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Electrocoating from aqueous systems of epoxy ester

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Epoxy esters offer good corrosion protection and are used for primer coatings for protection against corrosive environments. The paper deals with the formulation of water soluble epoxy ester resin, electrodeposition of the resin and paint from aqueous bath and evaluation of the coatings.

Key words: Electrodeposition, aqueous epoxy ester, corrosion protection

INTRODUCTION

There are a number of resin systems which can be electrodeposited like alkyds, epoxies, acrylics, butadienes etc. [1,2]. Because of the uniformity of the coating and the excellent bonding strength to metallic substrate, apart from the elimination/reduction of toxic hazards, the method has become very popular and is being used by several metal finishing and other industries, especially for automotive coatings. Epoxy resins can be modified to get anodic as well as cathodic systems [3].

EXPERIMENTAL

Preparation of resin and formulation of bath

Water soluble epoxy ester resin was prepared by heating appropriate amount of epoxy resin (epoxy equivalent 450-600), linseed fatty acid, maleic anhydride and small amounts of solvents like glycols. After preparing the resin which takes altogether 5-6 hours, electrocoating bath was formulated by solubilising the resin in water by means of organic base. Experiments were conducted to standardise the conditions for getting satisfactory coatings.

Preparation of electrocoated panels

Pretreated mild steel panels of size 5 cm × 7.5 cm were electrocoated for standardising the deposition conditions. Coatings were obtained at different concentrations, voltages, pH and temperatures. The optimum pigment concentration for getting quality coatings were also standardised with titanium dioxide and micaceous iron oxide pigments.

Evaluation of coatings

Electrocoatings were evaluated for their physical and corrosion resistance properties. Scratch hardness test was carried out as per BS 3900, impact by ASTM specification G14-77, adhesion using Hounsfield Tensometer and flexibility as per ASTM D 522. Resistance and capacitance measurements were conducted using Wayne Kerr Universal Bridge No. 244.

RESULTS AND DISCUSSION

Satisfactory coatings are obtained at a resin concentration of 10-15%. The current falls uniformly near zero within two minutes of deposition, showing that the deposit is uniform and with minimum pores at voltage upto 150V. Beyond this voltage the deposit gets ruptured in the middle and the current fall is nonuniform.

At low temperatures, the coating is not satisfactory as far as uniformity is concerned. Temperature in the range of 298-308K produces smooth and uniform coating. Coating without high pigmentation is glossy at this range of temperature though this is not of relevance when used as a primer. Deposits beyond 318K tend to be pitted.

As previously observed, in the case of certain anodic resins, the deposition at pH range 7-8 gives satisfactory results and beyond this, the thickness of the coating starts reducing; pH 7 to 7.5 is found to be optimum.

Table I shows the results of evaluation of physical and corrosion resistance properties. The thickness of the coating obtained which can be varied slightly by varying the operating parameters is in the range of 30-35 μm. The bond strength value indicates that the coatings have got very good adhesion to mild steel substrate. It has been found that the adhesion value is actually more than the value indicated as the coatings undergo cohesion failure rather than adhesion failure.

The resistance to sodium chloride by salt spray and immersion is over 500 hours which indicates its protective property in marine environments. Capacitance and resistance measurements by using 3% sodium chloride solution shows that the film provides good barrier

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TABLE–I: Characteristics of deposits

No.	Properties	Results
1.	Adhesion (psi)	4200-4500
2.	Scratch hardness	Passes 3 kg.
3.	Flexibility	Passes 1/4″
4.	Salt spray resistance (3% NaCl)	Over 500 hrs.
5.	Immersion in 3% NaCl solution	Over 20 days.
6.	Resistance mega ohms (30 days)	40 (Initial) 20 (Final)
7.	Capacitance nF (30 days)	1.4 (Initial) 1.87 (Final)

protection. The resistance drops slightly in the first 24 hours and then remains almost constant for a long period. The initial drop can be attributed to the slight swelling of the film caused by the uptake of small amount of water.

Pigmentation with titanium dioxide and micaceous iron oxide produces deposits with very good scratch resistance and abrasion resistance.

CONCLUSION

Anodic electrocoatings produced from aqueous epoxy ester system offer good corrosion protection and can be successfully used as a primer in highly corrosive marine environments.

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