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Evaluation of Mechanical Properties of Bamboo and Glass fibre Hybrid composite material

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A B S T R A C T

Polymeric materials reinforced with synthetic fibres such as glass, carbon, and agamid offer higher stiffness and strength to weight ratio than conventional construction materials like wood, concrete, and steel. Despite these advantages, synthetic fibre reinforced polymer composites widespread usetends to decline because of their high initial costs and adverse environmental impact. In recent years, the natural fibre composites have attracted substantial importance among the structural materials. There has been a fast-growing interest in using the natural fibres as reinforcements in the composites. The attractive features of natural fibres are their low cost, lightweight, high specific modulus, renewability and biodegradability. Among many natural fibres (like jute, sisal, bamboo, E-Glass, banana, etc.), bamboo fibre is one of the most promising ones because of its low cost, lightweight, short growth cycle and high availability.

This project's objective is to investigate the fibre orientation reinforced hybrid polymer nano composites that combine with hybrid composites i.e. BAMBOO/E-GLASS and epoxy polymer in the ratio of E-glass fibre 35%+bamboo 11%, E-glass, Fibre 37%+bamboo 10%, E-glass Fibre 38%+bamboo 09% of volume are to be considered.

The mechanical properties are to be calculated by carrying out tests on specimen's tension, hardness, and Flexural according to the test procedure laid down in ASTM standards. Finally, after obtaining the tested results, those values are checked.

Keywords:Epoxy, E-glass Fiber, Matrix, Bamboo, Reinforcement, Tensionhardnessand Flexural

1. Introduction

1.1 Polymers Composites

Composites can be defined as materials that consist of two or more chemically and physically different phases separated by a distinct interface. The different systems are combined judiciously to achieve a system with more useful structural or functional properties not attainable by any of the constituent alone. Composites, the wonder materials are becoming an essential part of today's materials due to the advantages such as low weight, corrosion resistance, high fatigue strength, and faster assembly. They are extensively used as materials in making aircraft structures, electronic packaging to medical equipment, and space vehicle to homebuilding.

The basic difference between blends and composites is that the two main constituents in the composites remain recognizable while these may not be recognizable in blends. The predominant useful materials used in our day-today life are wood, concrete, ceramics, and so on. Surprisingly, the most important polymeric composites are found in nature and these are known as natural composites. The connective tissues in mammals belong to the most advanced polymer composites known to mankind where the fibrous protein, collagen is the reinforcement. It functions both as soft and hard connective tissue.

Composites are combination of materials differing in composition, where the individual constituents retain their separate identities. These separate constituents act together to give the necessary mechanical strength or stiffness to the composite part. Composite material is a material composed of two or more distinct phases (matrix phase and dispersed phase) and having bulk properties significantly different from those of any of the constituents. Matrix phase is the primary phase having a continuous character.

Composites in structural applications have the following characteristics:

They generally consist of two or more physically distinct and mechanically separable materials.

They are made by mixing the separate materials in such a way as to achieve controlled and uniform dispersion of the constituents.

They have superior mechanical properties and in some cases uniquely different from the properties of their constituents.

Wood is a natural composite of cellulose fibers in a matrix of lignin. Most primitive man-made composite materials were straw and mud combined to form bricks for building construction. Most visible applications pave our roadways in the form of either steel and aggregate reinforced Portland cement or asphalt concrete. Reinforced concrete is another example of composite material. The steel and concrete retain their individual identities in the finished structure. However, because they work together, the steel carries the tension loads and concrete carries the compression loads.

Most advanced examples perform routinely on spacecraft in demanding environments. Advanced composites have high-performance fiber reinforcements in a polymer matrix material such as epoxy. Examples are graphite/epoxy, Kevlar/epoxy, and boron/epoxy composites. Advanced composites are traditionally used in the aerospace industries, but these materials have not found applications in commercial industries as well.

1.2 Constituents of the composite

Fibers or particles embedded in matrix of another material are the best example of modern-day composite materials, which are mostly structural.

Laminates are composite material where different layers of materials give them then specific character of a composite material having a specific function to perform. Fabrics have no matrix to fall back on, but in them, fibers of different compositions combine to give them a specific character. Reinforcing materials generally with stand maximum load and serve the desirable properties.

Further, though composite types are often distinguishable from one another, no clear determination can be really made. To facilitate definition, the accent is often shifted to the levels at which differentiation take place viz., microscopic or macroscopic

In matrix-based structural composites, the matrix serves two paramount purposes viz., binding the reinforcement phases in place and deforming to distribute the stresses among the constituent reinforcement materials under an applied force.

The demands on matrices are many. They may need to temperature variations, be conductors or resistors of electricity, have moisture sensitivity etc. This may offer weight advantages, ease of handling and other merits which may also become applicable depending on the purpose for which matrices are chosen.

Solids that accommodate stress to incorporate other constituents provide strong bonds for the reinforcing phase are potential matrix materials. A few inorganic materials, polymers and metals have found applications as mate3ix materials in the designing of structural composites, with commendable success. These materials remain elastic till failure occurs and show decreased failure strain, when loaded in tension and compression.

Composites cannot be made from constituents with divergent linear expansion characteristics. The interface is the area of contact between the reinforcement and the matrix materials. In some cases, the region is a distinct added phase. Whenever there is inter-phase, there has to be two inter-phases between each side of the inter-phase and its ad joint constituent. Some composites provide inter-phases when surfaces dissimilar constituents interact with each other. Choice of fabrication method depends on matrix properties and the effect of matrix on properties of reinforcement. One of the prime considerations in the selection and fabrication of composites is that the constituents should be chemically inert non-reactive.

1.3 Matrix

Most commercially produced composites use a polymer material often called a resin solution. There are many different polymers available depending upon the starting raw ingredients. There are several broad categories, each with numerous variations. The most common are known as polyester, vinyl ester, epoxy, phenolic, polyimide, polyamide, polypropylene, polyether ether ketone (PEEK), and other. The reinforcement materials are often fibers but can be common ground minerals.The various methods described below have been developed to reduce the resin content of the final product. As a rule of thumb, hand layup results in a product containing 60% resin and 40%, whereas vacuum infusion gives a final product with 40% resin and 60% fiber content. The strength of the product is greatly dependent on this ration.

PMCs are popular due to their low cost and simple fabrication methods. Use of non reinforced polymers as structure materials is limited by low level of their mechanical properties, namely strength, modulus, and impact resistance. Reinforcement of polymers by strong fibrous network permits fabrication of PMCs, which is characterized by the following:

1.4 Reinforcement

Reinforcement for the composites can be fibers, fabrics particles or whiskers. Fibers are essentially characterized by one very long axis with two axes either often circular or near circular. Particles have no preferred orientation and so does their shape. Whiskers have a preferred shape but are small both in diameter and length as compared to fibers.

Reinforcing constituents in composites, as the word indicates, provide the strength that makes the composite what it is. But they also sever certain additional purposes of heat resistance or conduction, resistance to corrosion and provide rigidity. Reinforcement can be made to perform all or one of these functions per the requirements.

A reinforcement that embellishes the matrix strength must be stronger and stiffer then the matrix and capable of changing failure mechanism to the advantage of the composite. This means that the ductility should be minimal or even nil the composite must behave as brittle as possible.

Nomenclature

- Tensile Test
- Shore Hardness Test
- Flexural Test

1.1. Materials and Methods

Three measures are in readiness. Of the three yarns, one is only made of synthetically processed fabrics, while two are antacid treated with permangan. Treatment of the filaments in this illustration is as shown here:

Bamboo was treated with 5% NaOH at room temperature for 30 minutes highly concentrated hydrochloric acid look through any single aspect of the entire paper in litmus: Throughout the whole paper-testing time, litmus tests were often used to screen for prejudice At the end of drying, the NaOH-treated filaments were exposed to 80oC for three hours in a forced air furnace.

Treatment includes vaporising 1 permanganate at varying temperatures and pressures and stirring for a period of time, which improves permanganate dissociation.for the first submerged in a solution of 5 percent NaOH at room temperature At the element they have been washed to extract sodium hydroxide has been sifted and modified. After this, the treatment, 1ppm perm-potassium permanganate was added to CH3CO They were ground at 80 degrees Celsius for three hours and then sifted and sieved to extract fine flour through heating and then adding quarry materials (sand, kaolin, limestone, and colemanite), the fluid is melted and becomes formed. The fluid is pumped out by 5-24-gram bushings and the temperature of the bushing is then reduced to produce 5- to 24ths of an inch fine fibreglass. All the filaments are strung together or haphazardly associated or scatted, and coated with scale to prevent the glass from being harmed in the scarping process.

1.1.1 Properties of fibreglass

In comparison to the metallic, the fragility of plastic, the functional power of fibglass is notable in this way, it is used to develop the workmanship

Electrical characteristics: conductivity, ability to conduct

Although the fibreglass remains thin, it serves the purpose of protecting electric circuits, no matter what thickness is selected.

Because fibreglass is a stone, it may be incombustant. It doesn't doesn't produce or sustain a heat. When used as a heater, the device does not burn or emit noxious fumes. Fibre glass is not subject to changes in temperature and humidity. It has a poor elasticity. There could be several different sizes of matrices in a fibreglass system, all which could be reinforced with mineral lattices and all could be constructed to various degrees of complexity. Non-spoiling fibreglass: Mice and creepy-crawly stuff should not change its properties. It is poor thermal conductivity of the fibres that make it suitable for bending enterprise. Di Electricity: The potential to become electrically conductive when saturated

1.1.2 Applications of Fiberglass in one of a kind Industries

The warmth of the high-temperature content acts as a strong alternative to the trendiness of the products that results from well supply. Because fibreglass is durable, secure, and tends to provide a lot of warmth, it is used as a present-day insulation. Their aim is not only to ensure the protection of the equipment, but also to provide more innovative methods for defence. Maybe the primary reason that fibreglass is used in industries is so widely is that it is great for refreshing. Fibrill grinding is used in a number of industries, including packaging, wineries, and breweries.

There's a high demand for fibreglass these days, both for imperviousness and tint. The automobile looks better when it has been washed in the sun and is shiny, more than it does before. Artificial floor coarseness illustrate plastic risks There are artificial substances that go hand and hand with the tar.

Cools towers: Due to the continuous wetness, rust, and well-being concerns, they must be shielded from corrosion and maintained. Fiberglass is used to construct high towers that shield people and animals.

The Moors erode, rust, and loose their charm with the help of the malodorous seawater. This form of fibreglass is protected under warranties in this manner.

In the fowl and hamburger tending flora, fibreglass is used to catch all the blood. Much of the regions of meals that employ glass in the making process of homogenization, on the other hand, include fibreglass as an ingredient that is not affordable.

Because of its function of assisting rocks in having to maintain and supporting, all varieties of fibreglass can be used for all wellsprings. It is customary in large public waterworks for fibreglass to polish the nozzles and lighting fixtures to prevent being ruined by drops of citizens. In addition, this holds back citizens from going down into the wells.

The mounted coarseness of fibreglass grinding serves to lessen slipping in wet and oil areas. Fibreg milling is used in environments where artificial wear is permissible. Such media can not be seen. Car production: Fibreglass is commonly used in automotive manufacturing. Pretty excellent, the structure and the main parts are constructed of fibreglass. Fibglass is used for different sectors in the military and civil avionic environments such as check gauges, ducting, as well as for backyard poultry and agriculture.

1.1.3Bamboo

Bamboo material is any fabric, yarn or attire produced using bamboo filaments. While verifiably utilized uniquely for primary components, like clamors and the ribs of bodices, lately various advancements have been built up that permit bamboo fiber to be utilized for a wide scope of material and design applications.

Models incorporate apparel, for example, shirt tops, pants, a sock for grown-ups and kids just as bedding, for example, sheets and cushion covers. Bamboo yarn can likewise be mixed with other material strands like hemp or spandex. Bamboo is an option in contrast to plastic that is sustainable and can be renewed at a quick rate.

Current apparel marked as being produced using bamboo is normally thick rayon, a fiber made by dissolving the cellulose in the bamboo, and afterward expelling it to frame filaments. This cycle eliminates the regular attributes of bamboo fiber, delivering it indistinguishable from rayon from other cellulose sources.

1.1.4 Epoxy and resin:

The manufacture of the polymer network composite was done at room temperature. The necessary fixings are LY-556 Resin and HY-951 Hardener were blended completely in the beaker,and the combination so made was moved to carbon texture the carbon composite is created utilizing straightforward hand layup strategy to the mould,and the form is fixed with the assistance of nuts and fasteners.

Table 1 - TENSILE STRENGTH TEST.

Samples	UTS (N/mm2)	Elongation (%)
E-glass fibre35%+bamboo 11%	83	9.18
E-glass Fibre37%+bamboo 10%	87.044	9.24
E-glass Fibre38%+bamboo 09%	91.024	9.36

2. Test Specimens

The cover setting on the board is tenderly taken out by delivering the Teflon sheet. The overlay has on the edges with the strands are sliced in to make cover to a uniform shape. Strands are cut by the carpentry etch. The additional parts are likewise cut by the etch.

The examples for pliable and flexural tests were cut on the CNC machine according to ASTM standards. ASTM D790 and ASTMD 638 example shape is set apart on a paper; this paper is reordered on the overlay. The shape is to be sliced on the cover to make the example. The dimensional subtleties are as demonstrated in their particular charts.

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3. Specimen calculations

For each layer (Bamboo) in -100mm*200mm*126g/m2
Samples 1,2 & 3 -0.1m*0.2m*126 g/m2
= 2.52 g
For each layer (E-Glass fibre) in sample-1 -100mm*200mm*420 g/m2
- 0.1m*0.2m*420 g/m2
= 8.4g
For each layer (E-Glass fibre) in sample-2 -100mm*200mm*462g/m2
-0.1m*0.2m*462 g/m2
=9.24g
For each layer (E-Glass fibre) in sample-3 -100mm*200mm*504 g/m2
-0.1m*0.2*504g/m2
=10.08g
At 35% E-Glass fibreLaminate 1
E-glass fibre -8.4 g
Bamboo fibre -2.52g
Epoxy resin -10.92 g
Hardener -1.92g
Total fabric weight -23.78g
At 37 % E-Glass fibreLaminate 2
E-glass fibre -9.24g
Bamboo fibre -2.52 g
Epoxy resin -11.76g
Hardener -1.18g
Total fabric weight -24.7 g
At 38% E-Glass fibreLaminate 3
E-glass fibre -10.08g
Bamboo fibre-2.52g
Epoxy resin-12.6g
Hardener -1.24g
Total fabric weight -26.44g

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