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Electrolytic Manganese Dioxide (EMD) from Manganese Cake- A Byproduct of Nodule Process

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Abstract:

Electrolytic manganese dioxide (EMD) was prepared from manganese cake, a by-product obtained during processing of deep sea ocean nodules through the NH_3-SO_2 leaching route. The samples were characterized by XRD, SEM and their discharge capacity was determined. It was found that the EMD obtained was of γ-variety with spherical and uniform particles. The EMD produced from manganese cake showed a highest discharge capacity of 290 mAh/g which is industrially acceptable value for preparing primary alkaline batteries.

KEY WORDS: Manganese Nodules, Manganese Cake, Leaching, Electrolytic Manganese Dioxide, Electrolysis, Discharge capacity

INTRODUCTION

Electrolytic Manganese Dioxide (EMD) is used as a cathode mixture material for dry-cell batteries, such as alkaline batteries, zinc-carbon batteries, rechargeable alkaline batteries etc. Natural manganese dioxide (NMD) can be used in the Leclanche cells. But in alkaline, lithium and other "modern" batteries, synthetic manganese dioxide with improved qualities is required. Among the large variety of manganese oxides, γ-type manganese dioxide is widely used (Jantscher et al., 1999) as γ-variety compounds have high intercalation voltage. They have the ability to maintain high discharge rates, a good performance over a wide temperature range and have a long storage life. Manganese dioxide can be used as a promising material of pseudo capacitor due to its super electrochemical performance, environment friendly nature and lower cost.

Manganese dioxide can be prepared both electrolytically and chemically. But γ-manganese dioxide can be produced by electrochemical method that has superior electrochemical properties than chemically prepared manganese dioxide (Chou.s. et.al, 2006).

Manganese content in the polymetallic nodules varies between 20 – 33% depending upon the location (Das, 2005). Although the primary interest in processing deep-sea nodules is for recovery of nickel, copper, and cobalt, recovery of manganese will add to overall economics of the process.

Processing of polymetallic nodules through reductive ammoniacal leaching process (das et al. 1998) followed by demanganisation and solvent-extraction/electrowinning for recovery of Cu, Ni and Co has been developed by IMMT, Bhubaneswar which was tested in pilot scale at CRDL, HZL, Udaipur. One of the unit operations in the process is precipitation of partially leached manganese from leach liquor through demanganisation as manganese cake. Manganese cake contains manganese as the major element along with other elements as impurities such as such as Cu, Ni, Co, Zn, and Fe etc. Typical composition of Mn cake (as such basis) is Mn 57.15%, Fe 0.58%, Ni 0.12%, Cu 0.18%, Co 0.044% and Zn 0.21%.

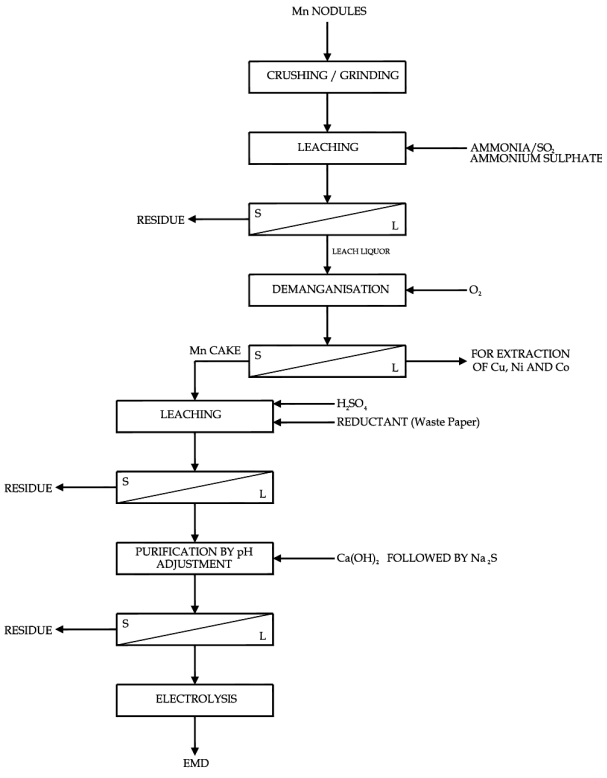

Fig.1. Flow sheet for the processing polymetallic nodules for preparation of EMD.