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Activated electrolytic manganese dioxide for lithium cells

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Electrolytic manganese dioxide (EMD) has been activated by digesting with sulphuric acid. This EMD after heating in air to 573K was used as cathode material in lithium cells. Comparison has been made between lithium button cells containing heated EMD, activated EMD and activated and heated EMD as cathode materials respectively.

Key words: Activated electrolytic manganese dioxide, lithium cell

INTRODUCTION

Activation of natural or chemical MnO_2 has been attempted successfully by several workers. This activation is considered to involve disproportionation reaction which is very good for high drain discharges. This paper reports the activtion of EMD by treatment with sulphuric acid and its performance in lithium cells.

EXPERIMENTAL

Activation

The EMD obtained through chloride route [1] was heated with sulphuric acid (1 mole H_2SO_4 per 100 g MnO_2) for 3 hours at 373K. Then it was washed with distilled water and pH adjusted to 7 and dried. A part of this sample was heated to 573K in a furnace in air [2]. A part of normal EMD was also heated to 573K in a furnace to give gamma-beta variety [3].

Lithium cells were fabricated in a dry box. Details of purification and cell fabrication have been reported earlier [2]. Same weight of each EMD was used for making cathode materials. Indigenous polypropylene and cellulose were compared as separators. The cells were dishcarged at 200 microampere. Voltage vs time curves were plotted.

Total absorption test for separator

A weighed 25 × 150mm strip of the material was totally immersed in the electrolyte. After soaking for 10 minutes, the sample was removed, allowed to drain for 3 minutes and reweighed. The percentage weight gain is a measure of total absorption [4].

RESULTS AND DISCUSSION

Figures 1 and 2 show the discharge curves. It is well known that heating MnO_2 to 573K changes the occluded water content. This in turn enhances the performance [3]. From the figures it is clear that the cellulose separator is inferior to polypropylene. This may be due to the high resistance of celluose material. The total absorption of polypropylene was 948% and for cellulose it was 247%. From these figures, it is obvious that the porosity of polypropylene is more.

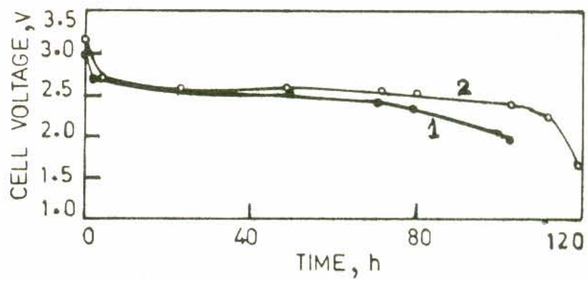

Fig. 1: Discharge curves of cells with cellulose separator. (1) Activated EMD cathode (2) Heated EMD cathode

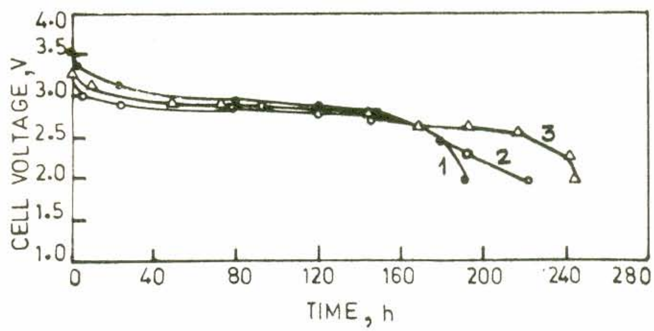

Fig. 2: Discharge curves of cells with indigenous polypropylene separator. (1) Activated EMD cathode (2) Heated EMD cathode (3) Activated and heated EMD cathodes

It may be observed from Fig 2 that the performance of activated EMD is less than that of heated EMD. But the performance of activated and heated EMD is the highest. This indicates that activation is effective only after heating it. Activation or heating, if done separately, is not effective. It means that the occluded water content is not changing due to activation. After heating it, it might be changing.

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