Studies On Physio-Chemical And Anti-Corrosive Behavior Of Modified Polyesteramides Coatings From Sustainable Resource

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Introduction:

Corrosion has long been recognized a process that caused colossal loss to structures and machinery amounting to more than 7-8% of GNP in developed countries and Rs. 38,000 crores per annum in India. Among various methods to control corrosion, polymeric coatings and paints have found wide applications. Normally surface coatings are obtained through petroleum resources, while are predicted to exhaust in the near future. This has led to spiraling increase in the cost of petrobased chemicals, polymers and plastics. There is an urgency to find an easy, non-toxic, non-polluting and eco-friendly method of corrosion protective coatings. Seed oils can play an important role in this end. These oils, while constitute a major renewable resource, are generally non-toxic and are important source for production of several polymers like alkyd, polyetheramide, polyurethane, polyesteramide resins and so on.

Polyesteramide resin is amide modified alkyd possessing both amide and ester groups, with improved characteristics in terms of drying, hardness, water resistance over normal alkyds, it displays a good combination of properties of both polyamide and alkyd resins. A number of polyesteramides have been developed from different seeds oils with good chemical and excellent thermal resistance.

It is observed that polyesteramide coatings take shorter time (10-20 minutes) for curing at elevated temperatures (at an above 175 ^{O}C) while considerably longer time (12-20days) for room temperature curing. Besides this, their appreciable intractability, limited solubility in organic solvent, high melting points and high curing temperatures make the curing of polyesteramides a high energy consuming as well as multi-step process.

It is therefore, desirable to develop a simple curing route operative at ambient temperature to produce coatings of improved physico-mechanical and anticorrosive properties compared to high temperature baked coatings of polyesteramide.

Therefore the aim of our work is to *modify polyesteramide resin to overcome the aforementioned drawbacks and to investigate the possibility of their use in the field of surface coatings.*Several attempts have been made to develop polyesteramide resin through their modification by BMF, styrene, metal octoate/naphthenate (as activator), and urethanes; PEAs still require necessary research work in lowering the curing temperature, and in improving their the physico-mechanical, anticorrosive properties and antimicrobial activity of polyesteramide resins.

Our approach is novel since in India, which is rich in agro waste and has poor petrochemical feed stocks, utilization of exclusive seed oils, which are non-toxic, biodegradable, non polluting and relatively harmless to the environment, could offer significant advantages over fossil fuels. Greater utilization of these indigenously available resources will not only provide an array of valuable economic products but also open an opportunity for employment potential and self-reliance as well as saving in foreign exchanges.

The thesis has been divided in six chapters as follows:

Chapter 1

INTRODUCTION AND LITERATURE REVIEW

This chapter includes general introduction, literature review on corrosion protective coatings and their applications. Types and kinds of oil based polymeric resins such as polyamide, polyimide, epoxies, polyurethane, IPN, polyetheramide, alkyds and polyesteramide for coatings applications, and their characterization such as physico chemical, physico-mechanical and corrosion resistance by standard methods while structural characterization by FT-IR, ^{1}H-NMR and ^{13}C-NMR spectral techniques, along with techniques of coatings. This chapter also includes statement of problems, aims and objectives.

Chapter 2

LOW TEMPERATURE SYNTHESIS, CHARACTERIZATION AND EVALUATION OF ANTI-CORROSIVE PROPERTIES OF LINSEED OIL BASED POLYESTERAMIDE

Synthesis of linseed oil based polyesteramide at lower temperature in the absence of organic solvent through condensation polymerization reaction [Sf-LPEA] is given. This approach was employed to overcome the use of volatile organic solvents [VOCs] used

during processing and application of resins, which are ecologically harmful. The spectral techniques were used to confirm the structure of Sf-LPEA. Coating was prepared on mild steel strips of standard size. The physico-chemical, physico-mechanical and chemical resistance properties of the resin were investigated by standard methods. DSC and TGA were used to determine respectively the curing behaviour and thermal stability of the resin. The comparative study of Sf-LPEA properties with reported polyesteramide [LPEA], which are normally synthesized at higher temperature in organic solvent. It was found that Sf-LPEA exhibited improved physico-mechanical and chemical resistance properties as well as higher thermal stability compared to LPEA, and hence can find application as corrosion protective coating.

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Chapter 3

SYNTHESIS, CHARACTERIZATION AND EVALUATION OF ANTI-CORROSIVE PROPERTIES OF Acrylic Modified Polyesteramide Coatings Synthesized from LINSEED OIL

Synthesis and characterization of bifunctional acrylic copolymer [poly (styrene-co-maleic anhydride)] modified polyesteramide has been described to improve the physico-mechanical and chemical/corrosion resistance properties in terms of alkali resistance, scratch hardness, and thermal stability and to reduced baking temperature of plain polyesteramide. The structural elucidation of modified polyesteramide resin (SCPEA) was carried out by spectral studies. The physico-mechanical and chemical-resistance properties were investigated by standard laboratory methods and thermal stability was investigated by thermo gravimetric analysis (TGA). A comparative study of properties of PEA and SCPEA was carried out. It was observed that the SCPEA showed better properties than the reported polyesteramide.

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Chapter 4

SYNTHESIS, CHARACTERIZATION AND EVALUATION OF ANTI-CORROSIVE PROPERTIES OF AMBIEnt cured polyesteramideS from LINSEED OIL

Ambient-cured polyesteramide (APEA) resin was synthesized by complete replacement

of phthalic anhydride by poly (styrene-co-maleic anhydride) [SMA]. To further improve the physico-mechanical and chemical/corrosion resistance performance of APEA film by minor inclusion of phthalic anhydride was made in APEA [APEAPh]. The physico-chemical characterizations of both resins were carried out by standard methods. The structure elucidations of these resins were carried out by spectral analysis. The thermal stability behaviour was studied by TGA and DSC techniques. Physico-mechanical and chemical/corrosion resistance test of APEAPh coatings show that the presence of phthalic anhydride in APEA considerably enhances the physico-mechanical and corrosion resistance performance.

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Chapter 5

SYNTHESIS, CHARACTERIZATION AND EVALUATION OF ANTI-CORROSIVE AND ANTIBACTERIAL PROPERTIES OF tRANSITION METALs incorporated polyesteramideS from linseed oil

We have taken an attempt to incorporate transition metals in linseed oil based polyesteramide [M-LPEA] and determine the effect of completely filled, half filled and incompletely filled d orbitals of metals in polyesteramide resins. The structural elucidations of M-LPEAs were carried out by spectral studies. The physico-mechanical and chemical/corrosion resistance properties were investigated by standard methods and thermal stability studies were performed by thermal analysis method. It was observed that the completely filled metals incorporated polyesteramide resins give baked coatings whereas half and partially filled metals incorporated polyesteramide resins give room temperature cured coatings. These coatings show higher thermal stability and better film properties than plain polyesteramide. Antibacterial activity of these resins were also performed by agar diffusion method and found that that transition metal incorporated polyesteramide can also used as antibacterial coatings.

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Chapter 6

SYNTHESIS, CHARACTERIZATION AND EVALUATION OF ANTI-CORROSIVE PROPERTIES OF Urethane modified zinc and Cadmium incorporated polyesteramide from LINSEED OIL

We have taken an attempt to introduce urethane linkages in zinc and cadmium incorporated polyesteramide for improvement in their curing as well as physico-mechanical and chemical/corrosion resistance performance. The structural elucidations of urethane modified zinc and cadmium incorporated polyesteramide were carried out by spectral studies. The physico-mechanical and chemical/corrosion resistance properties were investigated by standard methods and thermal stability was investigated by thermo gravimetric analysis method. Antibacterial activities of these modified polyesteramides were also performed by agar diffusion method and can be used as antibacterial coatings. The aforementioned properties of urethane modified zinc and cadmium incorporated polyesteramide compared with unmodified zinc and cadmium incorporated polyesteramide and observed that urethane modified zinc and cadmium incorporated polyesteramides shows room temperature cured film with improved physico-mechanical and corrosion resistance properties than unmodified zinc and cadmium incorporated polyesteramide.

Present chapter also describes the suggestion for future plan.