charges were the same except for occasional temporal extensions for equalization. Two batteries were discharged at 145 A d.c. for 142 cycles. The ratio of these watt-hours out to a NEMA (National Electrical Manufacturers Association) standard 75 amperes discharge energy ranged from 0.89 to 0.94 with a peak of 0.94 from cycles 55 to 95. Next, two dry charged batteries were pulsed at 167 Hertz with 290 ampere peaks and a 50 percent duty cycle. The ratios ranged from 0.75 to 0.84 with pulses ranging from 0.83 to 0.85 from cycles 25 to about 65. The center cell electrolyte temperature varied typically from 37 to 47 °C for the pulsed discharges and from 37 to 42 °C for a d.c. discharge.

At least five cycles each on a set of three batteries were completed for frequencies of 0, 30, 166 and 267 Hz with a fixed current amplitude of 300 amperes and duty cycles ranging from 9 to 80%.

X-ray diffraction and microscopic examination of the active material of the lead-acid battery plates after cycling, with and without high current pulsed discharges, indicated that pulsing might be responsible for a definite 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 ultimate goals of the program are to gain knowledge of the effects of EV waveforms on battery capacity and life for minimization of negative controller effects, to recommend improved battery designs based on microstructure analysis, and to predict life.

Recent publications

- 1 E. J. Dowgiallo, S. M. Caulder, A. C. Simon and F. Pierce, Effects of high current pulse discharge on electric vehicle lead-acid batteries, I. Electrical parameters, *156th Meeting of the Electrochemical Society, Los Angeles, CA, October 14 - 19, 1979.*
- 2 S. M. Caulder, A. C. Simon and E. J. Dowgiallo, Effects of high current pulse discharges on electric vehicle lead-acid batteries, II. Microstructural parameters, *156th Meeting of the Electrochemical Society, Los Angeles, CA, October 14 - 19, 1979.*