MECHANICAL PROPERTIES EVALUATION OF HYBRID POLYMER COMPOSITES WITH BAMBOO AND E-GLASS FIBER PRODUCED BY HAND LAY-UP PROCESS

Mr. Alok kumar[1], B.Krishnasanthosh[2], B.Venkatesh[3], V.Kishore[4]
[1]Assistant Professor, [234]U. G. Scholars, Department of Mechanical engineering,
[1234]Godavari Institute of Engineering and Technology (Autonomous), Rajahmundry, Andhra Pradesh, India.

Abstract

High exploitation rates and low recovery rates quickly deplete global natural resources, increasing the risk of global warming and pollution. In recent years, the development of polymer composites
Reinforced with natural fibers such as jute, bamboo, linen, sisal, hemp, and the coir has become increasingly important. Natural fiber, commonly used in most parts of the world, requires minimal financial input and maintenance. Environmentally friendly and economical for polymer composites reinforced with synthetic fibers. However, composites reinforced with natural fibers have low water absorption and may not meet the requirements of specific applications. Due to this problem, natural fibers can be combined with synthetic fibers having the same matrix material to obtain the greatest advantage in improving its properties. In this case, hybrid composites made from natural fiber and fiber-reinforced polymer composites are very important for current needs. This article discusses the mechanical properties of bidirectional bamboo reinforced fibers and epoxy hybrid composite elements. Mechanical properties such as impact strength, flexural strength, and moisture absorption are evaluated experimentally following ASTM standards. Conclusions are drawn from the results of the experiment.

Keywords: bamboo, fiberglass, epoxy.

1. INTRODUCTION

The worldwide interest for wood as a structural material is consistently developing, while the accessibility of this common asset is decreasing. This circumstance has prompted the advancement of elective materials. Of the different engineered materials that have been 'investigated and supported, polymer composites guarantee significant cooperation as building materials. There has been a developing enthusiasm for using common strands as a fortification in polymer composite for making ease development materials as of late. Characteristic filaments are imminent strengthening materials and their utilization as of not long ago has been more conventional than specialized. They have since a long time ago filled numerous valuable needs however the use of the material innovation for the use of normal filaments as a fortification in polymer network occurred in nearly late years. Financial and other related factors in many creating nations where regular strands are rich interest that researchers and specialists apply fitting innovation to use these normal filaments as adequately and monetarily as conceivable to deliver great quality fiber fortified polymer composites for lodging and different needs. Among the different common strands, bamboo is exceptionally compelling in that its composites have high effect quality other than having moderate elastic and flexural properties contrasted with different lignocelluloses filaments. The characteristic assets of the World are draining quickly because of the high pace of abuse and the low pace of rebuilding, prompting an expansion in an Earth-wide temperature boost and contamination risks. Lately, there has been expanding enthusiasm for the substitution of manufactured filaments in strengthened plastic composites by common plant strands, for example, jute, coir, flax, hemp, and sisal. Bamboo is one of the common filaments broadly accessible in many pieces of the world; it requires the least money related information and upkeep for development and is frequently developed in badlands, which helps in soil preservation. Focal points of bamboo fiber are low thickness and high explicit quality, biodegradable and inexhaustible assets, and it gives warm and acoustic protection. Bamboo fiber is better than other common strands, for example, jute from multiple points of view, including its higher quality, splendid gleaming shading, huge staple length, poor pleat property, variety in properties and quality because of the developing conditions, constrained most extreme preparing temperatures

2. EXPERIMENTATION

2.1. Materials

2.1.1. Bamboo

Bamboos remember probably the quickest developing plants for the world, because of an interesting rhizome subordinate System. Certain types of bamboo can develop 91cm (36 inches) inside a 24-hour time frame. Goliath bamboos are the biggest individuals from the grass family. Bamboo has a higher explicit compressive quality than wood, block, or cement Furthermore, a particular rigidity that adversaries steel.

Fig. 2.1 Bamboo fiber

2.1.2 Extraction of bamboo

Collecting bamboo sticks

↓

Soaked in water for one day

↓

Hand peeling of fibers from wet sticks

↓

Fibers dried in sun for one day

↓

Cut fibers in the required length

↓

Dried in the oven at 100^0 C to remove moisture

Fig 2.2 Extraction of bamboo

2.1.3. Glass

Glass filaments are the most well-known of all strengthening strands for (plastic) network composites. The head focal points of glass fiber are ease, high rigidity, high compound resistance, and fantastic protecting properties. The two kinds of glass strands normally utilized in the fiber-reinforced plastic enterprises are glass and S - Glass, another sort known as C-Glass is utilized in chemical applications requiring more noteworthy erosion protection from acids than is given by E – Glass

Fig 2.3 E-glass fiber

2.1.4. Epoxy Resin

Epoxy or polyiodide is a thermosetting epoxide polymer that fixes (polymers and cross-connections) When blended in with catalyzing specialist or "hardener". Epoxy gum and added substances add to the thickness of the framework and the contracting attributes. The measure of the fillers and diluents will affect both the physical and taking care of the properties of the pitch framework.

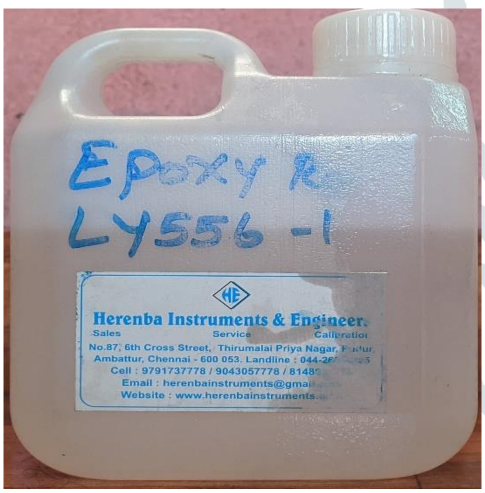

Fig2.4 Epoxy resin

Fig 2.5 Hardener

2.1.5. Hardener

Epoxy hardeners are not impetuses and they respond with the epoxy pitches, extraordinarily adding to a definitive property of the relieved epoxy tar framework. Epoxy hardeners give gel time, blended consistency, de-form time of the epoxy pitch system. Physical properties of the epoxy tar frameworks, for example, ductile, pressure, flexural properties, and so forth. are likewise affected by epoxy hardeners. The presentation of epoxy hardeners in the epoxy pitch framework relies upon the compound qualities while applying the epoxy pitches framework.

2.2. Preparation of composites

The framework of unsaturated polyester and monomer of styrene are blended in the proportion of 100:25 parts by weight separately. Later the added substance glass is blended completely and afterward the quickening agent of methyl ethyl ketone peroxide 1% by weight and impetus of Cobalt Naphthenate of 1% by weight were added to the blend and blended all together. Right now composites were set up by hand lay-up strategy, the discharging specialist of silicon is splashed to glass form and the network blend is poured into the shape. The fiber is added to the lattice blend, which was poured in the glass form. The overabundance pitch was expelled from the form and the glass plate was set on top. The castings were permitted to remedy for 24hrs at room temperature and afterward throwing is set at a temperature of 80℃ for 4 hrs. The composite is discharged from the shape and is sliced to get ready test examples.

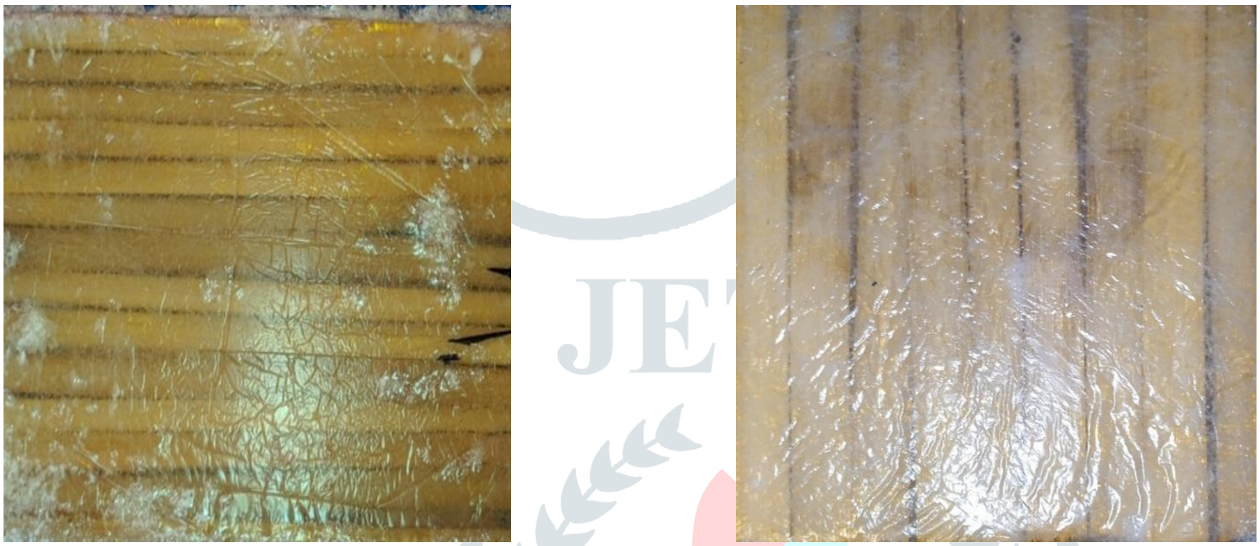

Fig2.6 Bamboo fiber composites

3. RESULTS AND DISCUSSION

3.1 IZOD Impact Test:

A pendulum-type single blow impact test in which the specimen, usually notched, is fixed at one end and free at another end. The specimen is broken by a falling pendulum. The energy absorbed as measured by the subsequent rise of the pendulum is a measure of impact strength or notch toughness.

Toughness: The ability of the material to absorb energy and deform plastically before fracture. It is usually measured by the energy absorbed in a notched impact test like Charpy and Izod tests. The area under the stress-strain curve in a tensile test is also a measure of toughness and as such is proportional to the combined effects of tensile strength and ductility.

The Izod impact energy (I) i.e, the energy required to break the specimen is obtained directly from the test. The depth below the notch and the breadth of the specimen are measured (i.e d and b). The effective cross-sectional area below the

Impact strength

S.No	Material	Initial reading k1 in J	Final reading k2 in J	Energy absorb K=k1-k2	Izod impact strength I=K/A
1	Specimen1	170	130	40	400
2	Specimen2	170	118	52	520

Table 3.1 Impact test readings

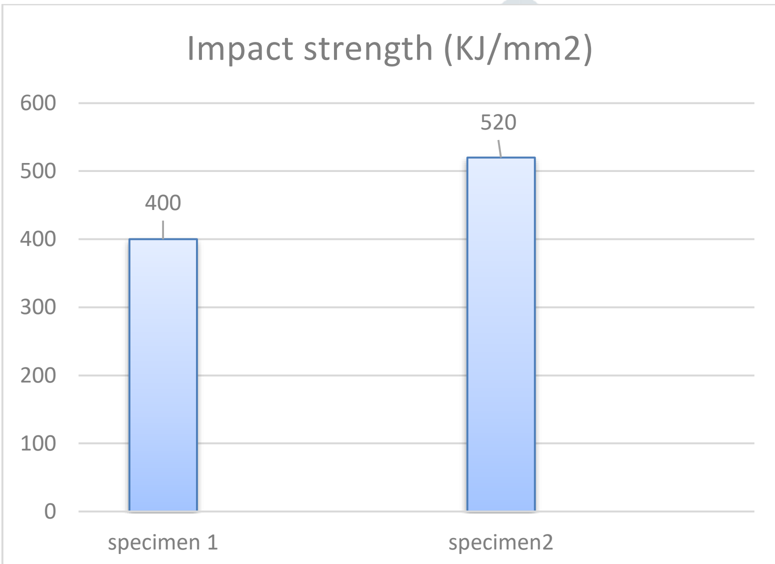

Fig 3.1 Impact strength (KJ/mm2)

5.2 Flexural test

The action of Bending or curving is called Flexure. Flexural strength is the maximum resistance of a material in bending. This is typically applicable for structural elements whose behavior can be reflected by beams .flexural strength is expressed in terms of modulus of rupture (MOR) in Mpa or Pa .the flexural strength is a commonly used in the design of rigid pavements

Flexural strength

S.No	Materials	Peak load (KN)	Flexural modulus in Mpa	Flexural strength (N/mm^2)
1	Specimen 1	3.47	102.5	32.71
2	Specimen-2	4.12	123.92	41.20

Table 3.2 Flexural test readings

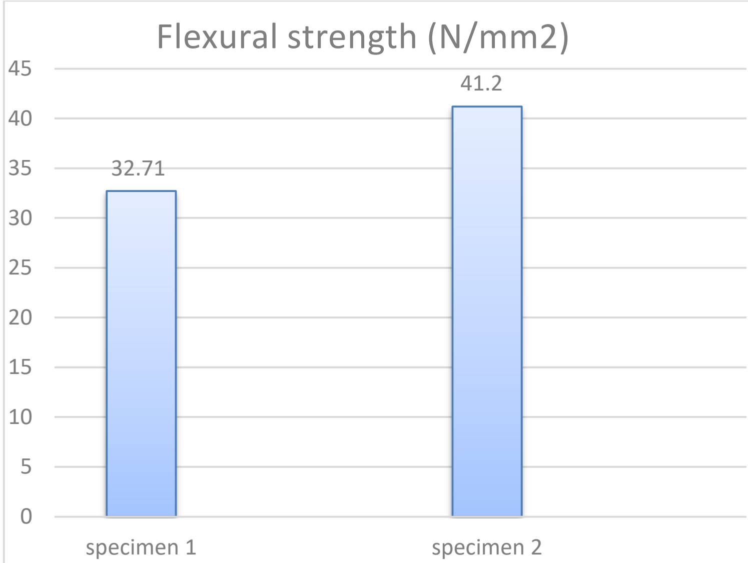

Fig 3.2 Flexural strength (N/mm2)

3.3 Water absorption test

Water Absorption 24 Hour/Equilibrium ASTM D570 Water absorption is used to determine the amount of water absorbed under specified conditions. Factors affecting water absorption include the type of plastic, additives used, temperature and length of exposure. The data sheds light on the performance of the materials in water or humid environments.

Percent Water Absorption = [(Wet weight - Dry weight)/ Dry weight] x 100

Size of specimen=300*200 mm

S.No	Material	Amount of Water Absorbed (g)	Percentage of Water Absorbed (%)
1	Category -1	0.23	1.3
2	Category-2	0.18	1.1

Table 3.3 Impact test readings

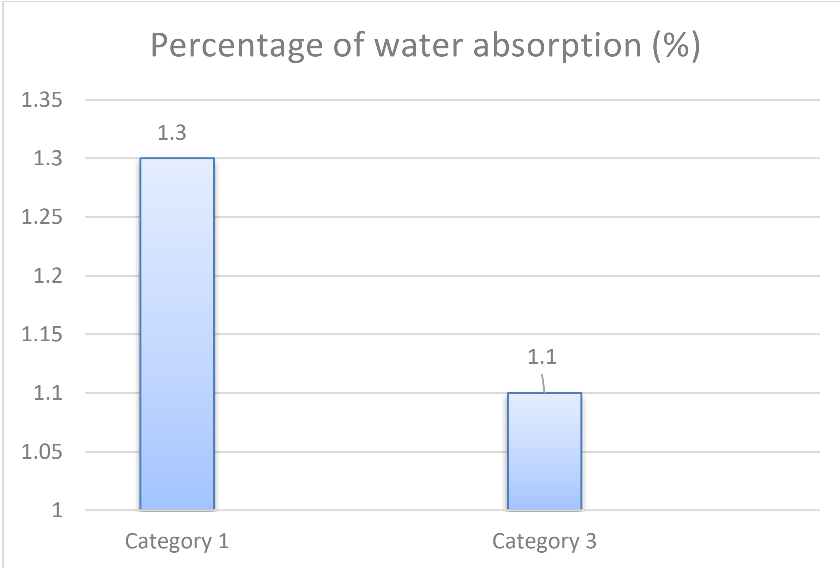

Fig 3.3 Percentage of water absorption (%)

CONCLUSION

The use of bamboo fiber as a reinforcing agent in polymer-based composites was reviewed from viewpoints of status and future expectations of natural fibers in general, structure and properties of bamboo fiber, fiber surface modifications, and physical and mechanical properties of bamboo fiber-based polymer composites. Bamboo fibers have good potential as reinforcements in polymer (thermoplastics, thermoset, and rubbers) composites. Due to the low density and high specific properties of bamboo fibers, composites based on these fibers may have very good implications in the automotive and transportation industry. However, suitable cost-effective design and fabrication techniques for manufacture should be developed. Bamboo fiber polymer composites with and without hybridization should be developed and characterized to arrive at a series of composites that may find use in several areas such as marine, structural, consumer articles and industrials applications.

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