Bulletin of Electrochemistry 6 (6) June 1990, pp 588–589

Performance study of acrylic coatings by electrochemical techniques

Guruviah, Syed Azim and S M Krishnan

Central Electrochemical Research Institute, Karaikudi-623 006, INDIA

An acrylic resin was prepared from acrylic ester monomers and blended with a liquid epoxy resin along with pigments, additives and solvents to get a thermosetting acrylic paint. The paint was coated over sandblasted steel specimens and stoved at 433K for 20 minutes at three DFT levels of 40, 60 and 100 μm. They were immersed in NaCl, NaOH and HCl over a period of 3 months and their corrosion resistance behaviour was assessed using AC impedance technique.

Key words: Acrylic coatings, impedance technique

INTRODUCTION

In recent times, many workers have successfully monitored and reported the behaviour and breakdown of organic protective coatings over metals by impedance measurements [1–4]. This technique also enables to analytically examine the various processes involved in the protective action of these coatings [5,6].

EXPERIMENTAL

An acrylic resin was polymerised from methyl methacrylate,

TABLE–I: Impedance measurement values for the thermosetting acrylic paint

S.No.	Electrolyte	DFT (μm)	OCP (mV)	R_s (ohm·cm^{-2})	R_p (ohm·cm^{-2})	$C_{dl}F$ (Farads)	
1.	NaCl (3%)	40	i	−487	100	3.0×10^{3}	5.3×10^{-8}
2.			f	−661	10	100	7.0×10^{-6}
3.		60	i	−643	-	4.0×10^{5}	1.9×10^{-9}
4.			f	−656	100	1.4×10^{4}	1.8×10^{-8}
5.		100	i	−593	-	7.0×10^{5}	2.3×10^{-9}
6.			f	−667	117	2.7×10^{3}	6.2×10^{-8}
1.	HCl (1%)	40	i	−613	1000.0	1.0×10^{8}	1.02×10^{-8}
2.			f	−678	251.1	1.5×10^{5}	6.30×10^{-6}
3.		60	i	−638	630.0	3.2×10^{8}	3.16×10^{-8}
4.			f	−790	200.0	2.0×10^{6}	5.00×10^{-7}
5.		100	i	−616	1000.0	1.0×10^{9}	1.00×10^{-9}
6.			f	−678	316.0	1.6×10^{5}	6.30×10^{-6}
1.	NaOH (1%)	40	i	−251	125.7	2.5×10^{7}	3.90×10^{-9}
2.			f	−207	-	6.3×10^{5}	1.59×10^{-6}
3.		60	i	−350	251.0	6.3×10^{7}	1.58×10^{-9}
4.			f	−249	158.5	3.2×10^{4}	3.20×10^{-6}
5.		100	i	-	316.2	3.0×10^{8}	1.25×10^{-9}
6.			f	−240	-	1.3×10^{6}	7.9×10^{-6}

Note: i represents the initial value and f represents the final value at the end of 3 months

0256-1654/90/$ 3-50/

2-ethyl hexyl acrylate, styrene and acrylic acid monomers, blended with epoxy resin, dispersed with pigments, solvents to get a thermosetting acrylic paint as described earlier [7]. The paint was coated over sand blasted mild steel specimens of size 2.5 x 2.5 cm to get DFTs of 40, 60 and 100 μm. They were masked by wax to expose an area of 1 cm^2 and immersed in 3% NaCl, 1% HCl and 1% NaOH for a period of 3 months. Impedance measurements were carried out at corrosion potential at regular intervals using a three electrode set up. PARC's electrochemical impedance system was used for the study as described earlier[8]. In this study Bode plots were used to determine the values of solution resistance R_s, paint film resistance R_p and double layer capacitance C_{dl}, for assessing the corrosion behaviour of the developed system.

RESULTS AND DISCUSSION

Bode plots were made at corrosion potential for the painted samples by applying 10 mV AC signal. From the plots, solution resistance, R_s, paint film resistance R_p and double layer capacitance C_{dl} values were calculated. They are given in Table I. Though measurements were carried out at regular intervals during the period of 3 months, only the initial and final values are given in the Table. R_p values suggest that this coating has better corrosion resistance properties in all the electrolytes as found in the earlier studies using accelerated tests [7]. The R_p values suggest that though the coating is highly resistant to acidic and alkaline media, it is comparatively less resistant in 3% NaCl, in which case a higher DFT has to be used to make it equally resistant. Also from the Table, it can be seen in all the three cases, the R_p values decrease slowly with increase in immersion time, and the C_{dl} values show a reverse trend. This clearly indicates permeation of respective ions into the paint film [8].

CONCLUSION

It is concluded that the thermosetting acrylic paint prepared in CECRI shows good corrosion resistance properties in the electrolytes studied.

REFERENCES

1. L Beaunier, I Epelboin, J C Lestrade and H Takenwuti, *Surface Technol*, **4** (1976) 273
2. G W Walter, *Proc 7th Int Cong on Metallic Corrosion*, Brazil, Oct. (1978) p 1744
3. F Mansfeld, M W Kendig and S Tsai, *Corrosion*, **38** (1982) 478
4. M Kendig, F Mansfeld and S Tsai, *Corros Sci*, **23** (1983) 317
5. J Wolsterholme, *Corros Sci*, **13** (1973) 521
6. T Szaner and A Brandt, *J Oil Colour Chem Assoc*, **67** (1984) 13
7. S M Krishnan and S Guruviah, Indian Pat filed.
8. Syed Azim and S Guruviah, *10th Int Cong on Metallic Corrosion*, Madras, Nov (1987) p 139