Comparison of Mechanical Properties of Carbon Glass & Palm Banana Fibres Reinforced Hybrid Composite Bar

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Abstract— The composite materials are supplanting the customary materials, in light of its predominant properties, for example, high rigidity, low warm extension, high quality to weight proportion. The advancements of new materials are on the iron block and are developing step by step. Common fiber composites, for example, palm and banana polymer composites turned out to be more alluring because of their high particular quality, lightweight and biodegradability. Blending of normal fiber with Glass-Fiber Reinforced Polymers (GFRPs) are finding expanded applications. In this examination, carbon-palm-banana-glass fiber fortified polyester composites is produced and their mechanical properties, for example, elasticity, flexural quality and effect quality are assessed. The interfacial properties, interior splits and inward structure of the cracked surfaces are assessed The outcomes showed that the consolidation of palm-banana and carbon fiber with GFRP can enhance the properties and utilized as a substitute material for glass fiber strengthened polymer composites.

Key words: Carbon Fibre, Glass Fibre, Palm Fibre, Banana Fibre, Phenolic Resin, Mechanical

I. INTRODUCTION

A. Overview of Composites

Throughout the most recent thirty years composite materials, plastics and earthenware production have been the overwhelming developing materials. The volume and number of utilizations of composite materials have developed consistently, entering and overcoming new markets determinedly. Present day composite materials constitute a critical extent of the built materials advertise extending from regular items to complex specialty applications. While composites have officially demonstrated their value as weight-sparing materials, the present test is to influence them to financially savvy.

The endeavors to deliver monetarily alluring composite parts have brought about a few imaginative assembling methods at present being utilized as a part of the composites business. It is basic that there be an incorporated exertion in outline, material, process, tooling, quality confirmation, producing, and even program administration for composites to end up plainly aggressive with metals.

The composites business has started to perceive that the business uses of composites guarantee to offer significantly bigger business openings than the aviation part because of the sheer size of transportation industry.

B. Classifications of Composites

Comprehensively, composite materials can be ordered into three gatherings on the premise of grid material:

1) Metal Matrix Composites (MMC)
2) Ceramic Matrix Composites (CMC)
3) Polymer Matrix Composites (PMC)

1) Polymer Matrix Composites

Most normally utilized grid materials are polymeric. The explanations behind this are twofold. When all is said in done the mechanical properties of polymers are insufficient for some auxiliary purposes. Specifically their quality and solidness are low contrasted with metals and earthenware production. These challenges are overwhelmed by fortifying different materials with polymers. Furthermore the handling of polymer framework composites require not include high weight and doesn't require high temperature.

Likewise hardware required for assembling polymer grid composites are more straightforward. Therefore polymer framework composites grew quickly and soon ended up plainly well known for basic applications. Composites are utilized on the grounds that general properties of the composites are better than those of the individual parts for instance polymer/artistic. Composites have a more prominent modulus than the polymer segment however aren't as weak as earthenware production.

a) Two sorts of polymer composites are:

– Fiber fortified polymer (FRP)
– Particle fortified polymer (PRP)

b) Fiber Reinforced Polymer

Regular fiber fortified composites are made out of strands and a grid. Filaments are the fortification and the primary wellspring of quality while lattice sticks every one of the strands together fit as a fiddle and exchanges worries between the strengthening filaments. The strands convey the heaps along their longitudinal bearings.

c) Molecule Reinforced Polymer

Particles utilized for strengthening incorporate earthenware production and glasses, for example, little mineral particles, metal particles, for example, aluminum and shapeless materials, including polymers and carbon dark. Particles are utilized to build the modules of the lattice and to diminish the malleability of the grid. Particles are likewise used to lessen the cost of the composites. Fortifications and frameworks can be normal, reasonable materials and are effectively processed. Some of the valuable properties of pottery and glasses incorporate high softening temp., low thickness, high quality, solidness; wear protection, and consumption protection.

C. Characteristics of Composites

A composite material comprises of two stages. It comprises of at least one irregular stages inserted in a ceaseless stage. The irregular stage is generally harder and more grounded than the constant stage and is known as the "fortification" or "strengthening material", though the persistent stage is named as the „ matrix".

Lattice is made out of any of the three fundamental material sort i.e. polymers, metals or pottery. The network frames the mass shape or the part or item. The optional stage inserted in the network is an intermittent stage.

D. Natural Fiber Reinforced Composites

The enthusiasm for common fiber-fortified polymer composite materials is quickly becoming both as far as their modern applications and key research.

Plants, such as flax, cotton, hemp, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, and so on. And additionally wood, utilized from time immemorial as a wellspring of language cellulosic filaments, are increasingly frequently connected as the fortification of composites.

Their availability, renewability, low thickness, and cost and palatable mechanical properties make them an appealing biological contrasting option to glass, carbon and man-made strands utilized for the assembling of composites.

The common fiber-containing composites are all the more earth well disposed, and are utilized as a part of transportation, military applications, building and development ventures, bundling and purchaser items.

E. Classifications of Natural Fibres

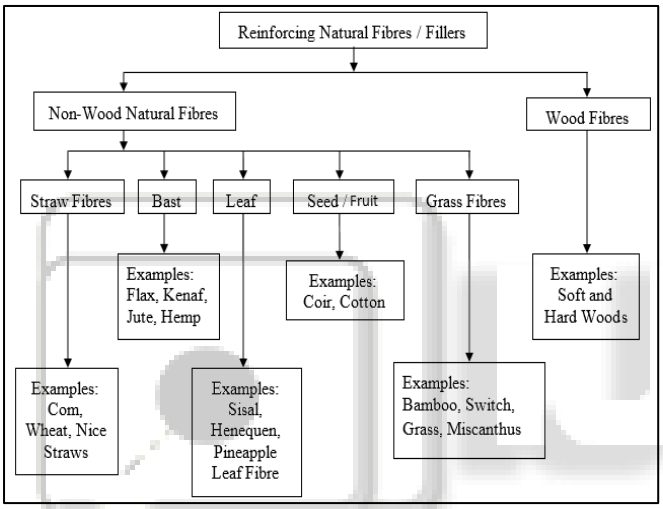

Fig. 1: Classification of Natural Fibers

F. Overview of Carbon Fiber

Carbon filaments are strands around 5-10 micrometers in measurement and made generally out of carbon particles. The properties of carbon filaments, for example, high firmness, high rigidity, low weight, high compound protection. Be that as it may, they are moderately costly when contrasted with different filaments. Removed carbon fiber.

G. Characteristic of Carbon Fiber

Carbon fiber is most prominently used to strengthen composite materials, particularly the class of materials known as carbon fiber or graphitr fortified polymers.

Non-polymer materials can likewise be utilized as lattice for carbon strands.

The expanding utilization of carbon fiber composites is diplacing aluminum from aviation applications for different metals in view of galvanic erosion.

H. Overview of Banana Fiber

Banana Fiber Banana plant gives the scrumptious natural product as well as gives material fiber, the banana fiber. It develops effectively as it sets out youthful shoots and is most normally found in hot tropical atmospheres

All assortments of banana plants have strands in plenitude. These filaments are gotten after the organic product is reaped and fall in the gathering of bast strands. This plant has for quite some time been a decent hotspot for top notch materials in many parts of the world, particularly in Japan and Nepal.

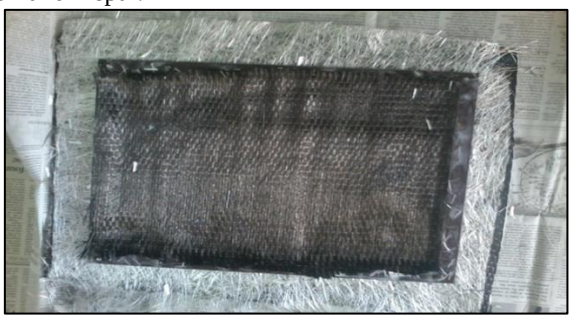

Fig. 2

I. Extraction of Banana Fiber

Fig. 3: extracted banana fiber

The processes for making yarn from banana fibers vary from region to region. Most popular methods among these are those followed in Japan and Nepal.

II. LITERATURE REVIEW

Author Name	Composition		Work Done
	Fibres	Resin / Cement	
Chaithanyan C. [1]	Coir fibre	Isophthalic phenolic resin	Mechanical properties
Zhong J.B. [2]	Carbon fibre	Urea-formaldehyde resin	Mechanical properties
Aruna M. [3]	Carbon fibre	Cement	Mechanical properties
Ashok Kumar M. [4]	Carbon fibre + Glass fibre	Epoxy resin	Mechanical& Thermal properties
Roberto Fujiyama [5]	Carbon fibre	Cement	Mechanical properties
Velmurugan G. [6]	Carbon fibre + Coir fibre	Epoxy resin	Mechanical properties
Fávaro S.L. [7]	Carbon fibre	High-density polyethylene	Chemical, morphological and mechanical analysis

Sakthivel M. [8]	Banana, Coir and Carbon fibre	Polyester resin	Mechanical properties
Girisha C. [9]	Carbon, Coconut and Coir fibre	Epoxy resin	Water absorption and Mechanical properties
Olusegun David Samuel[10]	Glass, palm, carbon and Banana fibre	General purpose resin	Mechanical properties

Table 1

III. MATERIALS AND METHODS

A. Introduction

This section portrays the points of interest of handling of the composite bar. The crude materials utilized as a part of this work are

- Carbon fiber
- Banana fiber
- Glass fiber
- Phenolic gum

B. Carbon Fiber

Carbon strands are filaments around 5-10 micrometers in distance across and made for the most part out of carbon molecules. The properties of carbon filaments, for example, high solidness, high elasticity, low weight, high synthetic protection. Be that as it may, they are moderately costly when contrasted with different strands. Extricated carbon fiber is as appeared in Figure

C. Banana Fiber

Banana Fiber Banana plant gives the scrumptious organic product as well as gives material fiber, the banana fiber. It develops effectively as it sets out youthful shoots and is most normally found in hot tropical atmospheres. All assortments of banana plants have strands in wealth. These strands are acquired after the natural product is gathered and fall in the gathering of bast filaments. This plant has for quite some time been a decent hotspot for fantastic materials in many parts of the world, particularly in Japan and Nepal.

D. Glass Fiber

The most widely recognized sorts of glass fiber utilized as a part of fiberglass is E-glass, which is alumino-borosilicate glass with under 1% soluble base oxides, chiefly utilized for glass reinforced plastics. Different sorts of glass utilized are A-glass (Alkali-lime glass with next to zero boron oxide), E-CR-glass (Electrical/Chemical Resistance; alumino-lime silicate with under 1% soluble base oxides, with high corrosive protection), C-glass (salt lime glass with high boron oxide content, utilized for glass staple strands and protection), D-glass (borosilicate glass, named for its low Dielectric consistent), R-glass (alumino silicate glass without MgO and CaO with high mechanical necessities as support), and S-glass (alumino silicate glass without CaO yet with high MgO content with high rigidity).

E. Phenolic Resin

The response of a natural corrosive with a liquor brings about the development of the ester. By utilizing adi-practical corrosive and a di-utilitarian liquor direct phenolic is created. Properties of the phenolic can be fluctuated by utilizing diverse blends of various di-acids and glycols. One such mix produces opthalic sap. They are delivered from isophthalic acids and are described by more prominent quality, warm protection, sturdiness and adaptability. The corrosive gatherings are isolated by one carbon of benzene ring. This builds the chance to create polymers with awesome linearity and high atomic weight. They are for the most part utilized as a part of car parts, knocking down some pins dividers, fuel, swimming pools, aviation items and common development items

F. Preparation of Resin

The lattice used to create the fiber material is phenolic having a thickness of 1.10 g/cc. To enhance the rate of the response, a quickening agent and an impetus are added to the first lattice material. The methyl ethyl ketone peroxide (MEKP) is included as an impetus and cobalt napthanate is included as a quickening agent, in the proportion 1:0.02:0.02.The arrangement is blended and mixed before applying on the cover.

G. Specimen Preparation

To set up the composite bar, a trim box is utilized. The trim box is cleaned with refined water to expel the impurities. Then a layer of wax layer is connected all through the embellishment box to encourage simple expulsion of the cover. Before the trim procedure, a corrosive arrangement of poly vinyl acetic acid derivation is connected on the surface of the embellishment box which goes about as a discharging operator. This is trailed by an abide time of 30 minutes for the trim box to get dried. A layer of blended tar is connected on the cleaned surface before setting a layer of carbon fiber.

Substitute layer of fiber is kept with a layer of gum over it. Ensuing layers of carbon, banana and glass fiber are put till the required thickness is acquired. The completed composite now is shut by upper bite the dust and kept in all-inclusive testing machine for compression. Then a heap of 10 tons is connected for sequentially for 5 hrs. The composite is made to cure for 24 hours under hot conditions. After curing, the composites are estimated by the measures for composite bar.

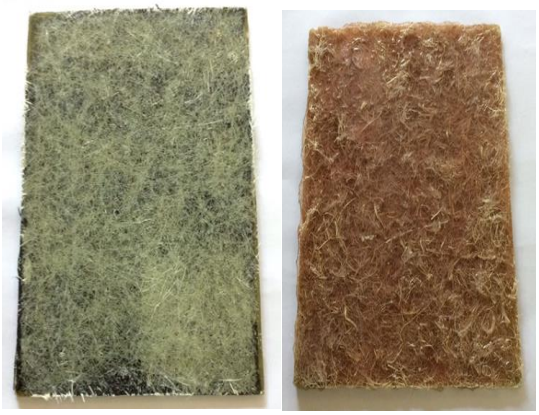

Fig. 4: Specimen Preparation

IV. MECHANICAL PROPERTIES

A. Introduction

The accompanying mechanical properties of composite bar are assessed.

- Impact quality
- Flexural quality
- Tensile quality

B. Impact Strength

Effect test is completed to discover measure of vitality required to break the material and furthermore the durability of the material at yield quality. This test is completed in IZOD/Izod setup and standard took after is 64 x 12 x 5 mm. The focal point of the example is made into a state of V-score and it is stacked for testing. The pendulum is available in the sit without moving position and it is discharged to hit the V-score more than once until the point that it gets falls flat. The impact of strain rate on crack and malleability of the material can be dictated by utilizing the effect test. Example for affect quality is as appeared in Figure.

C. Flexural Strength

Three point flexural test is the most well-known test conveyed for composite materials. The standard utilized for flexural test is 140 x 15 x 5 mm. The Universal Testing Machine is utilized to complete the Flexural test. Flexural test decides the greatest anxiety prompted in the furthest fiber. In this test, example is subjected to stack at its halfway between the backings until the point when it cracks and breaks. This test relates to the conduct of example as like a just upheld pillar. Standard example for flexural quality.

D. Tensile Strength

The elastic test game plan is appeared in the Figure. In this test, the example is settled like a just bolstered bar. Elastic testing is a dangerous test process that gives data about the rigidity, yield quality and pliability of a material.

V. RESULTS

A. Impact Strength

The effect test is done utilizing Izod affect test machine with the goal that misfortune in vitality is resolved. The Carbon - Glass cross breed composite has high effect quality. The purpose behind high effect quality is because of the nearness of every one of the two (carbon and glass) strands in exchange arrangement of composite. The vitality consumed by the composite example.

When it is affected by a substantial blow from pendulum split is shaped. The break for the most part goes through the fiber and sap of the composite. So when break engenders through the composite assimilate.

Fig. 5: Impact Test Machine(Izod)

B. Flexural Strength

Fig 5.2Testing of Fluctural Strength

The flexural quality is done in all-inclusive testing machine. The example course of action for flexural quality is appeared in Figure the composite example is settled like a just upheld shaft on all-inclusive testing machine. The heap is connected on the example persistently till the composite example fall flat. The example is broken at 15 KN and it introduced in Table 5.2. The split example isshowninFigure5.2. Table 5.2 Summary of Mechanical Properties

Mechanical Properties	Result	
	Sample A	Sample B
Impact strength (Joules)		
Flexural strength (Mpa)		
Compressive strength(N/mm^2)		
Specimen A(5mm): Carbon (20%), Glass (20%), Resin (60%) Specimen B(5mm): Palm (30%), Banana (20%), Resin (50%)		

REFERENCES

[1] Chaithanyan C., Venkatasubramanian H., Dr. Raghuraman S. and Panneerselvam T. (2013), 'Evaluation of mechanical properties of glass-carbon reinforced hybrid composites using phenolic resin', International Journal of Innovative Research in Science, Engineering and Technology, Vol. 2, pp. 7479–7487.
[2] Zhong J. B., Lv J. and Wei C. (2007), 'Mechanical properties of carbon fibre reinforced urea-formaldehyde resin composites', eXPRESS Polymer Letters, Vol. 1, pp. 681– 687.
[3] Aruna M. (2014), 'Mechanical Behaviour of carbon Fibre Reinforced Cement Composites', International Journal of Mechanical, Industrial Science and Engineering, Vol. 8, pp. 84-87.
[4] Ashok Kumar M. and Ramachandra Reddy G. (2012), 'Mechanical & thermal properties of epoxy based hybrid composites reinforced with carbon/glass fibres', International Journal of Fibre and Textile Research, Vol. 2, pp. 26-29.
[5] Roberto Fujiyama1, Fathi Darwish and Marcos Pereira (2013), 'Mechanical characterization of carbon fibre reinforced cement mortar', 13th International Conference on Fracture, Beijing, China, pp. 1-7. 6. Velmurugan G., Venkatesan S.P., Prakash P.V., Sathishkumar N. and Vijayakumar N. (2014), 'Mechanical testing of hybrid composite material (carbon and coir)', International Journal of Scientific and Research Publications, Vol. 4, pp. 1-6.
[6] Fávaro S. L., Ganzerli T. A., de Carvalho Neto A. G. V. and Radovanovic E. (2010), 'Chemical, morphological and mechanical analysis of carbon fibre-reinforced recycled high-density polyethylene composites', eXPRESS Polymer Letters, Vol. 4, pp. 465473.
[7] Sakthivel M. and Ramesh S. (2013), 'Mechanical properties of natural fibre (banana, coir, carbon) polymer composites', Science Park, Vol. 1, pp. 1-6.
[8] Karthi.R.R 1, Dhanabalan.S2 Comparitive Analysis of Plain and Herringbone Grooved Journal Bearing Under The Hydrodynamic Lubrication Conditions In Pak. J. Biotechnol. Vol. 14 Special Issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 25-31 (2017)
[9] Dhanabalan.S1, Karthi.R.R2, Sivakumar K3, and Sathiya Narayanan C4 Optimization of rotary EDM Process Parameters for Inconel 718 Using Artificial Neural Network in Pak. J. Biotechnol. Vol. 14 special issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 58- 60 (2017)
[10] Dhanabalan.S1, Karthi.R.R2 Multi-Objective Optimization of EDM Parameters for Ti alloy in Pak. J. Biotechnol. Vol. 14 special issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 54-57 (2017)
[11] Boopathi 1,Kapil Kumar2, Karthi 5 Comparative Analysis of Drag Force in various Car Bodies using CFD - A Review in IJIRST || National Conference on Recent Advancements in Mechanical Engineering (RAME'17) || March 2017
[12] Karthi, R.R., Dhanabalan.S, an Investigation on Micro Robot for Medical Applications in Pak. J. Biotechnol. Vol. 14 special issue I (International Conference on Futuristic Innovations in Mechanical Engineering and Manufacturing Management) Pp. 32- 36 (2017)
[13] Karthi.R. R, Tamilarasu.B, Navaneethan.S Stewart-Gough Platform Manipulator with Six Degrees of Freedom Mechanism WWJMRD 2017; 3(8): 101-107 www.wwjmrd.com International Journal e-ISSN: 2454-6615 2017
[14] Karthi.R.R, Tamilarasu.B, Nagaraj.R, Boobal.A Knee Design for a Bipedal Walking Robot Based On Passive Dynamic Walking IJIR 2017; 3(11): 202-208 www.onlinejournal.in ISSN: 2454-1362
[15] Karthi R.R, Tamilarasu.B, Harshankumar.M, Sounder Rajesh.P Design And Synthesis Of Six Legged Walking Robot Using Single Degrees Of Freedom Linkage IJRDT 2017; 8(4): 176-189 www.ijrdt.org in ISSN (O) :- 2349-3585
[16] Karthi R.R , Tamilarasu.B , Gokul.P, Ragu.P Design and Analysis of Mechanical Behavior of Al-Si in Railway Vehicle Brake Slack Adjuster IJSRST 2017; 3(7):739-743 www.ijsrst.com in Print ISSN: 2395-6011

