RECHARGEABLE ALKALINE MANGANESE TECHNOLOGY: PAST-PRESENT-FUTURE

J. Daniel-Ivad and K. Kordesch

Battery Technologies Inc., 30 Pollard St., Richmond Hill, Ontario, Canada L4B 1C3

This paper will discuss the history of the rechargeable alkaline battery technology from the early days of alkaline cell chemistry in the 1950's to present day products available on the market. In addition, an outlook will be given where rechargeable alkaline technology may be in the future.

Below is a chronology of significant events that will be addressed:

Year	Event
1882	Probably first description of an alkaline MnO_2 cell in German patent 24552 of G. Leuchs
1903	Description of another "wet alkaline cell" in US Patent 746,227 of S. Yai
1912	First alkaline "dry cells" described in German patent 261,319 of E. Aschenbach
1952	W.S. Herbert introduced first commercial alkaline MnO2 "crown" cell for low drain
1960	US patent 2,960,558 of K. Kordesch, P. Marsal and L. Urry describes the invention of the "modern" alkaline cell w/ sleeve type pelletized cathode on the outside in contact w/ the can
1962	US patent 3,024,297 of L. Urry describes a method of forming a cathode depolarizer mix for a rechargeable alkaline cell
~1970	First commercial rechargeable alkaline cells introduced by Union Carbide Corp. and Mallory Corp., but soon withdrawn.
~1980	Research on rechargeable alkaline manganese chemistry was intensified at the TU Graz under the leadership of Prof. Dr. K. Kordesch
1981	Kordesch et al studied the rechargeability of 12 International Common Samples
1983	US patent 4,384,029 of K. Kordesch and J. Gsellman describes a new cell design w/ the cathode constrained by a metal cage.
1985	Titanium doped electrolytic manganese dioxide for improved cycle life described in German patent 3,337,568 of K. Kordesch and J. Gsellman
1986	Battery Technologies Inc. (BTI) founded w/ the mission to commercialize rechargeable alkaline manganese (RAM™) technology
1990	US patent 4,925,747 of K. Kordesch and K. Tomantschger describes the internal pressure management of sealed cells via hydrogen recombination by catalytic means
1991	Ph.D. Thesis of J. Daniel-Ivad on Rechargeable Alkaline Manganese Cells focusing on mercury-free designs
1992	US patent 5,108,852 of K. Tomantschger and C. Michalowski describes a basic rechargeable alkaline cell w/o constraining the cathode
1993	US patent 5,108,852 of R. Flack describes an improved separator bottom seal
1993	Rayovac Corporation launched BTI licensed RAM™ cells manufactured and sold under their trademark RENEWAL™ in the United States
1994	US patent 5,281,497 of K. Kordesch, J. Daniel-Ivad and R. Flack describes a mercury-free rechargeable cell w/ an anode having gas release properties and a hydrogen recombination system to limit in-cell gas pressure
1994	Pure Energy Battery Corporation launched BTI licensed RAM™ cells manufactured under their trademark PURE ENERGY™ in Canada. Cells are mercury-free.
1995	US patent 5,424,145 of J. Daniel-Ivad, J. Book and K. Tomantschger describes a basic rechargeable cell w/ specific anode to cathode Ah-balance to achieve satisfactory performance in consumer use/misuse.
1995	Rayovac's RENEWAL™ cells become mercury-free
1996	US patent 5,626,988 of K. Tomantschger, J. Book and J. Daniel-Ivad describes a mercury-free rechargeable cell w/ a special anode process for reliable performance
1996	Young Poong Corporation launched BTI licensed RAM™ cells manufactured under their trademark ALCAVA™ in South Korea.
1997	AccuCell started to sell BTI licensed RAM™ cells in Germany.
1998	Grand Batteries Technologies launched BTI licensed RAM™ cells manufactured under their trademark GRANDCELL™ in Malaysia
1998	Single-use alkaline cell producers introduce cells capable of higher drain rates
1999	BTI released 1st Generation High-Rate RAM™ cell specifications for production
1999	Endurance cycling breakthrough of RAM™ cells in Cordless Phone test: 6500 cycles for 5 minute call, then recharge in cradle
2000	"Marathon" RAM™ cell research to extend the deep discharge stability from 25 to 50 cycles initiated
2000	US patent 6,099,987 of J. Daniel-Ivad, J. Book and E. Daniel-Ivad describes a cylindrical cell w/ a cup seal for improved cumulative performance.
2001	BTI acquired the Dema Group, a Swedish distribution company, and launched Demacell™ RAM™ cells in an effort to promote a European expansion of the technology.