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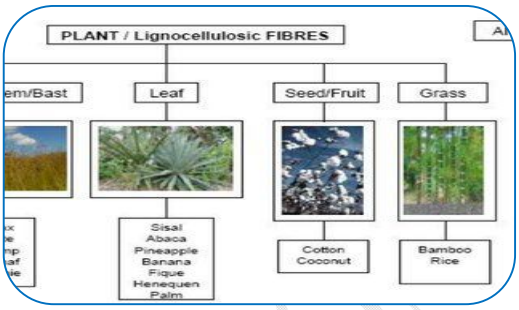
A REVIEW ON ADVANCED METHODS OF EPOXY COMPOSITES SYNTHESIS BASED ON VEGETABLE OILS USING NATURAL FIBRES



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ABSTRACT:

In recent years the use of renewable resourses' in the fabrication of various polymeric materials has been re-energized because of the environmental concerns. This review present the synthesis of epoxy composites based on vegetable oils using natural fibres. Vegetable oils are good renewable source of raw materials. It is readily available and inexpensive. They are used to prepare various types of polymers. They have high contents of unsaturated fatty acid and can be converted into epoxy fatty acids by epoxidation. Epoxy composites were prepared from epoxy resin and natural fibres. The properties of resins and epoxy composites were examined by NMR, FT-IR, TGA, DTA, SEM analysis.

KEYWORDS: *Vegetable oils, Epoxidation, Epoxy resin, Natural fibres, Epoxy composites.*

1. INTRODUCTION

Epoxidised vegetable oils can be used as plasticizers, stabilizers and lubricants in the polymer industry. Vegetable oils are quite rich in nature. Soybeen oil, castor oil, rape seed oil, palm oil etc are different examples of vegetable oils. Vegetable oils are triglycerides which contain different fatty acids such as oleic acid, linolenic acid, linolic acid, stearic acid and palmitic acid. These oils are readily available and low-cost, can be used to synthesize various types of polymers (Blayo, 2001).

The unsaturation present in vegetable oils can be chemically adapted to a value added product by a complicated reaction called 'epoxidation'. Due to the high reactivity of the oxirane ring epoxides can also act as a raw material for synthesis of variety of chemicals such as alcohols (polyols), glycols, lubricants, plasticizer and stabilizer for polymers and their demand is increasing day by day. Vegetable oil represents one of the cheapest and most abundantly used in various fields due to theirs low toxicity and inherent biodegradability (Biermann, 2000).

Thus the economic value of the vegetable oil could be increased by converting thse vegetable oil into epoxidized vegetable oil (Petrovic, 2002). The double bonds in the vegetable oil are used as reactive sites in the coatings and they can also be functionalized by epoxidation. Thus the high molecular weight products can be obtained by ever-increasing the cross linking (Mungroo, 2008).

Petrochemical based resin such as epoxy, polyester and vinyl ester find more engineering applications because of their properties such as high stiffness and strength. But these resins have serious drawbacks in terms of biodegradability, initial processing cost, energy consumption and health hazards (Goud, 2006). Therefore a number of researchers have been studied vegetable oils are alternative feedstock to substitute for petroleum. Therefore it needs to be explored for the various applications in chemical industry (Valad, 2000).

2. EPOXY COMPOSITES BASED ON VEGETABLE OILS

Saheb and Jog explained the natural fiber composites. These natural fibers are low cost fibers with low density and high specific properties. These are biodegradable and non-abrasive. This work reported the natural fiber reinforced composites with special reference to the type of fibers, matrix polymers, and treatment of fibers and fiber-matrix interface (Saheb, 1999).

Hong and Wool developed the composite material from soybean oil and keratin fibers. The hollow keratin fibers were not filled by resin infusion and the composite retained a significant volume of air in the hollow structure of the fibers. They found that the retained air, the dielectric constant, *k*, of the composite material was in the range of 1.7–2.7, depending on the fiber volume fraction, and these values are appreciably lower than the conventional silicon dioxide or epoxy, or polymer dielectric insulators (Hong, 2005).

3. EPOXY BIOCOMPOSITES

Takahashi *et al.* made a study on biocomposites composed of epoxidized soybean oil cured with terpene -based acid anhydride and cellulose fibers. Epoxidized soybean oil (ESO) was cured with a terpene-based acid anhydride at 150°C, and the thermal and mechanical properties of the cured product were compared with ESO cured with hexahydrophthalic anhydride is prepared by compression molding method. The tensile strength of ESO-TPAn/lyocell composites increased with increasing fiber content (Takahashi, 2008).

4. NATURAL FIBER COMPOSITES

Adekunle *et al.* synthsised soybean oils for use as a biobased thermoset resins in structural natural fiber composites. Biobased thermosets resins synthesized by functionalizing the triglycerides of epoxidized soybean oil with methacrylic acid, acetyl anhydride, and methacrylic anhydride. The obtained resins were characterized by FTIR, ^{1}H-NMR, and ^{13}C-NMR spectroscopy to confirm the functionalization reactions and the extent of epoxy conversion. (Adekunle, 2010).

Valodkar *et al.* developed biopolymers as effective fillers in natural rubber. Biocomposites of natural rubber blend was prepared by mastication technique. They are examined by their mechanical properties morphologies and compared with composites of the filler carbon black. The moisture-uptake of the composites is studied. They found that the adhesion between the polymer matrix and fillers increased, the water uptake decreased (Valodar, 2011).

5. EPOXIDATION OF VEGETABLE OILS

Saurabh *et al.* explained the epoxidation of vegetable oils. Most of the vegetable oils have high contents of unsaturated fatty acid and can be converted into epoxy fatty acid by conventional epoxidation, catalytic acidic ion exchange resin, metal catalyst epoxidation or using chemoenzymatic epoxidation. This study shows that In-situ epoxidation of vegetable oil is more convenient and economically viable method for large scale epoxidation which shows utility especially in plasticizer and stabilizer used in polymers (Saurabh, 2011).

6. BIOPOLYMERS FROM VEGETABLE OIL

Sheela and David synthesized biopolymers from sesame oil with vinyl acetate and N- Vinyl 2-pyrrolidone co monomers. Glycerolysis of sesame oil was carried out first then the resin was prepared by the reaction of the monoglyceride with cyclohexane dicarboxylic anhydride at 80 Celsius for 2 hours. The prepared polymers were characterised by NMR and FT-IR analysis. Biodegradation of the polymers is also tested by soil burial test and SEM micrographs assess surface damage and to look for the presence and nature of microbial growth (Sheela, 2015).

7. NATURAL FIBER REINFORCED COMPOSITES

Mohammed *et al.* developed a review on natural fiber reinforced polymer composite and its applications**.** The effects of various chemical treatments on the mechanical and thermal properties of

natural fibers reinforcements thermosetting and thermoplastic and composites were studied. A number of drawbacks of NFPCs like higher water absorption, inferior fire resistance, and lower mechanical properties limited its applications (Mohammed, 2015).

Asim *et al.* explained the review on pineapple leave fiber and its composites. From the socioeconomic potential, PALF can be a new source of raw material to the industries and can be potential replacement of the expensive and nonrenewable synthetic fibre. However, few studies on PALF have been done staging the interfacial adhesion between fibres and reinforcement compatibility of fibre. In this review, author covered the basic information of PALF and compared the chemical, physical, and mechanical properties with other natural fibres (Asim, 2015).

Roslan *et al.* explained the mechanical properties of bamboo reinforced epoxy sandwich structure composites. Square and triangular honeycomb structures were manufactured by the slotting technique. The experimental data were showed that the unidirectional bamboo-epoxy composite with 0° orientation presented the highest tensile strength. They found that the smaller cell size of honeycomb is competent to absorb more energy than the bigger one (Roslan, 2015).

Gupta *et al.* proposed the potential of jute fibre reinforced polymer composites. This study focused the mechanical characterization of jute fibre reinforced polymer composites. The effect of various factors such as fibre loading, fibre size and chemical treatments are also studied. They found that the mechanical properties were increased by the chemical treatments (Gupta, 2015).

Baroncini *et al.* explained the recent advances in bio-based epoxy resins and bio-based epoxy curing agents. To transform epoxy resins into crosslinked networks with desirable thermal and mechanical properties, the resins must be cured with a curing agent. This review encompasses recent developments using bio-based epoxy resins and bio-based epoxy curing agents (Baroncini, 2016).

Shuhimi *et al.* proposed the effect of operating parameters and chemical treatment on the tribological performance of natural fiber composites. The influences of chemical treatment were characterized by scanning electron microscopy (SEM) analysis. They found that the operating drawback, fiber orientation and chemical treatment has significant effects on the tribological performance of natural composites and clear understanding of the factors that affect the tribological performance is very essential in performance improvement on natural fibers reinforced polymer composite for potential applications (Shuhimi, 2017).

8. EPOXY NANOCOMPOSITES

Saba *et al.* made a study on isolation and characterization of cellulose nanofibers (CNFs) from the Northern Bleached Softwood Kraft. Epoxy nanocomposites were prepared by hand lay-up technique and prepared nanocomposites were characterized by using SEM, TEM, FT-IR and XRD analysis. This shows the additions of CNFs considerably enhance the mechanical properties of epoxy composites but a remarkable improvement is observed for 0.75% CNFs as compared to the rest epoxy nanocomposites (Saba, 2017).

CONCLUSION

Epoxy resins are important polymeric materials they are used to plastisizer and stablizer in polymers. Vegetable oil based epoxy composites prepared by using natural fibre as reinforcing phase. Natural fibre reinforced composite materials having sensible matrix behaviour. Epoxy composite materials have excellent mechanical and thermal properties. They are readily available inexpensive and biodegradable. They have wide range of applications.

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