

PREPARATION AND TENSILE CHARACTERIZATION OF JUTE BASED BIO COMPOSITES

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Abstract

In recent days the natural fibers of renewable natural resources have the ability to behave as a reinforcing material for polymer composites, instead of using the carbon and other artificial fibers in all this jute is commonly used natural fiber because of its merits like it is easily available less density less production cost with good mechanical properties. to this composite material the mechanical attributes depends on various factors like fiber length, quantity, etc in this research work attempts has made to investigate experimentally the impact of jute fiber glass fibre carbon fibre and epoxy resin on the tensile properties of composites at different temperatures and to determine the tensile properties jute based epoxy bio composites at different temperatures, composite consist of two materials in that first material is known as the reinforcing phase. It is of fibres sheets or particles form and it is mixed with another material known as matrix phase. It is noted that natural fibre composites are eco-friendly as compared to glass fibre composites and also shows that the jute fibre introduced the resin matrix as reinforcement it optimizes the mechanical properties.

Keywords: Fibres, Renioforcement, Bio composites, Matrix

1. INTRODUCTION

To produce 'green' products ecological concerns have initiated substantially interest in natural materials. Increasing crude oil prices of the raw material of synthetic fibre and high processing cost initiate the development concepts of sustainability and reconsideration of renewable resources because of the quick increasing environmental awareness, and increasing global waste problems. In automotive parts Natural fibre will find many applications as reinforcing material.

Natural fibre can be used in automotive applications, construction as well as in packaging industries with few drawbacks. in thermo set and thermoplastic matrices form. The conventional inorganic fibre in polymer matrix composites being replaced by natural fibres the use of natural fiber is increasing very rapidly in recent days. Natural fiber-reinforced thermoplastics have the ability to replace the wood-based material in many applications. in the future natural fibre have more biodegradability, light weight, low cost, compared to glass and carbon fibre ,leads to development of green material. , in recent years, natural fibres have attracted more and more interest as reinforcements for both thermoplastic and thermosetting polymer composites. Because Nowadays, the increasing environmental awareness around now more focus is to produce green materials some specific properties of Natural fibre enhances to replace it with glass and carbon fibre.

Bio-composites obtained from natural fibre and thermoplastics and thermo sets can maintain the balance between economy and environment due to this they can be used in the fields of aerospace, defence, marine, sporting goods, These materials exhibit good durability, design

flexibility and lightweight. Due to some desired properties of bio-composites they can be used for many special purpose applications.

In the present chapter we will mainly concentrate on the structure, properties and recyclability of commonly used natural fiber reinforced polymer composites. With the structures of other natural fibre.

1.1 Significance of Proposed Project

Several researchers have carried out extensive experimental investigations on various properties of composites such as strength, hardness, toughness, density of fiber reinforced composites. As reinforcing natural fibre yields environmental benefits with respect to disposability and utilization of raw material. It possesses good electrical resistance, resistance to fracture, low density, bio degradability and environmental friendly. It was reported that combination of natural fiber and polymer resin has great synergy. The volume fraction of reinforcement has also significant effect on hardness of natural fiber composites. In the present work, an attempt has made to prepare Jute Epoxy reinforced polymer composites, glass Epoxy reinforced polymer composites, carbon and jute Epoxy reinforced polymer composites to study the tensile properties at different temperatures.

1.2 Problem Statement

Preparation and experimental study on tensile properties of the Jute based bio composites at different temperatures.

1.2.1 Objectives of the Project Work

- Preparation of bio-composites by using carbon fibre and short Jute fibre, glass fibre, in Epoxy resin matrix.
- To study experimentally the effect of Jute fibre, glass fibre, carbon fibre and Epoxy resin on the tensile properties of composites at different temperatures.
- To determine tensile properties of Jute based Epoxy bio composites at different temperatures (0°, 27°C, 50°C, 80°C, 110°C).
- To analyze and interpret the results.

1.3 Scope of the proposed project work

This project is limited preparation of jute based bio composites using short jute fibre, glass fibre, and carbon fibre as reinforcements in epoxy resin and to study experimentally the effect of Jute fibre, glass fibre, carbon fibre and Epoxy resin on the tensile properties of composites at different temperatures (0°, 27°C, 50°C, 80°C, 110°C).

2. FABRICATION AND TESTING

This chapter describes the preparation and fabrication of specimens according to the American Standards for Testing Materials (ASTM).

The present study involves the evaluation of the Tensile properties of the new class of composite i.e., Short Jute fibre, glass fibre, and carbon fibre reinforced with Epoxy resin with Adhesive agent at different temperatures.

The following methods are adopted for various activities

1. Fabrication by Hot Compression molding technique.
2. Tests for mechanical characterization
3. Tensile test

2.1 Fabrication by Hot Compression Molding Technique

- First chopped jute fibre, Glass fibre, carbon fibre and pre weighed amount of resin are mixed and water is added to the mixture of chopped jute fibre and resins here water act as binder which hold chopped jute fibre and resin firmly .talc and Calcium carbonate are added as fillers
- Wait until full water is absorbed
- Layers of chopped jute fibre and resin are formed one over the other like sandwich model
- This sandwich model is compressed in cold compression molding machine to prepare biocomposite
- After bio composite removed from compression molding machine instant cooling is done through blower or any other means
- Then bio composite covered by Teflon for uniform distribution of heat
- Then keep the composite for some time and finally cut the specimen in to required sizes.

2.1.1 Materials used for Fabrication

The materials used in preparation of composite specimens are mentioned in detail below.

For BJE Series

- Matrix used: Epoxy resin(A-331), with 10% talc and 5 % Calcium Carbonate
- Reinforcement: Short Jute fibre(1mm-2mm)
- Hardener: A-062 (100ml per kg of resin)

For FGJ Series

- Matrix used: Matrix - epoxy, with 7% talc and 3 % Clay
- Reinforcement: Short Jute fibre(1mm-2mm),glass fibre and carbon fibre
- Hardener: A-062 (100ml per kg of resin)

For FGE Series

- Matrix used: Matrix - epoxy, with 10% talc and 5 % filler
- Reinforcement: Short glass fibre (1mm-2mm)
- Hardener: A-062 (100ml per kg of resin)

2.2 Piercing of Laminated into Desired Size

- To cut each laminate into required size a wire hacksaw blade is used
- Dog bone shape for tensile test according to ASTM D368 standard.

Table 1: Chemical structure of Jute fibre:

Constituent	Percentage
Cellulose	65%
Hemi-cellulose	22%
Lignin	11%
Water soluble	1.5%

2.2.1 Chemical Composition of Glass Fibre

Glass composed of SiO₂ 54% in weight, Al₂O₃ 14% in weight, CaO+MgO 22% in weight, B₂O₃ 10% in weight and Na₂O+K₂O less than 2% in weight. And Some other materials present in the form of impurity levels.

3. TESTS FOR MECHANICAL CHARACTERIZATION

3.1 Tensile Test

The tensile test has to be carried out according to ASTM D-638 standards ,which includes the tensile properties of reinforced in Dumbbell shaped test specimens is tested under normal working conditions and testing machine rpm.

3.1.1 Experimental Setup

A tensile testing machine is used to conduct the tension test under different loading conditions. The load cell of 10kn is

used to measure and apply the load on the composite specimen the load is applied uniformly at the rate of 10mm/min and respective displacement of the sample which is in touch with the specimen are noted down. The tensile testing machine is shown in the figure

3.1.2 Test Specimen

According to ASTM 638 composite specimens were prepared for test as shown in figure, the dimensions of the specimen are shown in the table below.

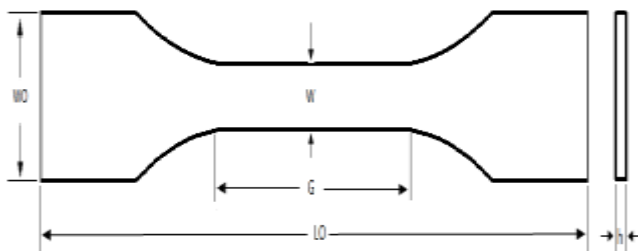


Fig 1: Tensile test specimen

Table 2: size of the tensile test specimen

Particulars	Size in mm
Overall length(LO)	170
Overall width(WO)	22
Gauge length(G)	50
Width of narrow section(W)	16



Fig 2: Specimens before and after tensile test

3.2 Procedure

The test specimen is placed in-between the two jaws of the machine, The constant load of 100mm/min is applied on the specimen. The specimen of 50mm gauge length, 25mm wide and 10mm thickness is used.

The specimen is fixed in the tensile machine jaws and initial adjustments are made. Then the machine is put on start and load will be applied uniformly on the specimen. The values of load and corresponding deflection are noted. From the obtained values strain Young’s modulus and stress, are to be evaluated using the suitable formulae. Then the graph of stress Vs strain is plotted. The obtained values of Young’s modulus are depend on the slope of linear portion of the stress-strain curve. Totally 30 samples were tested at different temperatures and the results are given in the table

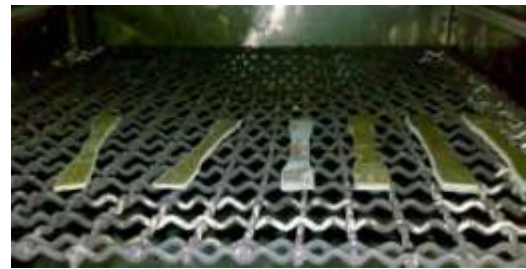


Fig 3: Specimens kept in oven for heat treatment

4. EXPERIMENTAL RESULTS

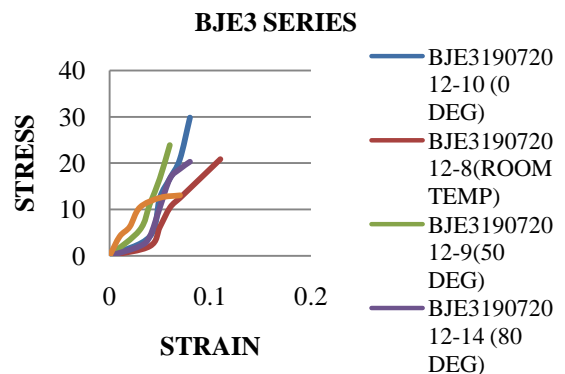


Fig 4: stress vs strain for BJE3 series

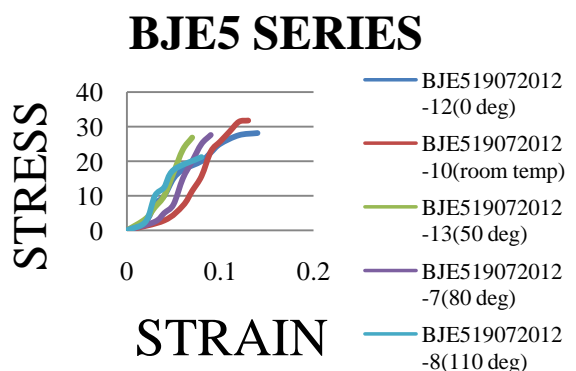


Fig 5: stress vs strain for BJE5 series

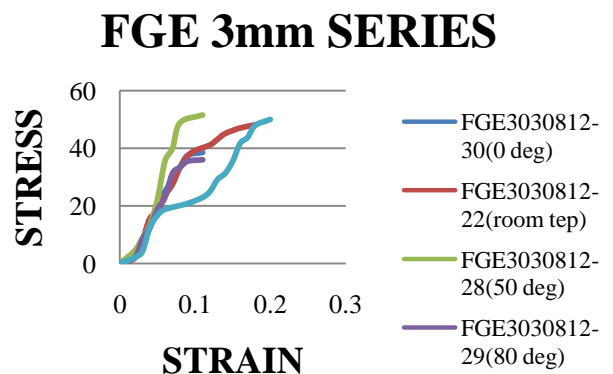


Fig 6: stress vs strain for FGE 3mm series

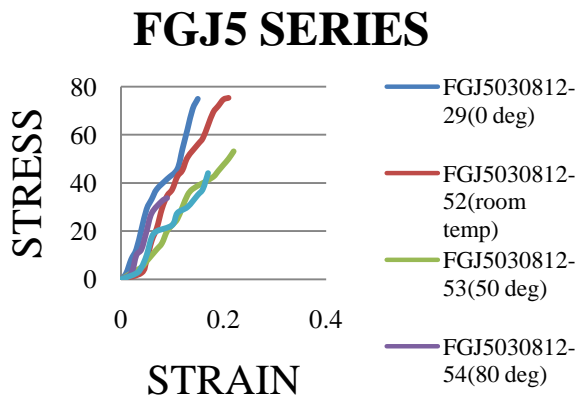


Fig 7: stress vs strain for FGJ5 series

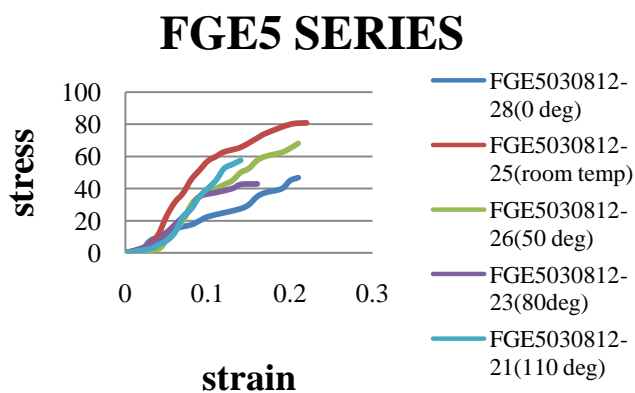


Fig 8: stress vs strain for FGE5 series

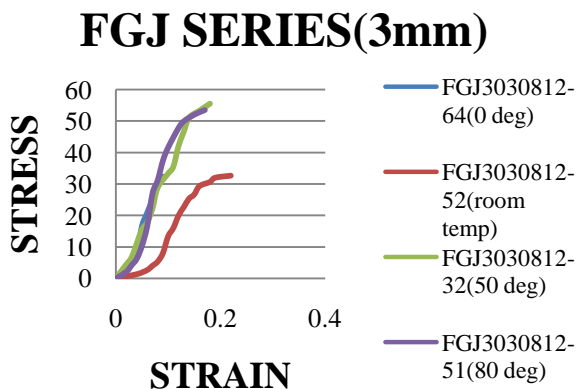


Fig 9: stress vs strain for FGJ 3mm series

5. CONCLUSION

- Hot compression molding method is effectively employed for the preparation of jute based biocomposites using glass fibre and carbon fibre
- From above results it is clear that all above specimens are brittle in nature.
- Natural fibre composites are more eco-friendly as compared to the glass fibre composites in most cases due to the following reasons:

- Natural fibre production has less environmental problems as compared to glass fibre production
- Natural fibre composites have more fibre content for the same performance
- For BJE series optimum properties are obtained in case temperature of 800C among different heating conditions. 1100C indicated a loss of strength, strain to fracture. This may be due to larger cross linkage of fibre at 1100C condition resulting loss of ductility of the matrix. At 500C composites exhibits fibre pull out.
- At higher temperatures the thermal degradation of fibre would occur, leading to the decrease of tensile properties
 - Specimens at 800C exhibited better performance upon heat treatment. This further proves the superiority of 800C over 500C and 1100C temperature conditions.
- For FGE series at temperatures from 0 to 50°C the tensile strength seems to be stable, which indicates the mechanical behavior of GFRP composites remains almost same this temperature range and after this range as temperature decreases tensile strength increases
- This phenomenon is due to the more stiffness of the amorphous polymer matrix because of low temperatures. Further, if the material contains a high level of moisture, then the volume expansion of the water during the freezing could cause the beginning of micro cracks and lowers the mechanical properties
- At high temperatures, near and above 100°C flexural modulus and , the mechanical strength reduces due to the change of state in the polymer
- Mechanical properties of glass fibre reinforced composites increased when the temperature decreased.
- After comparing the mechanical properties of jute reinforced and glass reinforced composites, the results show that the jute fibre when added into the resin matrix as reinforcement, improve the mechanical properties, but the improvement is less than that obtained by introduction of glass and other high performance fibre. Hence, the jute fibre can be used as reinforcement where modest strength and modulus are required. Another use for the jute fibre is that, it can be used as a “filler” fibre, replacing the glass as well as the resin in a filament wound component.

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