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Corrosion behaviour of cadmium electrodeposits from perchlorate bath

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In view of the possibility of obtaining cadmium deposits with higher corrosion resistance at cent percent cathode efficiency from perchlorate baths than from cyanide ones, the corrosion behaviour of cadmium electrodeposited on cold rolled steel from both the baths was investigated by the galvanostatic polarisation technique. The corrosion currents calculated from the current- potential plots were found to be considerably lower in the case of deposits from the perchlorate solution.

Key words: Cadmium deposit, perchlorate bath, i_{corr}

INTRODUCTION

The applications of cadmium electrodeposits are numerous. In view of their high corrosion resistance, adequate electrical conductivity and good solderability, they are used in electronics and aerospace components.

The performance characteristics of the perchlorate based cadmium baths and the associated hydrogen permeation characteristics had earlier been reported by the authors [1].

In this paper, the authors present the results on the corrosion behaviour of cadmium deposits obtained from perchlorate and cyanide baths.

EXPERIMENTAL

Cadmium was electrodeposited on steel specimens of 10 × 25 × 0.05 cm size, from solutions of compositions and operating conditions as given below:

Bath I

Cadmium (as perchlorate)	14-15 g/l
Perchlorate (as Na)	40-45 g/l
pH	1.0
Temperature	300K
Current density	100 $A.m^{-2}$

Bath II

Cadmium oxide	45.0 g/l
Sodium cyanide	120.0 g/l
Temperature	300K
Current density	100$A.m^{-2}$

TABLE–I: Results of galvanostatic polarisation studies

Nature of specimen	Plating thickness: Bath used	Plating thickness: μm	OCP (mV)	E_{corr} (mV)	i_{corr} ($mA.cm^{-2}$)
Pure cadmium	—	—	−770	−770	46
Cadmium plated on m.s.	Perchlorate	5.2	−770	−770	16
Cadmium plated on m.s	Perchlorate	8.1	−775	−780	14
Cadmium plated on m.s.	Cyanide	4.8	−769	−769	110
Cadmium plated on m.s.	Cyanide	6.8	−752	−752	65
Cadmium plated on m.s.	Cyanide	12.0	−750	−750	24
Mild steel	Nil	Nil	−538	−540	7

Specimens in duplicate were prepared with three different thicknesses, viz. 5, 8 and 12μm approximately.

For galvanostatic studies, the usual three electrode cell assembly set-up was used. The electrodeposited specimens were masked suitably to expose only 1.0 cm^2 area on one side. A large platinum foil (6.45 cm^2) and saturated calomel electrode were employed as auxiliary and reference electrodes respectively. A 5% neutral sodium chloride solution was used. Polarisation experiments were carried out by passing small currents to polarise the electrode over the potential range of ± 20 mV on either side from the corrosion potential and recording the steady-state potential values.

RESULTS AND DISCUSSION

The corrosion currents as obtained from the extrapolation of Tafel slopes to the corrosion potential for the different systems and the respective corrosion potentials are given in Table I.

Cadmium deposited from the cyanide bath is associated with larger currents especially when the deposit thickness is low. From the values of i_{corr} obtained for different thicknesses of deposits from perchlorate and cyanide baths, one can infer that the deposits obtained from the perchlorate bath have a resistance to corrosion whereas this is not so in the case of those from the cyanide bath. However, as observed in the salt spray test, the deposit with 12μm thickness has higher corrosion resistance and hence a lower i_{corr} value (24μA). It is seen that the corrosion potentials determined from the polarisation curves are almost the same both before and after polarisation especially in the case of pure cadmium and also perchlorate cadmium deposits. This indicates that the nature of electrode surface is not altered by polarisation. A comparison of the corrosion current for both the types of electroplates with that for pure cadmium, shows that the corrosion current is lower in the case of the electroplates.

The comparison of the polarisation behaviour of steel and that of cadmium deposits confirms the anodic nature of cadmium and its ability to confer sacrificial protection.

CONCLUSION

While cadmium deposits of lower thicknesses, e.g. 5.72μm from a perchlorate bath can offer good corrosion protection, a thickness of 12μm is necessary in the case of cyanide cadmium plating.

REFERENCES

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