CHAPTER 1

INTRODUCTION

PERFORMANCE OF POLYMER BLEND MATRIX EPOXY/ 5% UNSATURATED POLYESTER AND NATURAL FABRIC "HILDEGARDIA POPULIFOLIA" FOR USAGE IN GREEN COMPOSITES
1.1. INTRODUCTION

The general tendency of man is to lead a comfortable life. For this, he needs new and useful materials. Search for the new materials has been going on since times immemorial. Many new materials have been developed in the 20th century. Composite is one such material, which has revolutionized the concept of high strength.

The composite, as its name indicates, is made by combining two or more dissimilar materials in such a way that the resultant material is endowed with properties superior to any of its parental components. Unlike a chemical compound, the components of a composite neither take part in a chemical reaction nor do they dissolve completely or merge with one another. They remain strongly bonded together while maintaining an interface between each other and act in concert to give much-improved performance.

Composites are not new materials. The first composite was probably made in Biblical times when man added chopped straw to clay to make stronger bricks. The steel rod reinforced concrete widely used in modern buildings is also an example of a composite. With the in-exorable march of civilization, man felt that more novel materials are required. Necessity, as it is said, is the mother of invention. So, to meet his ever growing and diversifying needs, man started fabricating new materials from a judicious combination or manipulation of the old.

The tremendous progress in Science and Technology brought about the Industrial Revolution in the 19th century. As this revolution progressed and encompassed every aspect of human life, be it travel, work or play, an increasing need was felt for materials capable of resisting fatigue, environmental corrosion, pressure, stress, and exposure to chemicals. They

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also have to be adaptable for use under extreme temperature variations. Newer and more versatile materials in the form of composites were evolved as an answer to this need. Their emergence has a tremendous impact in several fields like transportation, marine engineering, chemical equipment and machinery, construction, electrical and electronic equipment, space technology, sports goods, and medical engineering. The aerospace and defence industries were also benefited greatly from the lightweight yet extremely hard composites that have evolved a lot. These alternatives to conventional materials took the industry by storm. Composites manufacturing is one of the fastest growing industries with the United States being the major consumer of these materials. The global consumption of composites is now around two million tons annually and is growing at the rate of ten percent [1] every year. In 1995, the advanced composite materials found a major market in aerospace field to the tune of 66% followed by sports (16%), and automobiles industry (14%). The field-wise distribution of the consumption of the advanced composite materials is shown in Figure 1.1.

Composites are materials based on the controlled distribution of one or more materials, termed as reinforcement, in a continuous phase of second material, called the matrix. The reinforcement is added to provide strength and stiffness to a composite. The matrix is also known as 'Binder' material. Its function is to make the composite resistant to degradation.

The ultimate performance of a composite depends not only on the matrix and the reinforcement but also on the matrix-reinforcement interface. The interface is a critical part of the composite technology [2-3]. A third material called coupling agent or compatibilizer controls it. Alkyl silanes, Organo titanates, high molecular weight carboxylic acids and esters etc., are some of the coupling agents. These coupling agents have two different functional groups on either side of the molecule; one is attracted to the resin and the other to the surface of the filler [4]. However, when both the matrix and fiber are organic in nature, greater
Figure 1.1. Field wise distribution for the consumption of the advanced composite materials.

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bonding is expected between these components and as a result coupling agent is generally not required [5].

1.2. NATURAL FIBRE - POLYMER COMPOSITES

A number of scientists tried to develop different types of composites by combining various resins with natural fibres [6-14]. Apart from sisal, other natural fibres like jute, coir, banana, and bamboo fibres were also used for the development of polymer composites [15-32]. Several reports are available in the literature on the development of natural fibre-thermoplastics [33-40].

In order to select the components for fabricating the composites, it is customary to test their performance. Keeping this in mind, the author tested the performance of the blend she developed as matrix and the natural fibre bamboo and the fabric "Hildegardia populifolia" as reinforcement. As some of the natural fibres are also used as reinforcements in thermoplastic composites, the author studied the thermal degradation behaviour of bamboo fibres to ascertain whether they are stable at the melting temperature of common thermoplastics.

1.3. AIM AND SCOPE OF PRESENT WORK

Though polymers are serving the society to the maximum extent, simultaneously they are also posing some environmental problems due to their non-judicious use. The main problem with most of the polymers is their non-degradable nature. It is the primary duty of all scientists in general and polymer scientists in particular to see that the environment is not polluted by the polymers. Keeping these things in mind, the author planned to test the performance of the natural fibre reinforcement and the matrix. Natural fibres are biodegradable. The author selected the blend of thermosetting epoxy resin and another

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thermosetting unsaturated polyester resin as matrix. The author selected the bamboo fibres as reinforcement as it is a fast growing species and is renewable. The author also selected the natural fabric *Hildegardia*, as it is widely available in Kadiri area of Anantapur district which is about 90 Km from Sri Krishnadevaraya University. Bamboo is a composite by itself in which the fibres are held together by lignin binder. *Hildegardia* has crystalline $\alpha$-cellulose besides an amorphous minor component of hemi-cellulose. The author treated the *Hildegardia* with alkali solution in order to remove the hemi-cellulose and grease before use. The author used a blend as the matrix because the Unsaturated polyester resin is toughening agent. As epoxy is a brittle matrix, the author wanted to improve its property by incorporating a toughening component in it.

The performance of the blend depends on the miscibility of its components. The author studied the miscibility of the polymer blend developed by her employing viscosity, ultrasonic velocity, and refractive index techniques. As a continuation of this work, the author wants to develop in future the green composites using the matrix materials developed and the natural fibre/fabric procured by her.

1.4. PUBLICATIONS BY THE AUTHOR

The author communicated some of the results of the work as research papers to internationally reputed refereed journals. Four research papers have already been accepted for publication and the revised manuscript of author paper has been submitted for publication. The reprints and acceptance letters of these papers are included at the end of this dissertation.
REFERENCES


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