Mechanical Properties of Kenaf, Glass Fiber and Silicon Carbide Reinforced Polyester Hybrid Composite

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Abstract

The Kenaf, Glass Fiber And Silicon Carbide Was Mixed With Araldite (Polyester) Resin In Different Reinforcement And Different Percentage And Effects Were Experimented. The Resultant Composite Material Was Tested For Its Mechanical Properties Like Tensile Strength And Flexural Strength And Impact Strength Using Conventional Testing Machines And Results Were Recorded. It Has Shown An Improvement In These Mechanical Properties After Reinforcement By Fibers. The Value Of Mechanical Properties Will Increase With Increasing Percentage Of Reinforcement.

Keywords:*Kenaf, Glass Fiber and Silicon Carbide, Polyester, Tensile Strength, Flexural Strength, Impact Strength.*

1. Introduction

Synthetic composites are made from synthesized polymers or small molecules. Synthetic fibres do not depend either on an agricultural crop or animals farming. And basically synthetic fibre composite properties are stronger than natural composite but synthetic fibres burn more readily than natural and cost of cost of making materials would be more. Some of the synthetic composites are carbon/graphite, boron, Kevlar and ceramic composite.

Fiberglass (or fiberglass) is a type of fiber reinforced plastic where the reinforcement fiber is specifically glass fiber. The glass fiber may be randomly arranged but is commonly woven into a mat. The plastic matrix may be a thermosetting plastic most often epoxy polyester resin or vinyl ester, or a thermoplastic. The glass fibers are made of various types of glass depending upon the fiberglass use. These glasses all contain silica or silicate, with varying amounts of oxides of calcium, magnesium, and sometimes boron. To be used in fiberglass, glass fibers are made with very low levels of defects. Fiber glass is a strong lightweight material and is used for many products. Although it is not as strong and stiff as composites based on carbon fiber, it is less brittle, and its raw materials are much cheaper. Its bulk strength and weight are also better than many metals, and it can be more readily moulded into complex shapes. Applications of fiberglass include aircraft, boats, automobiles, bath tubs and enclosures, swimming pools, etcThe genesis of using kenaf for pulp production dates back to the last century, with the work of by watt in 1980. In the dictionary of economic plant india, watt mentioned that the fiber of kenaf was used in bengal for the production of pulp. He also noted that the paper made from kenaf fiber was superior in strength to the paper used in making bank of england note (liu, 2002). kenaf was introduced to the united states during the 1940s as a substitute for jute (fisher, 1994). In 1960, the United States department of agriculture (usda) identified kenaf as the most promising of a wide variety of annual plants for paper making (fisher, 1994; nieschlag, et al., 1960). experiments in producing kenaf as a raw materials for pulp in the united states showed that the unit costs would be about half of that used in the production.

The evaluation of procedures for harvesting kenaf continues to be an important aspect of commercialization. The harvest method depends on the production location, the equipment availability, processing method, and final product use.
Polyesters are one of the least expensive resins available to the FRP boat builder utilizing female tooling in the form of a mold. Polyester has the advantage of being extremely inexpensive when compared with other thermoset resins i.e. vinyl esters and epoxies. If the upside is cheap pricing, the down side includes poor adhesions, high water absorption, high shrinkage, and high voc's. 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 1.Kenaf natural fiber

Figure 2. Polyester resins

Table 1.Physical and Mechanical Properties of Glass Fibers

Properties	**Glass**
Density(g/cm^3)	2.55
Tensile strength	2400
Young's modulus(GPa)	70-90
Moisture Absorption %	3
Elongation at break (%)	-

The hand lay-up method time of curing depends on type of polymer used for composite processing. For example, for epoxy based system, normal curing time at room temperature is 24-48 hours. This method is mainly suitable for thermosetting polymer based composites. Capital and infrastructural requirement is less as compared to other methods. Production rate is less and high volume fraction of reinforcement is difficult to achieve in the processed composites. Hand lay-up method finds application in many areas like aircraft components, automotive parts, boat hulls, deck etc. Generally, the materials used to develop composites through hand lay-up method also volume and mass calculation is given in table 2.

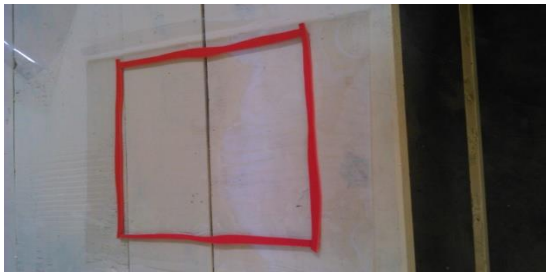

Figure 4. Hand lay process sheet

Figure 5. Sample preparation

Table 2.Volumes and Mass Calculation

Samples	Weight % of KenafFibre	Weight % of Glass Fibre	Weight % of Sic	Weight % of Polyester	Total Weight %
Sample 1	30	0	0	70	100
Sample 2	0	30	0	70	100
Sample 3	12.5	12.5	5	70	100
Sample 4	25	0	5	70	100
Sample 5	0	25	5	70	100

2. Materials and Methods

2.1 Tensile Test

Tensile test is a fundamental materials science TGST in which a sample is subjected to a controlled tension until failure. The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area. Form these measurements the following properties can also be determined. ASTM standard: d-3039

Figure 6. Tensile Test

2.2. FLEXURAL TEST

Flexural test is conducted to find out the flexural strength of the glass fibre epoxy composite specimens. Flexural test done in this work is by 3 point bend method. The specimen is simply supported at two points and the load is applied at the centre,

Figure 7. Flexural testing setup

Figure 8. Flexural testing specimen

2.3. Impact Test

Izod impact testing is an ASTM standard d-256 method of determining the impact resistance of materials. An arm held at a specific height. An arm held at a specific height is released. The arm hits the sample. The specimen either breaks or the weight rests on the specimen. From the energy absorbed by the sample its impact energy is determined. A notched sample is generally used to determine impact energy and notch sensitivity.

Figure 9. Impact testing machine Figure 10. Impact testing specimen different

3. Results and Discussion

3.1. Tensile Graphs & Bar Chart

The tensile strength of the kenaf, glass fiber with silicon carbide addition of hybrid polyester composite as shown in figure .the glass fiber addition of silicon carbide polyester composite material strength value is high compare to kenaf fiber composite and kenaf fiber with silicon carbide composite materials.

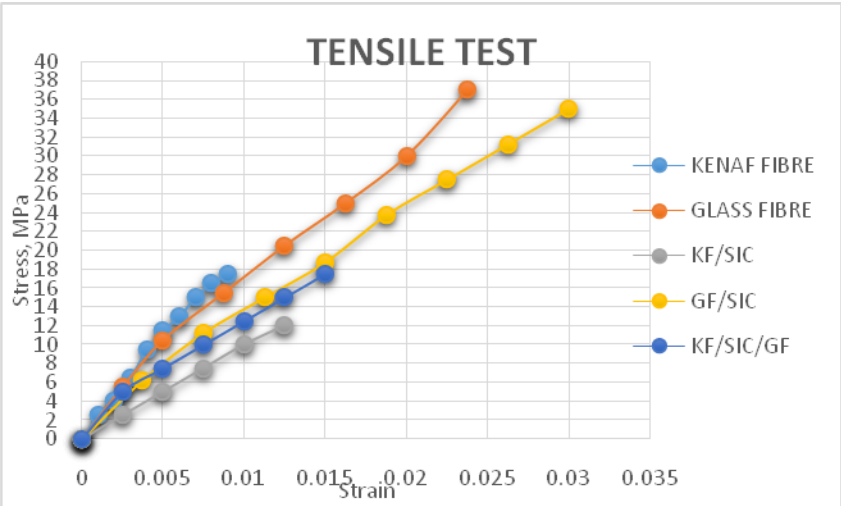

Figure 10.Stress VS Strain

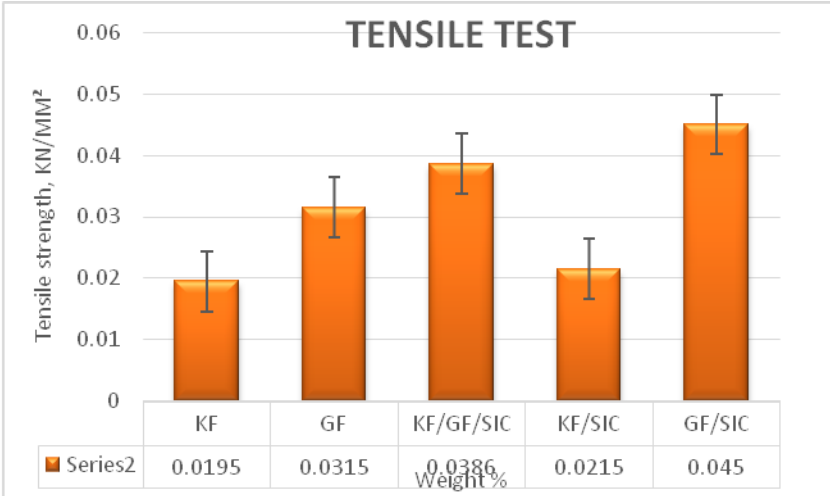

Figure 11.Tensile strength

3.2. Flexural Strength

Axial compression testing is a useful procedure for measuring the plastic flow behavior and ductile fracture limits of a material. Measuring the plastic flow behavior requires frictionless test conditions, while measuring ductile fracture limits takes advantage of the barrel formation and controlled stress and strain conditions at the equator of the barreled surface when compressions carried out with friction. The values of different sample graph as shown in figure 6 and 7.

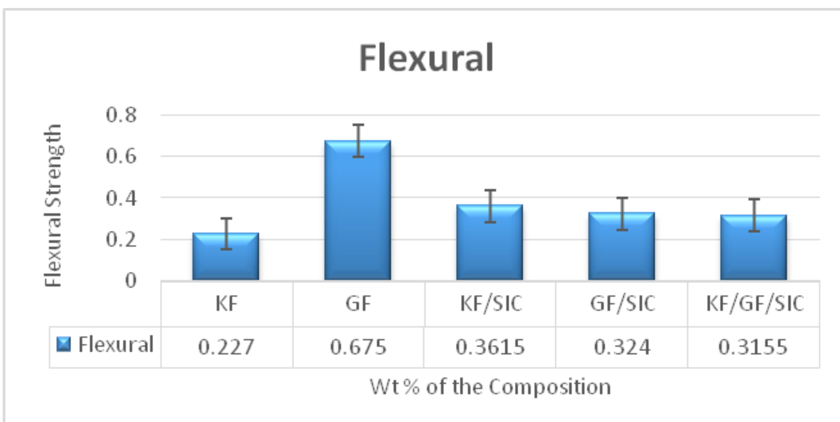

Figure 12.Flexural Strength

3.3. IMPACT TEST

The two tests use different specimens and methods of holding the specimens, but both tests make use of a pendulum-testing machine. For both tests, the specimen is broken by a single overload event due to the impact of the pendulum. A stop pointer is used to record how far the pendulum swings back up after fracturing the specimen. The impact toughness of a metal is determined by measuring the energy absorbed in the fracture of the specimen values are shown in figure 8.

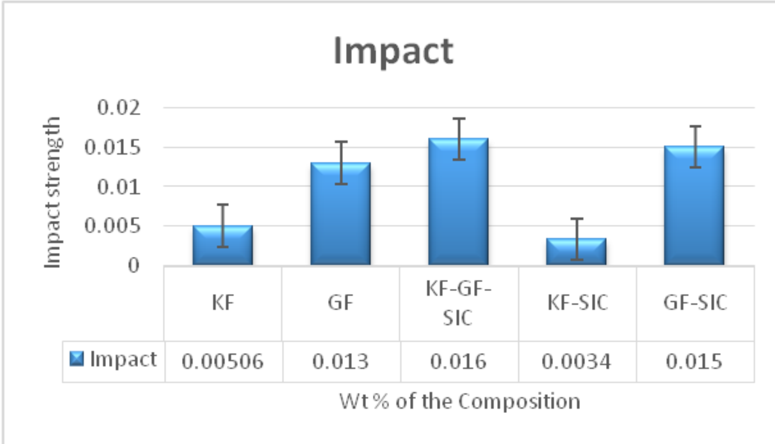

Figure 13. Impact Strength

4. Conclusion

The mechanical properties of kenaf fiber, glass fiber and silicon carbide in hybrid composite materials composites fabricated by die method were analyzed as a function of fibre length and fibre loading. The flexural properties were found to be higher in RTM composites fibre lengths, the stress value was lowered due the entanglements and fibre curling. It was found that increasing the fibre content had a positive effect on the flexural strength. The tensile, impact and flexural properties increased with fibre loading. The flexural strength increases with increase in fibre amount. the following are the results obtained from flexural, impact and tensile calculations, the maximum flexural strength, impact strength and tensile strength are obtained is kenaf fiber, glass fiber and silicon carbide composite materials.

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