Bulletin of Electrochemistry 6 (5) May 1990, pp 509–510

Effect of acetylene black on the reduction of m-dinitrobenzene depolarizer

N Muniyandi, R Udhayan and S Pitchumani

Central Electrochemical Research Institute, Karaikudi-623 006, INDIA

Among the many organic compounds used as depolarizers, m-dinitrobenzene (m-DNB) is found to be attractive due to its high coloumbic efficiency and voltage constancy. The performance of m-DNB depolarizer depends on the nature and quantity of conducting materials used. Optimised cathode mix consisting of m-DNB and acetylene black in the ratio 2:1 gives maximum capacity due to its high electrical conductivity.

Key words: m-dinitrobenzene depolarizer, acetylene black, magnesium-organic battery

INTRODUCTION

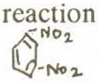
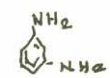
Particle size, surface area, conductivity, density and water absorption of the conducting material are main factors which control the reduction efficiency of m-dinitrobenzene (m-DNB). m-DNB lacks electrical conductivity and therefore requires a carbon black (CB)/acetylene black (AB) to improve the conductivity. In the present investigation, commercially available carbon black and imported (I-AB) , Trivancore (T-AB) and Mysore acetylene blacks (M-AB) in varying percentages (10–50%) are employed with m-DNB depolarizer. A suitable AB with optimum percentage to improve the electrical conductivity and maximum water absorption, which also improves the Mg-mDNB cell performance, is evaluated. The reduction products are analysed by IR spectroscopy.

EXPERIMENTAL

The cathode plate was prepared by pressing a mix containing m-DNB and CB/AB along with carboxy methyl cellulose binder over a copper mesh. The surface conductivity of the plates in different samples was measured by using four probe conductivity cell. Particle size, surface area of the samples were analysed by Malvern particle sizer. The above cathode plates (2 × 3 cm) were coupled with magnesium alloy anode in $Mg(ClO_4)_2$ electrolyte and then discharged at 40 mA current drain upto the cut off voltage of 0.8V.

RESULTS AND DISCUSSION

Generally, the reduction efficiency of m-DNB depends on three factors viz. pH of the electrolyte, current drain and presence of a catalyst [1]. When these three factors are kpet constant, the variation of the cathode composition alone influences the cell performance. When the quantity of different varieties of AB varied in the cathode mix, the cell capacity also considerably varied. The comparison of optimum percentage (50%) of four samples reveals that T-AB is the best variety with high capacity as shown in Table I. Tables II and III show the surface area, average particle size analysis and electrical conductivity measurements. According to these results, I-AB and M-AB samples are better in their performance upto 20%. The 50% T-AB gives better capacity than other samples. This may be due to better water absorption which is essential in the specific reaction as shown below [2]:

6Mg +  $+ 8H_2O \longrightarrow 6Mg(OH)_2 +$ 

The IR data supports the quantity of reduction products formed during the discharge period.

TABLE I: Capacity obtained in CB/AB

Quantity (%)	Capacity: Carbon black (Ah)	I-AB (Ah)	T-AB (Ah)	M-AB (Ah)
10	-	0.10	0.04	0.08
20	-	0.44	0.10	0.16
30	-	0.48	0.44	0.36
40	-	0.54	0.60	0.52
50	0.26	0.60	0.68	0.56

TABLE II: Particle size and surface area analysis

Samples	Average micron size (μm)	Sp.surface area (sq.m/cc)
Carbon black	36.3	0.05
I-AB	22.6	0.05
T-AB	37.3	0.05
M-AB	36.3	0.05

TABLE III: Electrical conductivity

Quantity (%)	Conductivity			
	Carbon black (mΩ)	I-AB (mΩ)	T-AB (mΩ)	M-AB (mΩ)
10	11.10	11.50	12.98	11.00
20	10.45	11.45	12.50	10.75
30	9.91	11.25	12.10	10.34
40	9.58	11.15	11.60	9.95
50	9.50	11.05	11.10	9.75

REFERENCES

1. M A Gutjahr and K D Beccu, Extended Abstracts. The Electrochemical Society Spring Meeting, Los Angeles, U.S.A, No. 279 (1970) 678
2. G S Lozier and J B Eisen *17th Annual Power Sources Conf*., Fort Monmouth, New Jersey, U.S.A (1963) p 149