A DETAILED STUDY ON MECHANICAL PROPERTIES OF NATURAL FIBRES

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Abstract – *Natural fibers will take a major role in emerging"green" economy based on energy efficiency, the use of renewable materials in polymer products, industrial processes that reduce carbon emission and recyclable materials that minimize waste. Composite materials is a material made from two or more constituent material with significantly different properties, when combined produce a material with different characteristics than the individual components. Last few decades have seen composite material being used in various application. Many types of natural fiber have been investigated for their use in daily accessories, automobiles, etc. Natural fibers in simple definition are fibers that are not synthetic or manmade. These composie materials made up of natural fibres are called bio composites.*

Keywords-Natural fibers, composite material, recyclable, automobiles.

1. INTRODUCTION

The term natural fibers defines the fibers that are produced by plants, animals and geological process. Natural fibers can be used for high tech application like in automobile industries. Natural fibers are classified into plant fibers, animal fibers and geological fibers. The use of natural fiber as reinforcing materials in both thermoplastics and thermoset matrix composites provides positive environmental benefits with respect to ultimate disposability and best utilization of raw material. It has been observed that natural fiber reinforced composites have properties similar to traditional synthetic fiber reinforced composites.

The most commonly used natural fibers include jute, coir, sisal, rice husk, goat hair, coconut, hemp, flax ,abaca, etc. There are some other composite materials other than natural fibers reinforced like carbon fiber, cellulose fiber, fiber glass composites, micro fiber composites, phenolic composites.

Some of the other unrecognized strong natural fibers include banana stem, pineapple leaf, bamboos and so on. These fibers gives enormous strength than the commonly used natural fibers. Glass fibers are used because they provide additional strength and stiffness when mixed with the resins. Banana fibers are easily available in the environment where we exists. Many banana tress which falls down due to natural disaster can also be made into use by this process.

Banana fibers are basically rich in their tensile property which is one of the essential mechanical property. During the extraction of banana fiber, the squeezed wax like liquid from the stem can be used as a organic manure in cultivation of plants.

Because of the lack of adequate knowledge of the physical and mechanical properties of pineapple leaves it has not been properly utilized in industrial sides. The pineapple fiber are rich in impact strength. Pineapple fibers are one of the easily available fibers in the world. Pineapple leaves when burned produce toxic gases like CFC and CO2 which in turn has adverse effect in the environment. Therefore these products are taken into account as they are available readily. The fibers from the pineapple can be extracted by using ceramic or by using fiber extracting machine.

Epoxy resins are one of the commonly used resin in the field of natural fibers. Epoxy resins being inexpensive has superior properties is extensively used as indispensable insulating material in heavy apparatus. These properties lead them to extremely versatile materials like circuit board, structural fiber reinforced composites, electronic component. Hybrid fibers and composites form the key to successful development of next generation aerospace propulsion and power system. Polymer matrix composites plays a significant role in future automobile components. In this 21st century we are in need of light but stronger materials, therefore these polymer matrix composites has a major role. From automobile to aerospace, medical, military technology, corrosion resistant material composite materials are considered as the most important factor.

The aerospace industry is estimated to consume about 50 percent of advanced composites production in the future. Compared with metal, the principal advantages of advanced composites in aerospace application are their superior strength and stiffness resulting in weight saving of 10 to 60 percent over metal design.

2. CHARACTERSTICS OF NATURAL FIBERS

The natural fibres possess some of the important mechanical properties which makes them suitable to replace the existing components of automobiles. The uni-directionally arranged natural fibers posses less strength than the fibers arranged in the mat forms. The Mechanical properties of fiber reinforced composites depends upon the properties of the constituent materials type, quantity, fiber distribution and orientation. Recently the efforts to reduce the weight of automobiles by the increased use of plastics and their composites.

2.1 BANANA FIBRE

The banana fibers are waste products of banana cultivation, therefore without any additional cost these fibers can be obtained for industrial purposes. The chemical composition of banana is cellulose, hemi-cellulose and lignin. Its one of the highly strong fiber with smaller elongation. It has a unique property to absorb and to release moisture very fast. The tensile, flexural, hardness increases when the fiber content is increases with the resins added. The tensile strength of banana fibre ranges from 527-914 Mpa and its young's modulus is about 27-32 Gpa. Therefore this fiber when combined with reinforcing agent and other natural fiber there is high chance of possessing rich mechanical properties.

2.2 PINEAPPLE FIBRE

Pineapple fiber is one of the fiber which has a good potential in reinforcement in thermoplastic composite. Pineapple leaf fiber serving as reinforcement fiber in most of the plastic matrix as it is cheap, exhibiting superior properties when compared to other natural fibers. The acid and alkali treated fibers shows greater amorphous region than the untreated one. Maximum shrinkage was found to occur within 20 minutes of the alkali treatment. Pineapple leaf fiber also lose strength and elongation in wet condition. This loss of strength in these condition is due to the penetration of water molecule in the multi-cellular region. Pineapple when treated with 18% of NaOH imparted the crimp and enhanced the breaking elongation of pineapple leaf fiber. The elastic modulus and tensile modulus values are in range of 15-53Gpa and from 210-695Mpa.

2.3 JUTE FIBRE

Jute is the second most important fiber after cotton due to its versatility. The jute fiber comes from the stem and the ribbon of the jute plant. Jute fibers are primarily composed of plant materials called cellulose and lignin. The jute fiber when mixed with epoxy exhibit better tensile and compressive strength. Strength increases with increases in fiber percentage. But impact strength has no noticeable changes after addition of fiber. The tensile modulus increased linearly with increasing content of jute fibers. The mechanical properties of composite materials depend on many factors, which include fiber length, shape, size, composition, orientation and distribution.

2.4 COIR FIBRE

Coir is the fibrous material found between the hard, internal shell, and the outer coat of a coconut. They are pale when immature, but later become hardened and yellowed as a layer of lignin is deposited on their walls. Each cell is about 1 mm long and 10 to 20 μm in diameter. The coir fiber is relatively waterproof, and is one of the few natural fibers resistant to damage by saltwater. . Flexural strength was increased up to 25 % with coconut fiber only. The strength of coconut fiber reinforced composites tends to decrease with the amount of fiber which indicates ineffective stress transfer between the fiber and matrix.

2.5 SISAL FIBRE

Sisal fiber are strong light in weight, abundant, non-abrasive, non-hazardous and inexpensive. They can serve as excellent reinforcing agent for plastics. It is one of the most extensively cultivated hard fiber in the world and it accounts for

half the total production of textile fiber. The reason for this is due to the ease of cultivation of sisal plants, which have short renewing times and is fairly easy to grow in all kinds of environments.

3. REINFORCING AND ADHESIVES AGENTS

Epoxy resin refers to a type of reactive pre polymer and polymer containing epoxide groups. The mechanical performance of composite materials is usually associated with the properties of their reinforcement. The matrix materials also play an important role as is the case for thermosetting resin matrix composites which can be designed for specific applications by properly changing the polymer used as matrix. The mechanical, physical and chemical properties of the polymer matrix can be tailored by changing the processing conditions and the type and amount of the chemical substance used as hardener. The versatile characteristic of epoxy and its diversity made it suitable for different industrial applications such as laminated circuit board, electronic component encapsulations, surface coatings, potting, fiber reinforcement, and adhesives. Epoxy resin is superior to other types of resins because it has low shrink during cure, and excellent moisture and chemical resistance. It is impact resistant, it has good electrical and insulating properties. The various combinations of epoxy resins and reinforcements gives a wider range of properties obtainable in molded parts. Epoxy resin is different from polyester resins with regard to curing. It is cured by a curing agent called "hardener" rather than a catalyst.

Glass fiber also called fiberglass. It is material made from extremely fine fiber of glass. Fiberglass is a lightweight, extremely strong, and robust material. Glass fibers are useful because of their high ratio of surface area to weight. However, the increased surface area makes them much more susceptible to chemical attack. By trapping air within them, blocks of glass fiber make good thermal insulation. In contrast to carbon fiber, glass can undergo more elongation before it breaks. There is a correlation between bending diameter of the filament and the filament diameter. Glass fiber is one of the excellent reinforcing agent for a thermosetting plastics.

4. CONCLUSION

A composite is combination of two materials in which one of the materials, called the reinforcing phase, is in the form of fibers, sheets, or particles and is embedded in the other material called matrix phase. The reinforcing material and the matrix material can be metal, ceramic or polymer. A composite material can be prepared by putting together all the above mentioned natural fibers along with some reinforcing agent. Since these fibres are possessing high mechanical properties they will be playing a vital role in all the industrial applications and also it can replace the current composite materials made up of natural fibres at less cost itself. The alkali treated natural fibres shows greater results when compared to the untreated natural fibres. Treating the natural fibers with different percentage of alkali solution gives different results, therefore according to those results these fibres can be used for versatile applications. Therefore these natural fibers can be made into a fibrous composite material which may result in reduction of waste in the environment.

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