GRACE DAKASEP ALKALINE BATTERY SEPARATOR

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Summary

The Grace DAKASEP separator was originally developed as a wicking layer for nickel–zinc alkaline batteries. DAKASEP is a filled, non-woven separator which is flexible and heat sealable. Through modification of formulation and processing variables, products with a variety of properties can be produced. Variations of DAKASEP have been tested in Ni–H_2, Ni–Zn, Ni–Cd, and primary alkaline batteries with good results. Data are presented here for separators designed for Zn–HgO primary batteries. Actual performance data for Zn–HgO E-1 size cells are also included.

1. Introduction

In alkaline battery systems, where a dendristatic separator is not required, the separator can be a porous diaphragm. The purpose of the separator is to provide a separation between electrodes of opposite charge, provide an electrolyte reservoir, provide uniform electrolyte distribution across the electrode surface to permit uniform current density, and allow space for electrode expansion. In order to achieve these requirements, the separator must be capable of exhibiting a high degree of absorption or wicking and be sufficiently porous to carry and evenly distribute the electrolyte. In addition, the separator should be thin (less than about 10 mils) in order to minimize both the amount of electrolyte and the electrode gap required, and thereby to maximize the energy and power density of the battery. Also, the separator should be flexible and made of a thermoplastic to permit formation of an envelope or pocket around each electrode [1].

Battery separators used today in alkaline battery systems are commonly composed of polypropylene, polyamide or nylon non-woven sheets. These separators suffer from insufficient wicking and/or lack the necessary chemical and/or oxidation resistance in an alkaline environment.

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2. Description of separator

The Grace DAKASEP separator is formed from about 50 wt.% polyolefin synthetic pulp, about 40 wt.% alkaline-resistant inorganic filler, and about 10 wt.% polyolefin long fibers (greater than 0.25 in. in length) [1]. The separator is formed from an aqueous slurry on conventional paper-making equipment.

Table 1 shows the properties of DAKASEP which are optimized for Zn–HgO primary batteries. The separator has high tensile strength, 12 μm average pore size, a relatively low porosity of 46 - 48% and, consequently, moderately high resistivity. Through the use of fillers with different chemical and/or physical properties, and through separator formulation changes, the properties can be tailored to the battery manufacturer's specifications. Versions have been produced with greater than 70% porosity and resistivities, in 33 wt.% KOH, as low as 3 Ω cm.

TABLE 1

Grace DAKASEP alkaline battery separator characteristics

Property	Value
Ream weight (lb/3000 ft^2)	74.2
Thickness (mils)	11.5
Tensile strength (lb/$in.^2$)	1260
Tensile (pounds/in.)	14.5
Maximum pore size (micron)	21.1
Average pore size (micron)	12.0
Porosity (vol.%)	46
Wetout time (s in 33% KOH)	< 3
Resistivity (Ω cm in 33% KOH)	15.0

3. Results

Figures 1 and 2 present performance data for Zn–HgO E-1 size cells containing DAKASEP with the properties shown in Table 1. The cells of Fig. 1 were discharged at ambient temperature across a fixed load of 15 Ω, while those of Fig. 2 were discharged across a fixed load of 35 Ω. In both Figures, results for 5 cells are depicted. The performance from cell to cell (for a given discharge condition) is very reproducible. This indicates that the separator is uniformly wetted by electrolyte. At lower currents the utilization of active material is high, as indicated by the 1.1 A h capacity.

Variations of DAKASEP have been evaluated in Ni–H_2, Ni–Zn and Ni–Cd secondary batteries with good results. These findings will be reported.

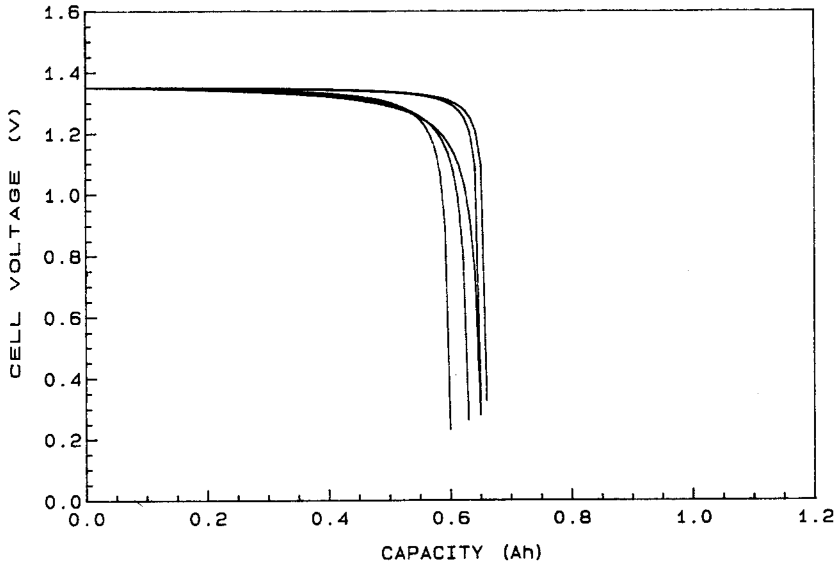

Fig. 1. Performance of E-1-size Zn–HgO cells (15 Ω load) containing Grace DAKASEP separator.

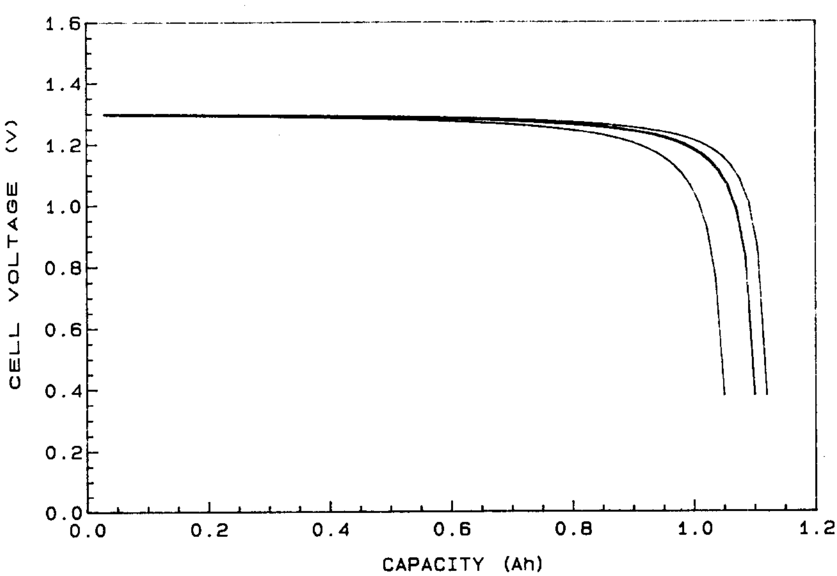

Fig. 2. Performance of E-1-size Zn–HgO cells (35 Ω load) containing Grace DAKASEP separator.

Reference

1 D. D. O'Rell *et al.*, *U.S. Pat. 4,330,602* (May 18, 1982).