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USE OF CARBON BLACK AS A SUBSTITUTE FOR ACETYLENE BLACK FOR PASTED DRY CELLS

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Acetylene black (AB) is the preferred carbon material due to its desirable properties and characteristics, especially in the case of paperlined cells where no electrolyte reservoir is present. However, in the present study it has been found that carbon black can be substituted for AB in pasted dry cells where an electrolyte reservoir is present in the form of the paste. Comparative studies (discharge behaviour) with a standard market product reveals that equivalent or even better discharge performance/life can be obtained using carbon black as a replacement but with modified and optimized composition of the black mix.

Keywords: Acetylene black, discharge performance

INTRODUCTION

Acetylene black (AB) has been widely employed as the preferred carbon material compared to the other carbon blacks for making dry cells due to its higher surface area, electrolyte retaining capacity and its chain structure which ensures better encapsulation and particle to particle contact for the MnO_2 particles [1]. It has been argued that AB is also more stable than other carbon/furnace blacks in oxidizing environments [2]. Unlike the paperlined cells, the pasted dry cells have a starch electrolyte gel which acts both as a separator and an electrolyte reservoir. In such cells, the cheaper carbon blacks (whose prices are roughly 1/2 to 2/3 that of acetylene black) can be substituted for AB (as higher electrolyte retaining capacity is not essential due to presence of the electrolyte reservoir) with some black mix composition optimization to obtain a desired level of performance and bring about a substantial cost reduction. It has been shown through the present work that the above concept holds good in actual dry cells and thus may be of commercial interest.

EXPERIMENTAL

The surface area of AB and carbon blacks were determined by the acetone absorption method [3]. Pasted R20 dry cells (ammonium chloride-zinc chloride type) were constructed (SG-7S) following standard procedures using the cheaper carbon black (generally termed as "soot" in the local market) with optimized black mix composition. 40 grams of black mix was used for making the cathode bobbin for the R20 cells. The cells were aged for two months and their OCV and short circuit currents were measured. For determination of the quality, the batteries were then subjected to the discharge test (viz., continuous discharge through a 2.2 ohm resistance and also through a 2.2 V torch bulb) and for comparison, a similar aged (based on the date of manufacture), standard batteries (Eveready, No 950) were also put to similar tests. The technical parameters and results (mean of three replications for both the battery types) are tabulated in Table I.

RESULTS AND DISCUSSION

The acetone absorption number was found to be 27 g/5 ml and 23 g/5 ml acetone solution for AB and carbon black respectively. These values are comparable to manufacturer's claims [4]. The higher value of acetone absorption number of AB is indicative of its higher surface area which is related to its higher electrolyte retaining capacity. This attribute of AB is very essential when it is used in paperlined cells where the electrolyte reservoir is absent. However, in the case of pasted cells, the higher electrolyte retention capacity of AB may play an insignificant role in enhancing the battery performance, as there exists a

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TABLE I: Performance characteristics of dry cells (SG-7S) vis a vis Eveready (No 950) cells

Parameters	Battery types	
	SG-7S	White eveready (No 950)
Age	2 months	2 months
O C V	1.54 V	1.56 V
Initial short circuiting current	5.48 A	4.48 A
Time taken for C C V to fall to 1 V (discharged through a 2.2 Ω resistance)	32 min	22 min
Time taken for C C V to fall to 0.75 V (discharged through a 2.2 Ω resistance)	140 min	120 min
Time taken for C C V to fall to 0.70 V (discharged through a 2.2 V torch bulb at ~200 mA)	13 hrs	12.5 hrs
Percentage EMD in total MnO_2 used	Nil	Not known
Cost of production per battery*	Rs.2.75	Not known

* Calculated based on the existing local raw material prices, labour etc., 1998

provision for electrolyte compartment. In such cells, it may be sufficient to use less electrolyte retaining carbon black as the conductive material. In order to test the above hypotheses, R20 cells were constructed with carbon black and their performance compared with the standard commercially available battery, which uses acetylene black as the conductive material. It can be seen from the values tabulated in Table I that at any point of time throughout the discharge period, for both the discharge types, the CCV of the SG-7S battery was higher than that of the Eveready battery, indicating better discharge characteristics. Also this battery shows higher OCV and short circuit current values. This enhanced performance of SG-7S batteries may be attributed to optimized composition of the black mix consisting of MnO_2, carbon black, ammonium chloride, zinc chloride, binder and water and the use of an organic additive [5]. During the discharge tests, it was also observed that the zinc cans of SG-7S cells were evenly corroded with very less paste leakage while the cans of Eveready batteries were subjected to severe uneven pitting corrosion, causing profound leakage of paste. This observation suggests that the overall cell composition is more balanced in the case of SG-7S batteries ensuring even current distribution throughout the bobbin and over the reacting surface of the zinc can, a criterion for long service life of the battery. On the basis of the above facts it can be presumed that carbon blacks can be substituted for acetylene black in pasted dry cells and a reasonable battery performance, comparable to good quality batteries can still be obtained.

CONCLUSION

It is thus evident that for pasted cells, the electrolyte retaining capacity of the carbon material used is not of prime importance. Cheaper carbon blacks can be used as a suitable replacement for acetylene black and a good discharge performance is obtainable by optimizing the black mix formulation. Such balanced cell composition can lead to increase in the life of the battery in addition to cost reduction.

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