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FABRICATION OF COMPOSITE MATERIAL USING COCANUT COIR FIBER

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Abstract: Fiber reinforced polymer composites has been used in a variety of application as class of structure material because of their many advantages such as relatively low cost of production, easy to fabricate and superior strength compare to neat polymer resins. Reinforcement in polymer is either synthetic or natural. Synthetic fiber such as glass, carbon etc. has high specific strength but their fields of application are limited due to higher cost of production. Recently there is an increase interest in natural composites which are made by reinforcement of natural fiber. Because the natural fiber give good property at lower cost of production In this connection an investigation have been carried out to make better utilization of coconut coir fiber which is very cheaply and easily found in India. The objective of the present research work to study the mechanical properties of coconut coir reinforced with epoxy composites. The effect of fiber loading and length on mechanical properties like tensile strength, flexural strength, hardness of composites is studied.

Keywords: coconut, composite, environment, husk, epoxy resin

I. INTRODUCTION

Composites are made up of two or more physical or mechanically distinguishable materials. Polymer matrix composites are plastics within which fibers are embedded. The plastic is known as the matrix, and the fibers orientated within it are known as the reinforcement. Natural fiber-reinforced polymer composites are gaining paramount importance day by day in the composite research field and industry due to their versatile diversified nature and renewability. They possess a range of potential advantages, especially with regard to their environmental performance. When natural fiber composite waste is incinerated, they do not cause net emission of carbon dioxide to the environment. The matrix type, amount, and properties of the filler and fiber–matrix interaction mainly affect the properties of lingo cellulosic natural fiber reinforced polymer composites. The properties of fiber –matrix interface are different from the properties of the bulk matrix. The interface also transfers stress between fiber and matrix and controls the properties and durability of the composites. Natural fibers, obtained from lingo cellulose, contain strongly polarized hydroxyl groups. As a result, they are generally hydrophilic. These hydroxyl groups are responsible for water absorption and deformation of the resultant products. As a result, the hydrophilic natural fibers are inherently incompatible with hydrophobic polymer. One way of increasing the compatibility is chemical treatment of natural fiber.

Hot compression is a well-known technique of producing polymer matrix composites. During hot compression, both heat and pressure are applied; thus, it produces god quality composites. This present chapter describes the manufacturing process of coir fiber-reinforced polymer composites using hot compression technique. The characterization techniques and properties of the composites are also included in the chapter

CLASIFICATION OF NATURAL FIBER

On the basis of the source origin, natural fibers are classified into three categories they are

- Mineral Fibers
- Animal Fibers
- Plant Fibers

Mineral Fibers:

Mineral fibers are the naturally occurring fiber or slightly modified fibers obtain from minerals. It has various categories they are following: Asbestos is the only naturally occurring mineral fiber. The Variations in mineral fiber are the serpentine and amphiboles. The Ceramic fibers are glass fibers, aluminum oxide, silicon carbide, and boron carbide. Metal fibers include aluminums fibers.

Animal fibers:

Animal fiber generally consists of proteins; examples mohair, wool, silk, alpaca. Animal hair (wool or hair) are the fibers got from animals e.g. Sheep's wool, goat hair (cashmere, mohair), alpaca hair, horse hair, etc. Silk fiber is the fibers collected from dried saliva of bugs or insects during the time of preparation of cocoons. Examples silk from silk worms. Avian fibers are the fibers from birds.

Plant fibers:

Plant fibers are generally consists of cellulose: examples cotton, flax, jute, ramie, sisal and hemp. Cellulose fibers are used in the Manufacture of paper and cloth.

The category of these fibers is as following: Seed fibers are the fibers obtain from the seed and seed case e.g. cotton and kapok. Leaf fibers are the fibers obtain from the leaves e.g. sisal and agave. Skin fibers are the fibers are obtain from the skin or blast surrounding the stem of the plant. This fibers having higher tensile strength than other fibers.

The natural fiber composites are very cost effective material for given applications:

- For the Storage devices: post-boxes, grain storage silos, bio-gas etc.
- For the Furniture: chair, table, shower etc.
- For the Electric devices: electrical appliances etc.
- For the Everyday applications: lampshades, suitcases etc.
- Transportation: automobile and railway coaches, boat etc.

MATERIALS AND METHODS

This chapter deals with the details of processing of the composites and the experimental procedures followed for their mechanical characterization. The raw materials used are:

- Epoxy resin.
- Coconut coir fiber.
- Hardener

The coconut fiber (Figure 3.1) which has been taken as reinforcement in this study is collected from local sources. The epoxy resins and the hardener are supplied by Ciba Geigy India Ltd. The moulds have been prepared of dimensions of 180×180×40 mm3. The coconut fiber of different length has been mixed with epoxy resins of their respective values by simple mechanical stirring and mixture are poured in various moulds, keeping the view on testing condition and characterization standards. The composites set of nine different compositions have been prepared with different length of coconut fiber. The details of composites and their compositions are shown in Table 3.1. A releasing agent has been use on mould sheet give easy removal of composites from the mould after curing. The air trapped is removed by sliding roller and the mould has been closed at temperature 30C for 24 hour. At a constant load of 50 kg. After curing, the specimen has been cut in suitable dimensions with help of diamond cutter for mechanical tests as per the ASTM standards.

Coconut coir:

Coir or coconut fiber is a hard structural commercial product that is obtained from the coconut husk. Coir is an outstanding substitute for cypress mulch or peat moss as it is a renewal resource, unlike peat and cypress. Its harvest does not cause environmental damage, as does peat mining, and it does not contain disease organisms transmittable to plants.

Individual coir fiber has a length of 0.3–1.0 mm, diameter of 0.01–0.0.2 mm, and aspect ratio of 35. It has medium- to large- sized and polygonal-rounded or elliptic-shaped lumen. The vascular bundle is collateral, which is surrounded by thick sclerenchymatous sheath. Lignin and hemicelluloses that form the cementing materials of fiber cells increase, while the pectin decreases with an increase in the age of the fiber. The fiber becomes stiffer and tougher with

SPECIMEN NOMENCLATURE (COIR FIBER) (%)	EPOXY RESIN (%)	HARDENER (%)
A – 20%	78%	2%
B – 40%	58%	2%
C – 50%	48%	2%

Wonders of coir:

- Not easily combustible
- Tough and durable
- Totally static free
- Easy to clean
- Flame retardant
- Provides excellent insulation against temperature and sound

Chemical Treatment of Coir Fiber:

Basic chromium sulphate and sodium bicarbonate treatments were conducted on coir fiber for increasing its compatibility with polypropylene. The chromium sulphate treatment was carried out for 3 h and called single-stage treatment (SST).On the other hand, the sodium bicarbonate was continued after the SST for two more hours. It was called double- stage treatment (DST). A pH of 2.5–3 was ensured during SST by preparing a 0.5 % chromium sulphate solution with 2/3 drops of HCl. The pH became 8–9 during the reaction. During SST, the coir was shaken for 3 h inside the prepared solution. The coir was then washed properly using distilled water.

The same procedure, with an addition of 0.02 % NaHCO3, was conducted for DST.
The coir fiber was shaken for two more hours inside the new solution. Finally, the treated fiber was taken out from the solution and washed with distilled water properly.

Finished fiber plate:

Mechanical testing of composites:

- Tensile test
- Rockwell Hardness test
- Charpy Impact test
- Bending test

The term compression molding belongs to the type of methods in which desiccated fortification is permeated inside the liquefied resin through sealed cavity or in closed mould called liquid composite molding (LCM). Replacement of synthetic fibers and reinforcements with natural plant fibers in the LCM processes significantly reduce the environmental influence; deliver supplementary economical, technological, ecological remunerations; and enhance the quality of composite parts prepared via customary open- mould processes. This technique offers a cost- effective substitute to prepare techniques besides conserving quality of the major composite part (Walbran et al. 2013). A growing list of composite manufacturing processes through closed mould . In the compression molding process, molding of material in a confined dimension and shape is done by applying pressure and heat.

Tensile test:

ASTM D3039 tensile testing is used to measure the force required to break a polymer composite specimen and the extent to which the specimen stretches or elongates to that breaking point. Tensile tests produce a stress-strain diagram, which is used to determine tensile modulus. The data is often used to specify a material, to design parts to withstand application force and as a quality control check of materials. Since the physical properties of many materials can vary depending on ambient temperature, it is sometimes appropriate to test materials at temperatures that simulate the intended end use environment.

Conclusions:

This experimental investigation of mechanical behavior ofcoconut coir reinforced epoxy composites leads to the following conclusions:

- In this work the successful fabrication of a coir fiber reinforces epoxy composites with different fiber lengths and loading is possible by simple hand lay-up technique.
- It has been noticed that the fiber loading and length has significant effect on the mechanical properties of the composites such as Rockwell hardness, tensile strength, tensile modulus .
- The mechanical properties of coir fiber reinforced composites increases with increase in fiber length and decrease with fiber loading. After tensile test, the fracture surface of composite reveals that the good interfacial bonding is responsible for better mechanical properties.

Scope for Future Work

For future scholar there is a very good opportunity to explore the preset area of research. The present work can be extended to investigate the other aspects such as fiber orientation; fiber treatment on mechanical behavior of coconut coir based polymer composite and the experimental values can be similarly analyzed.

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