INFLUENCE OF POLYANILINE BLEND ON THE PROTECTION OF ANODIZED ALUMINIUM SURFACE

S. Karthikeyan, S. Shriram, S. Pitchumani, S. Mohan*,
D. Kanagaraj, V. Raj,
Central ElectroChemical Research Institute,
Karaikudi – 630 006, India.

INTRODUCTION

Conventional corrosion protection of Aluminium is by anodizing, followed by sealing in chromate (1). However, the toxicity of the bohemite layer disables the eco-friendliness of the material. In order to replace this, we have recently reported (2) a non-toxic protective coating of conducting polymer over anodized aluminium. To improve the use of this class of polymer coatings, we report here, the use of a polyblend of polyaniline (PANi) and Polydimethylsiloxane (PDMS).

EXPERIMENTAL

Dispersions of Polyaniline were prepared by suspension polymerization technique, based on the patented procedure developed by us (3). This was used in conjunction with Polydimethylsiloxane as a polyblend in various proportions.

The aluminium substrate was subjected to standard surface treatment procedures before the deposition of the blend by a dip coating process. The PANi/PDMS blend coated panels were subjected to Polarization and Electrochemical Impedance Spectroscopy measurements, using BAS 100B Electrochemical Analyzer (area of exposure = 1 cm^2) in a three electrode assembly using 3% NaCl as a probe medium, with saturated Calomel electrode as the reference.

RESULTS AND DISCUSSION

The coating forms a homogenous film over the anodized surface. The polarization response for various compositions of the blend (refer Tab. I) is shown in Fig. 1. The figure shows a positive shift in the Corrosion Potential, E_{Cor}, indicating a further ennoblement of the anodized surface. This is in agreement with the model proposed by Tallman, et al (4). The corrosion rate $R_{Cor,}$, calculated by the standard procedure is tabulated for various compositions of the blende and the results are indicated in Tab. I. Based on these results, the best composition of the blend is predicted to be 30% of PDMS and 70% of PANi (wt%).

The efficiency of the polymer blend to serve as an anticorrosive film is further corroborated by the impedance measurements. From Fig. 2, it can be clearly seen that the charge transfer resistance increases with ageing for in the corrosive environment. An interesting deduction can be made from this observation, viz., under these circumstances, the redox-property of the conducting polymer is utilized to the maximum extent, in passivating the aluminium surface effectively. This deviation from the normal behavior of dielectric coatings is attributed to the role of conducting polyaniline in stabilizing the oxide layer, while permitting the reduction of oxygen at the polymer/electrolyte interface.

This study, thus, highlights the potential use of conducting polyaniline dispersion, as a corrosion resistant precursor, even in the presence of a dielectric medium.

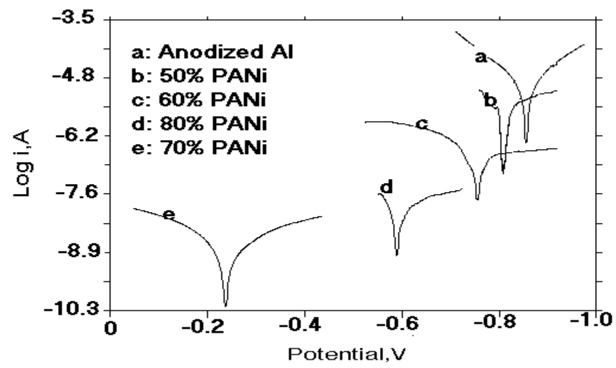

Fig. 1 Polarization Curves for various compositions of PANi/PDMS blend coating on Anodized Aluminium

Wt % of PANi	E_{Cor} (mV)	I_{Cor} (A)	Rate of Corrosion (mpy)
Anodized Al	-843	3.350×10^{-7}	1.452×10^{-4}
50	-804	6.823×10^{-8}	2.957×10^{-5}
60	-786	8.414×10^{-9}	3.646×10^{-6}
70	-250	7.674×10^{-11}	3.325×10^{-8}
80	-595	7.362×10^{-10}	3.190×10^{-7}

Tab. I. Rate of Corrosion for various compositions of PANi /PDMS Blend

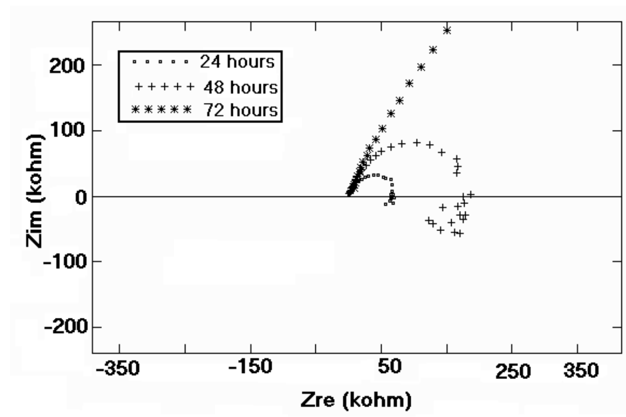

Fig. 2 Nyquist plot of PANi/PDMS blend coated anodized aluminium for various periods of exposure

REFERENCES

1. S.M. Cohen, Corrosion Eng. **51,** 71 (1995)

2. S. Pitchumani, S. Mohan, D. Kanagaraj, V. Raj, S. Karthikeyan, S. Shriram, ECS Extended Abstracts, 200th Annual Meeting, (2001) Abstract No. 512

3. S. Pitchumani, K.L.N. Phani, S. Ravichandran, S.K. Rangarajan, Indian Patent 424/Del/93

4. D.E. Tallman, Y. Pae and G.P. Bierwagen, Corr. Sci. **55**, 779 (1999)

* Author for Communication