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CATHODIC ELECTROPAINTING FROM EPOXY RESIN SYSTEMS

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ABSTRACT

Studies on cathodic electrocoating were undertaken with epoxy resins modified with linseed oil fatty acids. Different pigments were incorporated in the system and the conditions for getting satisfactory coatings were standardised.

Key Words : Electropainting, epoxy resins

INTRODUCTION

Electropainting technology has been developed to a commercially successful process for the application of coatings [1,2]. The process has found wide application in view of the advantage it has over the conventional techniques of paint application. Though developed as a one coat system, it can now be used for giving a second coat by modifying the bath and thus facilitating application of primers and finish coats. Though the anodic deposition technique was the first to be developed, at present cathodic technology has become more prominent due to certain specific advantages it has got over the former [3]. The main advantage is that the cathodic coating can have more corrosion resistance and colour retention due to the non-dissolution of the substrate material. This is especially important when the substrate is steel, and the problem of iron dissolution and consequent contamination of the deposit and the bath, are quite significant. Different water soluble cathodic resin systems are reported [4]

In this paper, results of the studies made on the electrodeposition from water-soluble epoxy resin systems modified with linseed oil fatty acid are presented.

EXPERIMENTAL

Water soluble resin based on oil modified epoxy was prepared by reacting epoxy resin and a base and then with linseed oil fatty acid. Epoxy resin was intially dissolved in minimum amount of organic solvent and the prescribed quantity of amine added and digested for 30 mins. at 120°C. The fatty acid was then added and again digested for 1 hr at 130°C. The resulting resin was water solubilised using acids like acetic acid, lactic acid etc.

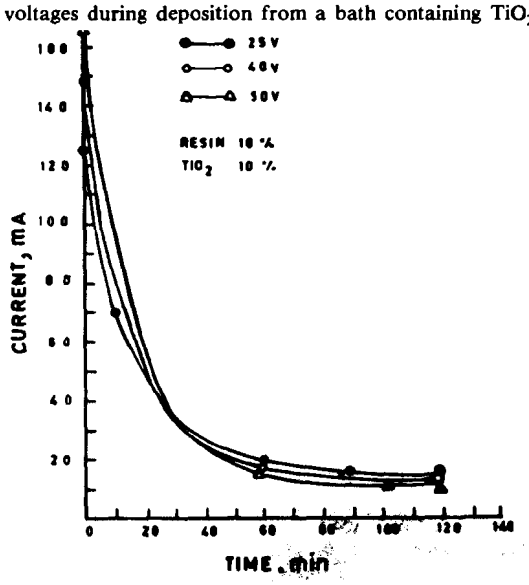
Pigmentation of bath was done by means of titanium dioxide and iron oxide separately. The pH of the bath was suitably adjusted with acetic acid. Deposition was carried out by varying the concentrations of the resin, PVC and also pH over mild steel panels of 5 x 10 x 0.15 cm; 10 x 10 x 0.15 cm; and 10 x 20 x 0.075 cm. The plates were cleaned well. Both sand blasted polished plates were used. Two anodes were used wherever deposits were needed on both sides. Deposition was carried out varying the parameters such as applied voltage from 25 V to 50 V, concentration of the binder and pigment volume concentration.

Effect of addition of the pigments, namely, rutile titanium dioxide and red iron oxide, were studied at two different PVC's of 10% and 15% and at two different resin concentrations of 10% and 15%. Deposition was carried out at 25V, 35V, 40V and 50V for 2 mts. duration. The deposit was later baked for 30 mts. at a temperature of 150°C and subjected to the following tests for evaluating the properties:

i) Scratch hardness test
The test was carried out as per IS specification 101 using ATVM 601 scratch hardness tester. A maximum load of 3 kg was used.
ii) Adhesion
Adhesion was assessed by the pull off test using an adhesive tape as per ASTM D 3559.
iii) Flexibility was assessed using the conical mandrel apparatus as per ASTM D522.
iv) Impact test
This test was done using 1.13 kgs weight. Samples were subjected to impact test by making the weight fall from different heights and coating examined for any damage.
v) Immersion in sodium chloride
Samples were kept immersed in 3% NaCl solution for a period of 30 days. The deposit was examined periodically and observation recorded.

RESULTS AND DISCUSSION

Earlier study (5) with water soluble system of the resin alone and without pigmentation had shown that a resin concentration of 10-15% gives satisfactory electrodeposits. In the present study, using TiO_2 and iron oxide as pigments, two resin concentrations were selected varying the PVC at both these concentrations. Figure 1 shows the variation of current with time at different voltages during deposition from a bath containing TiO_2. The



initial current is more when the concentration of resin is more as well as when the PVC is increased. During deposition the pattern of current fall is almost similar. Table I shows the effect of variation of resin and PVC concentrations on the nature of the deposit. Although at higher voltages

Table I: Effect of variation of concentrations of resin and PVC

Sl.No.	Pigment	Resin concentration(%)	PVC (%)	Nature of dip
1.	TiO_2	10	10	Uniform, smooth and glossy
2.	TiO_2	10	15	Uniform and smooth
3.	TiO_2	15	10	Uniform and smooth
4.	TiO_2	15	15	Slightly rough
5.	Iron oxide	10	10	Uniform and smooth
6.	Iron oxide	10	15	Uniform and smooth
7.	Iron oxide	15	10	Uniform and smooth
8.	Iron oxide	15	15	Rough deposit

the amount of paint deposited is more, there is an optimum and beyond which the deposit tends to become more matt thereby clearly showing the inclusion of more of pigment. This type of behaviour is quite favourable for deposition of primers or undercoats where pigment concentration should be more in the coating. However, at too high a PVC and voltage, the deposits become rough which should be checked. A resin concentration of 10% with 15% PVC will be an ideal bath for getting satisfactory deposits.

Table II gives the weight of paint deposited at different concentrations of resin and PVC. From the two resin concentrations selected, viz. 10 and

Table II: Weight deposited per unit area at different PVCs in TiO_2 bath Time = 2 mins.

Sl.No.	Resin concentration (%)	PVC (%)	Voltage (V)	Wt. of coating per sq. inch. (mg)
1.	10	10	25	49
2.	10	10	50	59
3.	10	15	25	58
4.	10	15	50	72
5.	15	10	25	52
6.	15	10	50	70
7.	15	15	25	60
8.	15	15	50	70

15% and the two PVCs 10 and 15%, it can be seen that the maximum weight deposited is at the lower resin concentration and higher PVC and as such there is no need to go in for higher resin concentration to get maximum deposition efficiency.

Table III shows the results of the physical tests and corrosion resistance studies carried out with the coating taken from a bath having a specific composition. The performance of the coating may be seen to be quite satisfactory.

Table III: Physical and corrosion resistance tests
Resin concentration 10% PVC 10% and Voltage 40 V

No	Nature of test	Result
1.	Scratch hardness test	Passes 3 kg.
2.	Adhesion test	Passes
3.	Flexibility	Passes 0.3 cms
4.	Impact test	Passes 25 cms
5.	Immersion in 3% NaCl for 30 days	Not affected

CONCLUSION

It is possible to get satisfactory electrodeposits from pigmented systems of water soluble modified epoxy resins. Smooth and glossy deposits could be obtained at a resin concentration of 10% at 15% pigment volume concentration and vice versa. Beyond 15% resin concentration and 15% PVC the coating has a tendency to become rough.

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