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A Polyesteramide Resin from *Jatropha curcas* Seed Oil for Anticorrosive Coating

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In recent years application of renewable resources has become the matter of choice in the field of coating and paint industries. India is an agriculture based country crowned with various plants and herbs. The seed oil of some plants and herbs neither used for edible purpose nor significantly used for medicinal purposes. Jatropha curcas seed oil having suitable unsaturation in the fatty acid chain, and also has low viscosity provide an opportunity to utilize in making polyesteramide resin. Polyesteramide resins contain sufficient amide linkage and known to improve water and chemical resistance performances. The polyesteramide of J.curcas applied on mild steel strips of required sized to investigate the protective efficiency. It has been found that the polyesteramide developed from the J.curcas not only protect the metals from the environmental attack but also required low solvent for application, i.e. friendly to environment also.

Key words: *Jatropha curcas* seed oil, Polyesteramide.

In recent years synthesis of the polymers from renewable resources has attracted considerable attention of the research scientists and academia through out the world, because of the continuous hike in price of petroleum and high rate of depletion of natural mineral resources 1-7. Furthermore, it has also been forecasted that petroleum stocks moving of the point of exhaustion by the late of 21st century 8-10 consequently much attention is focused in the development of materials from forest product which could be grown again and again. This has inspired investigation of the natural renewable sources as an alternative for the polymer industry1, 3, 11-13. These polymers having great application in different areas such as in adhesive, varnishes, Coatings materials, encapsulating materials and surgical equipments etc 5,6,14-16.

India possess vast forest resources and crowned with various herbs, plant and farm land, yielding variety of oil bearing seeds such as castor17-18, linseed19, Vernonia 20 *Anona squamossa*21, *Pungamia glabra* 22, soybean 23-24, cocos25, sunflower25-26, tung oil27-28 safflower 29-30, canola 30etc . The advantage of these polymeric starting materials include their low cost, ready availability and annual renew ability of resultant polymer material after the targeted use 4-5,31. The oil from various seeds contains fatty acid that vary from 14-22 carbon in length with 1-3 double bond30,32. Polyesteramide resins are amide modified alkyds largely used in paint and Coatings industries because of its better performances against environmental attack.

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JATROPHA tree yield non edible seeds which contain about 48% oil into appropriate percentage fatty acid. Although the *Jatropha* oil is of significant importance, but very little work has been reported in literature regarding its utility in synthesizing polymers30,34. Keeping the fact that *Jatropha curcus* will be going to one of the most abundant oil bearing plant.

In present work we have utilized the seed oil of the *Jatropha curcas* in making polyester amide resin with double objective utilization of a non-conventional seed oil in making coating material and reduce the pressure on utilization of petrochemical

EXPERIMENTAL

Materials

Oil was extracted from cursed seed of *Jatropha curcas* through soxhlet apparatus, petroleum ether (60-80) was used as solvent. The fatty acids composition of the oil is given in table-1. Diethanolamine purchased from H.D.Fine chemicals, sodium methoxide, xylene and pthalic acid were procured from Merk, India.

Syntheses of N.N-bis (2-hydroxy ethyl) ***Jatropha curcas*** **oil fatty amide (HEJCA)**

Diethanolamine 0.32 mole and sodium methoxide 0.007 mole were taken in four neck round bottom flask fitted with an electrical stirrer, thermometer, dropping funnel and condenser. The reaction mixture was heated to 120-140^{o} C . The *Jatropha curcas* oil (0.1 mole) was added drop wise into the reaction mixture over a period of one hour. The progress of reaction was monitored by TLC[35].

After the completion of reaction the product was dissolved in diethylether and washed with dilute aqueous 15% sodium chloride. The etherial solution was filtered and evaporated in a rotatory vacuum evaporator to obtain HEJCA.

Synthesis of ***Jatropha curcas*** **polyesteramide (JCPEA)**

HEJCA, pthalic acid in equal molar ratio and xylene as a solvent were placed in four necked round bottom flask fitted with a Dean Stark Trap, thermometer and mechanical stirrer. Reaction mixture was heated up to 160^{o}C. The progress of reaction was monitored by taking acid value at regular interval.

Characterization

The chemical characterization acid value, iodine value, hydroxyl value and saponification value of the oil HEJCA and Polyesteramide was done as per standard laboratory method and given in table 1. The solubility of polyesteramide in various organic solvent was checked at room temperature.

Preparation and testing of polymeric coatings

Coating of JCPEA were prepared on commercially mild strip 30x10x1 mm for chemical resistance and 70x25x1 for scratch, hardness and impact resistance. Coated samples were baked for 5-35 minutes in an oven at different temperatures (140-160^{o}C) to find out the optimum baking time and temperature . The best coatings were obtained by baking at 150 c for 20 minutes. The coating thickness were found between 120-150 μm.

RESULTS AND DISCUSSION

Chemical reaction and polymerization scheme of HEJCA and JCPEA are given in figure-1.The progressively decrease in acid value confirm the formation of polyesteramide [ ].

The various physical and chemical characterization of the oil, HEJCA and JCPEA are given table 1 and table 2.Table 2 shows progressive decrease in iodine value confirm the increase in

Table 1. Characterization of *Jatropha curcas* seed oil

Characteristic	***Jatropha curcas* oil**
Oil content	40%
Gardener color (no.)	4.0
Specific gravity	0.927
Refractive index	1.475
Iodine Value	75.18
Acid Value	11
Saponification Value	180

Table 2. Characterization of HEJCA and JCPEA

Characteristic	HEJCA	JCPEA
Yield	80.68	85.16%
Acid Value	8	10.6
Iodine Value	30	24
Saponificaton Value	144	132
Specific gravity	0.938	0.948

chain length of the polymer.The performances of the coating material in different chemical and corrosive environment is summarized in table-3.It is found that stability of JCPEA coatings is quite good in saline and acidic environment, however the performances in alkaline solution is poor. The JCPEA coating passes the flexibility test on 1/8 and 1/4 conical mandrels. The scratch resistance performances of the coating materials was studied on scrath harder apparatus. The coating of JCPEA passes the scratch hardness test upto the 2.5 kg. These results are comparable with other oil based coatings.

Table 3. The Physico-mechanical Properties of JCPEA

Test	Performance
1. Flexibility (1/8, 1/4 Conical Mandrals)	Pass
2. Scratch hardness (in kg)	2.5
3. Immergence test	
a. 2% HCl Solution (60 h)	A
b. 2% H_2So_4 Solution (48 h)	B
c. 3.5% NaCl Solution (2 h)	B
d. 5% NaOH Solution (2 h)	D

A= unaffected, B= slight loss in gloss, C= slight loss in gloss and weight and D= fill ruptured

CONCLUSION

The polyesteramide of *Jatropha curcas* seed oil is found to comparable with the reported traditional oil based polyesteramide. The color value of *Jatropha curcas* polyesteramide is very low therefore it provides an additional opportunity to develop different coloured coating materials. The JCPEA holds promise for commercial application.

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