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Evaluation of Mechanical Property Analysis of Jute and Glass Fibre Composites

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ABSTRACT

Composites are a combination of two materials in which one of the material is Called the reinforcing phase, is in the form of fibers, sheets, or particles, and is Embedded in the other material called the matrix phase. composites have been used extensively in applications such as pipes, boats, aerospace, and pressure vessels etc. Research to get new composites of desired properties is under progress. In these direction new composites with properties such as high specific strength, high chemical resistance, high resistance to electricity, high resistance to heat have been developed and compared.In this project jute and glass fiber and matrics composites used for polyster and epoxy have been manufactured, tested and the results have been compared. In comparison it was found that the mechanical properties and cost of jute manufactured by hand lay – up is better than Glass Fibre. This will find application in the fields, such as automotive body panels, decorative roofs, pipes, doors, windows, boats, chemical containers, coating for sea bridges, etc.

Keywords: Reinforcing Phase, FRP,Jute Fiber,Polyesters, Vinylesters Epoxies, Glass Fibers , Epoxy

I. INTRODUCTION

In the past decade, natural-fibers with thermoplastic and thermoset matrices have been embraced by car manufacturers and suppliers for door panels, seat backs, headliners, package trays, dashboards, and interior parts. Earlier FRP's are used in automotives for their light weight, high stiffness and strength for many applications. Due to the establishment of disposal methods for glass fiber reinforced plastics and their recycling laws are important contemporary subjects because many environment problems have appeared and worsened throughout the world. Due to global warming and other environmental effect, the search for the alternative and environmentally friendly material is a head. The use of natural fiber reinforced plastics represents attractive and suitable methods for replacing the synthetic fibers. Natural fibers are light and renewable; they are low-cost and high specific strength resource. Among various natural fibers, Jute fiber is of particular interest in that its composites have high tensile strength, high tensile modulus, and low elongation at break beside its low cost and eases of availability. Even though the information on the jute fiber is limited in literature, this work published in the field of jute fiber reinforced polymer composites with special references to the structure, physical and mechanical properties of the compare the jute and glass fiber composites. Among the various synthetic material that have been explored as an alternate to iron and steel for the use in automotive, plastics claim a major share as substitute. During the last decade, the study of filled plastic composites has simulated immense interest in meeting the shortage of plastic materials Plastics are used for almost everything from the articles of daily use to complicated structures; machine components etc.

Plastics find an extensive application as they are less weight, low water absorption, high stiffness and strength. In fact synthetic fibers like nylon, rayon, aramid, glass, polyester and carbon are extensively used as a reinforcement of plastics. At present due uncertain condition in the shortage and the cost of petroleum and it's by products there is a need to search for its alternate, which is nothing but natural. In recent years the vegetable/plant fibers proves itself as an alternative fibre to its synthetic counterpart.

Natural fibers are cheaper, bio–degradable and no health hazard. Furthermore natural fiber reinforced fibres are seen to have good potential in the future as a substitute. Natural fibers are extracted from various part of the plant. It is interesting to note that natural fibres such as jute, coir, banana, sisal, etc., are abundantly available in developing countries like India, SriLanka and some of the African countries but are not optimally utilized. At present these fibres are used in a conventional manner for the production of yams, ropes, mats and matting, as well as in making fancy articles like wall hangings, table mats, handbags and purses. Fibers such as cotton, banana and pineapple are also used in making cloth in addition to being used in the paper industry.

II. METHODS AND MATERIAL

Jute and Glass Fibre Preparation

Jute:

Jute plant not only gives the delicious fruit but it also provides textile fiber, jute fiber It grows easily as it sets out young shoots and is most commonly found in hot tropical climates. All varieties of jute plants have fibers in abundance. These fibers are obtained after the fruit is harvested and fall in the group of bast fibers. This plant has long been a good source for high quality textiles in many parts of the world.

The extraction of the natural fiber from the plant required certain care to avoid damage. In the present experiments, initially the jute plant sections were cut from the main stem of the plant and then rolled lightly to remove the excess moisture. Impurities in the rolled fibers such as pigments, broken fibers, coating of cellulose etc. were removed manually by means of a comb, and then the fibers were cleaned and dried. This mechanical and manual extraction of jute fibers was tedious, time consuming, and caused damage to the fiber.

Figure 1: JUTE

A special machine was designed and developed for the extraction of jute fibers in a mechanically automated manner. It consisted mainly of two horizontal beams whereby a carriage with an attached and specially designed comb, could move back and forth. The fiber extraction using this technique could be performed simply by placing a cleaned part of the jute stem on the fixed platform of the machine, and clamped at the ends by jaws. This eliminated elative movement of the stem and avoided premature breakage of the fibers. This was followed by cleaning and drying of the fibers in a chamber at 20˚C for three hours. The fibers were then labeled and ready for lamination process. The mechanical properties of these fibers were also tested and found to be greatly influenced by the condition of the fiber, whether the fiber was fresh or dried, and upon the part of the plant from which the fiber had been removed. The fibers were employed in a dry condition due to the knowledge that fiber wetness would directly influence the bonding between the fibers and the resin, resulting in weak adhesion.

Fresh jute fibers were collected after they were crushed by using a hand crushing machine. These fibers were then spread on a water proof sheet to reduce the moisture content. After approximately two weeks, the long jute fibers were shortened into a length of 10mm. Small size fibers were selected in order to design a composite with consistent properties. Due to the low moisture content of the jute fiber samples, no fungi grew during the storage. The jute fiber samples were then cleaned via pressurized water for about half an hour. This procedure removes fine dust particles in the jute fiber and organic materials from the samples. Then the fibers were dried with compressed air.

Glass Fiber:

Glass fibers are probably the most common of all reinforcing fibres for polymeric matrix composites. The major type of glass fibre is E-glass, which is a borosilicate glass with a little alkali present in its composition. E-glass represents one of the lowest costs of all commercially available reinforcing synthetic fibres, which is the major reason for its widespread use in the fibre reinforced composites industry.

In general, the principal advantages of glass fibres include high tensile strength, high chemical resistance and good insulating characteristics. On the other hand, the disadvantages are low modulus compared to other high performance fibres such as carbon and Kevlar fibres, relatively high specific gravity (among the commercial fibres), high cost (compared to natural fibres), sensitivity to abrasion with handling which frequently decreases tensile strength, low fatigue resistance and high hardness.

Polyester Resin:

Polyesters are one of the least expensive resins. Polyester has the advantage of being extremely inexpensive when compared with other thermoset resins i.e. vinylesters and epoxies. If the upside is cheap pricing, the down side includes poor adhesions, high water absorption, and high shrinkage. Polyester resins are only compatible with fiberglass fibers. Polyester is best suited for applications insensitive to weight and do not require high adhesion or fracture toughness. For instance if a simple inexpensive solid fiberglass part must be fabricated in open tooling in one operation and requires no secondary bonding. If shape accuracy is not critical, resistance to water is of no concern, and ventilation of the workspace is excellent, then polyester's a great candidate.

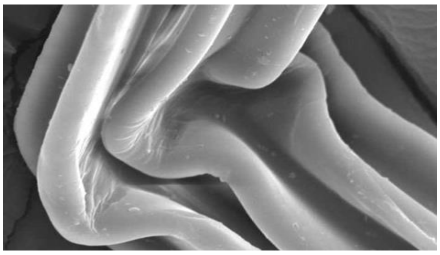

Figure 2: Polyester Resin

Epoxy Resin:

Epoxy resins are widely used in hand lay-up composites and are suitable for molding prepress. They are reasonably stable to chemical attacks and are excellent adherents having slow shrinkage during curing and no emission of volatile gases. These advantages, however, make the use of epoxies rather expensive. Also, they cannot be expected beyond a temperature of 140ºC. Their use in high technology areas where service temperatures are higher, as a result, is ruled out.

Figure 3: Epoxy Resin

III. RESULTS AND DISCUSSION

Hand lay-up is an open moulding method suitable for making a wide variety of composites products including: boats, tanks, bath ware, housings, RV/truck/auto components, architectural products, and many other products ranging from very small to very large. Production volume per mould is low; however, it is feasible to produce substantial production quantities using multiple moulds.

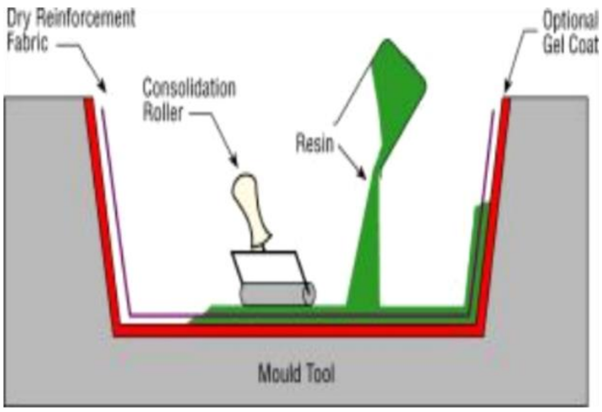

Figure 4: Hand Lay-Up

Table1: Values of mechanical properties for Tensile test

MECHANICAL PROPERTIES	JUTE			
	Speciimen-1	Specimen-2	Specimen-3	average
Ultimate/break load(KN)	0.410	0.430	0.630	0.49
Disp at fmax(mm)	1.000	0.900	1.200	1.033
Max, displacement (mm)	1.200	1.200	1.400	1.433
Area(mm)	48.000	48.000	24.000	40
Ultimate stress(KN/ mm^2)	0.009	0.009	0.026	0.014
Elongation (mm)	2.667	3.778	3.111	3.185
Yield stress(KN/ mm^2)	0.018	0.018	0.017	0.053

Table2: Values of mechanical properties for compression test

MECHANICAL PROPERTIES	JUTE			
	Speciimen-1	Specimen-2	Specimen-3	average
Ultimate/break load(KN)	0.330	0.355	0.415	0.366
Disp at fmax(mm)	1.300	0.900	1.600	1.266
Max, displacement (mm)	1.800	0.900	1.700	1.466
Area(mm)	150.000	150.000	150.000	150.0
Ultimate stress (KN/mm^2)	0.002	0.002	0.03	0.011

IV. CONCLUSION

The analysis of jute fiber and glass fiber hybrid composites based on the polyester and epoxy composites were investigated. The mechanical properties of Tensile and compression tests were performed on reinforced hybrid composites with fiber test results for break load, displacement, and max. Displacement, area, ultimate stress, elongation, and yield stress. The averages of all values are tabulated.

In this study, the mechanical properties of jute fiber and glass fiber on the polyester and epoxy composites are going to be investigated and increase in jute content will increase the mechanical properties.

A hybrid matrix composite contains the various natural fibers as the reinforcement phase was successfully fabricated.

Tensile and compression test are conducted for glass fibre as per the same method using in jute fibre and compare the values.

Jute and glass fibre composites after future tested in hardness test, impact test, flexural test and The homogeneity of natural fibres-matrix combinations and their bonding structures was characterized through scanning electron microscope analysis.

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