INFLUENCE OF ELECTRODE COMPOSITION ON CYCLING PERFORMANCE OF CYLINDRICAL NICKEL-ZINC CELLS

Waltraud Taucher-Mautner
and Karl Kordesch

Institute for Chemical Technology of Inorganic Materials
Graz University of Technology
Stremayrgasse 16/III, A-8010 Graz
AUSTRIA

The rechargeable alkaline nickel-zinc system is characterized by high specific energy (55-85 Wh/kg), a relatively high nominal voltage (1.6.V), low cost and it is environmentally benign compared to the nickel-cadmium system. The technology of flat plate construction of rechargeable nickel-zinc cells has been investigated for many years, but less effort was made to build a cylindrical nickel-zinc cell [1-3].

Nickel electrodes of AA-size nickel-zinc cells are prepared in our laboratory by a special pasting technique [4-5] that results in a highly porous nickel hydroxide cathode using lightweight nickel fiber substrates (1.6-2.3 mm foam) that are impregnated with active nickel hydroxide mixture. In order to improve conductivity between nickel hydroxide particles in the mixture metallic nickel (2-8.6 %) and cobalt powder (4.3-8 %) is added to increase nickel hydroxide utilization and discharge capacity of cylindrical nickel-zinc cells [6]. The preparation of pasted zinc anode is carried out by blending zinc oxide, zinc, gelling agent and electrolyte (7 M KOH) to build a gelous electrode.

Cylindrical nickel zinc cells have to be balanced in a nickel-limited way (Zn/Ni ratio approx. 2) to avoid parasitic hydrogen evolution at the zinc electrode during overcharging. The charging procedure can either be performed by constant voltage taper charging (1.9 V) or by constant current charging (50-100 mA). Discharge is carried out at 3.9 Ohm to a cut-off voltage of 800 mV. In general, nickel electrodes have to be slightly overcharged (5-10 %) to receive a better charge acceptance of the cathode and to compete with oxygen evolution at the end of the charging process.

The mAh-capacity that can be taken from AA-size nickel-zinc cells (approx. 550-400 mAh) at definite discharge/charge conditions mainly depends on foam thickness, paste composition and nickel hydroxide content. This work focuses on the investigation of different binder materials (polyvinyl alcohol/1.2 wt % solution, teflon/58 wt % suspension) that have to be added to the nickel hydroxide mixture to get an easy to spread and well adhesive paste. Performance data of AA-size nickel-zinc cells using different amounts of binder, various paste composition and loading with active nickel hydroxide will be presented in this paper.

For long-term cell operation (100-200 cycles) at deep discharge the improvement of zinc electrodes, that may suffer from shape change, dendrite formation and passivation, is another objective. From our recent studies of RAM-cells (rechargeable alkaline manganese dioxide) [7,8] we found out that different additives (e.g. EDTA, $Ca(OH)_2$) were able to improve the cumulative capacity of RAM-cells and diminish the capacity decline during cycling. Both additives were also applied to the gelous zinc anode of cylindrical nickel-zinc cells, although the anode composition of this system varies from RAM-anodes. The results of cell cycling performance of these experiments will also be presented and discussed.

Acknowledgment

The authors would like to thank Energy Ventures Inc., 1500 Montreal Road, Ottawa, ON K1A 0R6 for their support.

References

[1] J. Jindra, *J. Power Sources*, **66**, 15 (1997).
[2] A. Charkey and D. K. Coates, *US. Patent*, 5.863.676 (1999).
[3] W. Taucher, T.C. Adler, F.R. McLarnon and E.J. Cairns, *J. Power Sources*, **58**, 93 (1996).
[4] W. Taucher-Mautner and K. Kordesch, *1997 Joint International Meeting (192nd Meeting of ECS/48th Meeting of ISE)*, Aug.31-Sept.5, 1997, Paris, Batteries for Portable Applications and Electric Vehicles, Proc., Vol.97-18, 710.
[5] W. Taucher-Mautner and K. Kordesch, *50th ISE Meeting*, September 5-10, 1999, Pavia, Italy, Abstract No.485.
[6] W. Taucher-Mautner and K. Kordesch, *51st Annual ISE Meeting*, September 3-8, 2000, Warsaw, Poland, Abstract No.278.
[7] A. Stani, Diploma thesis, TU-Graz, 2000.
[8] A. Stani, W. Taucher-Mautner and K. Kordesch, "Improvement of the cycle life of AA-RAM cells", *2001 Joint International Meeting (200th Meeting of ECS/52nd Meeting of ISE)*, September 2-7, 2001, San Francisco.