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Lead-calcium alloy by fused salt electrolysis

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Lead-calcium alloy containing about 0.1% Ca is a useful grid material in lead acid battery. The alloy is prepared electrochemically by depositing calcium onto molten lead at 973-1023 K from a melt consisting of $CaCl_2$, KCl and CaF_2. The master alloy thus obtained is then dilted to 0.1% and its polarisation behaviour in 10N sulphuric acid has been studied and the results are presented in this paper.

Key words: Lead-calcium alloy, fused salt electrolysis, lead acid battery grid

INTRODUCTION

Pb-Ca alloy was first developed [1,2] with 0.06 to 0.085 w/o Ca. Presently Pb-Ca alloy finds extensive applications not only in maintainance-free lead acid batteries, stationary batteries for telephone and standby power sources, but also in making cold rolled sheets for use of pressure relief diaphragms in lightning arresters, in electrolytic Zn and Cu refinery and as cooling coils in highly corrosive chemicals, especially in the pesticides and insecticide factories.

The alloy was usually made by ingot melting of pure Pb and Ca under molten salt layer. An attempt has been made in the present study to prepare a master alloy of Pb-Ca by electrochemical technique of alloy deposition over molten cathode [3,4].

EXPERIMENTAL

Experimental cell employed essentially consisted of a mild steel vessel, lined inside with high alumina refractory. $CaCl_2$ and KCl in the ratio 4:1 were melted in the vessel. The melt was maintained at 923-973K by external heating with temperature control. Molten Pb was used as cathode. Ca was deposited over molten Pb by impressing constant current at 5.5-6.0V with cathode current density of 0.5 $A.cm^{-2}$. With a view to ensure proper mixing of calcium over the entire bulk of molten cathode, the latter was stirred at frequent intervals. At the end of the electrolysis the molten cathode was poured into a mould after decanting the electrolyte layer. Master alloy obtained was diluted to various stages by the addition of more Pb under controlled temperature of melting.

RESULTS AND DISCUSSION

Ca in the master alloy was analysed by Atomic Absorption Spectrometer and the alloy is found to contain 3.0 w/o Ca. Faradaic efficiency calculated on the basis of calcium deposited worked out to be 40%. Hardness was tested for the master alloy and also for the diluted alloys. VPN for pure Pb, 0.8 w/o Ca and 1.2 w/o Ca in the alloy was found to be 6.7, 51.8 and 153 $kg.mm^{-2}$ respectively. Polarisation study of the alloy containing 0.1 w/o Ca indicates less passivation current than for Spec pure Pb.

CONCLUSION

Feasibility of preparing master alloy of Pb-Ca which could be further diluted with Pb, to obtain such alloys as may be needed for lead acid batteries has been indicated through these studies. Further studies on the optimisation of electrolytic conditions and about the maximum limits to which Ca concentration can be built in the alloy is being studied. Actual testing of the alloy in the grid material is also under way.

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