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Characterization of Mechanical Behavior of New Hybrid Fiber Reinforced Composite Sheets: An Experimental Approach

K. Mallikarjuna, M. Ashok Kumar, T. Balasai Goud, G. Siva Prasad

Abstract*: Normally yarns as buttressing in composites generated ample attention in current years owing to eco-friendly nature and sustainability. This exploration examined the custom of coconut fiber act as strengthening the leeway of making fiber reinforced Sheet as an alternative for the metal roofing's of trade claims extending from edifice construction, where a virtuous performance during fire hazards and machine- driven possessions are crucial. This work shows that to develop a innovative category of general fiber epoxy composite to sightsee the budding of coconut sheath, jute fiber with graphite powder has provided, to understand the enhancement in forte of amalgam composite by mechanical testing viz ductile strength, bending strength by adding graphite powder and sawdust.

Index Terms*: Jute fiber, fiber reinforced sheet, natural coconut fiber, graphite powder, ductile strength, bending strength.

I. INTRODUCTION

Historically, methodological progresses have positioned around two focal areas, first one is the expansion of efficient energy bases and to get extreme conceivable purpose power from the accessible energy. The other (second) development is profoundly reliant on on the nature of engineering ingredients. Especially In pressure vessels expertise, high forte and rust resistance are both prerequisites for efficient operation. Whenever a designer faces such situations composite materials provide an efficient solution to such problems. Materials [1] are serene of two or more materials at a tiny scale and have chemically discrete stages. Heterogeneous at an infinitesimal scale but homogeneous at tiny scale integral things have pointedly diverse properties.
The two segments lead to a composite are:
Matrix
Reinforcement
A composite material a multiphase material that parades an amalgamation of properties that styles the composite greater to any other components phases. In infinitesimal composites the distinct stage is of microscopic dimensions. Structural minutiae are open through a micrographic checks in disparity the isolated phase for macroscopic composites most suitable examples are shingle and chippings in concrete. Satyanarayana et al focused[6] on Fibers from different structural parts of the coconut palm tree and the specimens have been examined for properties such as size, density, electrical resistivity, ultimate tensile strength, initial modulus and percentage elongation. Mishra et al deals [7] with the hybrid effect of composites made of jute/E-Glass fibers which are fabricated by hand layup method using LY556 Epoxy resin and HY951 hardener. Monteiro et al evaluated [8] the morphology and mechanical properties of coconut shell reinforced polyethylene composite to establish the possibility of using it as a new material for engineering applications.

Mukherjee et al determined [9] the stress-strain curve for sisal fibers based on experiment. SEM studies of the fractured tips of the sisal fibers reveal that the failure of the fiber is due to the uncoiling of micro-fibrils accompanied by de-cohesion and finally tearing of cell walls. Noorunnisa et al prepared [10] different fiber lengths of the hybrid composites of coir/silk unsaturated polyester-based hybrid composites. They found that there was a significant improvement in tensile, flexural, and compressive strengths of the coir / silk hybrid composites. Satyanarayana et al reviewed [11] the research work published in the field of sisal fiber reinforced polymer composites with special reference to the structure and properties of sisal fiber, processing techniques, and the physical and mechanical properties of the composites. Singha et al revealed [12] that mechanical properties such as tensile strength, compressive strength and wear resistance etc. of the urea-formaldehyde resin increases to considerable extent

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K. Mallikarjuna, Professor, Dept of ME, GPCET, Kurnool, Andhra Pradesh, INDIA.
M. Ashok Kumar, Professor, Dept of ME, RGMCET, Nandyal, Andhra Pradesh, INDIA
T. Balasai Goud, Assistant Professor, Dept of ME, BITS, Kurnool, Andhra Pradesh, INDIA.
G. Siva Prasad, Assistant Professor, Dept of ME, GPCET, Kurnool, Andhra Pradesh, INDIA.

II. EXPERIMENTAL WORK

A. Components

This work describes the particulars of meting out of composites and the trial actions shadowed the mechanical portrayal. The fresh ingredients used are

- Hardener solution and Epoxy resin
- Jute fiber
- Coconut sheet or Coir

B. Nomenclature

The following nomenclature in table 1[2] has been followed by us to prepare the specimen.

Table.1 Compositions With Respect To Fiber Percentage

Required materials	Required dimensions	Required quantity
Jute fiber	22X22X0.1 cm	10 gm
Coconut sheet	22X22X0.1 cm	5 gm
Epoxy resin	_	200 ml
Hardener	_	20 ml

C. Preparation of Composite Specimens

Preparation of Specimen Sheet 1 (5gm of coconut coir+ 10gm jute fiber)

- In this case, take 200 ml of Epoxy resin, and 20 ml each of hardener take them into a plastic mug and blend it by a glass rod to avoid creation of suds.
- Foam sheath mould is placed on a plane surface, then the sundry semi liquid is decanted unvaryingly on the mould with this sufficient jute fiber and coconut coir is positioned to mould and thoroughly mixed.
- After finishing of mould then place ohp sheet on the mould, rolling is done and place a weight on it and keep this mould for one day.
- After 24hrs, take the mould and keep it in the furnace for post curing process.
- This helps in removing the specimen sheet -I shown in Fig.1 from the mould and also the properties enhance by using this process. This procedure will be same for the other composite sheets shown in Fig.1, Fig.2 and Fig.3 but they differ only in their proportions of natural fiber and resin as shown in Table 2, Table 3.

Table2. Required Materials for Specimen Sheet–1

Name	COMPOSITION
S1	10gm of jute fiber + 5gm of coconut coir
S2	10gm of jute fiber + 5gm of coconut coir + 5gm of graphite powder
S3	10gm of jute fiber + 5gm of coconut coir + 20 gm of saw powder
S4	10gm of jute fiber + 5gm of coconut coir +5gm of graphite powder + 20 grams of saw powder

Resultant thickness of specimen sheet–1 = 3 mm

Preparation of Specimen Sheet 2 (5gm of coconut coir + 10gm jute fiber+5gm of graphite powder)

Table 3: Required Materials for Specimen Sheet -2

Required materials	Required dimensions	Required quantity
Jute fiber	22X22X0.1 cm	10 gm
Coconut sheet	22X22X0.1 cm	5 gm
Epoxy resin	_	200 ml
Hardener	_	20 ml
Graphite powder	_	5 gm

III. MECHANICAL TESTING OF SPECIMENS

A. Tensile Test

The trial sample imperiled to certain mechanical tests as per the ASTM Standards by subsequent fabrication. The tensile properties [3] of the samples of sizes 165

Resultant thickness of specimen sheet-2 = 3 mm

mm long, 13 mm wide and 3 mm thick, as publicized in fig 15. Were measured in accordance with ASTM: D638M. The samples verified at a swift of crosshead of 10 mm/min, Rusing an UTM machine

- ASTM D638M

Length of the material = 165mm Width of the material = 13mm Thickness of the material = 3mm

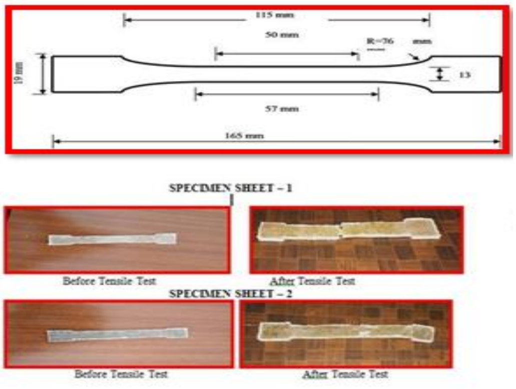

Fig:1 sample specimen for tensile test

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B. Flexural Test

Flexural test was done using 3-point bending method as per ASTM D 790-03 practice. The specimens were verified at a swift of head of 10 mm/min, at a temperature 18'C and humidity 50%. flexural strength [4] is defined as maximum in the superficial fiber this is intended at the exterior of the model on convex side.

Specifications

The ductile properties of the samples of sizes 100 mm long, 25 mm wide and 3 mm thick, as in fig 17. were measured in accordance with ASTM: D790M.The illustrative models' samples were tested at a cross head speed of 10 mm/min, using an UTM machine.

Fig 2: Sample Specimen

Specifications of Flexural Test Specimen

- ASTM D790M
  Length of the material = 100mm

Fig:2 sample specimen for Flexural test

IV. RESULTS & DISCUSSION

This section presents the mechanical characteristics of the hybrid fiber reinforced composites set for current investigation. Details of meting out of these composites and the tests conducted on them have already focused in the previous section. The outcomes of numerous portrayal tests are reported here. This includes assessment of ductile strength, bending strength, has been studied and discussed. The construal of the results and contrasting among various composite samples are also presented.

A. Tensile Properties of Specimen Sheets

Tensile properties indicate that in what way the material will retort to forces applied in tension. A ductile exam is a mechanical test where sample is laden in a right manner despite the applied load is measured and the stretching of the sample over a distance. Ductile exams are castoff to govern the modulus of elasticity, elastic limit, etc.

Tensile properties of all the four different specimens are tested by using "Jinan Chenda 20kN Computer Control Electronic Testing Machine" and the results are plotted as follows

Specimen Label	Max Load (N)	Load at Break (N)	Tensile stress at Max Load (MPa)	Young's Modulus (MPa)	Tensile Strain at Break Load (mm/mm)
Jute + Coir	1282.06	1281.80	42.74	2908.92	0.02750

Graphical representation

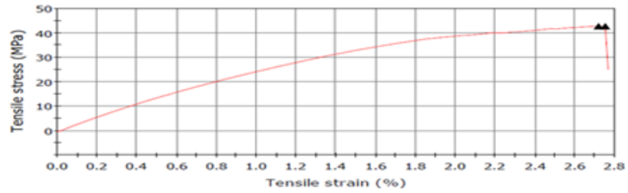

Fig 3 Tensile Properties of Specimen Sheet – 1

Specimen Label	Max Load (N)	Load at Break (N)	Tensile stress at Max Load (MPa)	Young's Modulus (MPa)	Tensile strain at Break Load (mm/mm)
Jute + Coir + Graphite powder	1396.69	1366.89	46.56	3459.66	0.01900

Graphical representation

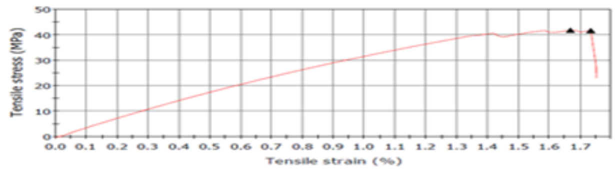

Fig 4: Tensile Properties of Specimen Sheet – 2

The above specimen behavior shown in fig 3 which is comprise of jute and coconut fiber having the break load of 1.2 kN with maximum tensile stress and tensile strain are 42.74 MPa and 0.02750 mm/mm respectively. The yield point is observed at (2.2, 40) of X and Y co-ordinates respectively. This specimen sheet bears the maximum load of 1282.06 N with Young's modulus of 2908.92 MPa. Another specimen shown in fig 4 which comprises of jute and coconut fiber with Graphite powder as additional reinforcement having the break load of 1.3 kN with maximum tensile stress and tensile strain are 42.74 MPa and 0.02750 mm/mm respectively. The yield point is observed at (1.45, 39.0) of X and Y co-ordinates respectively. This specimen sheet bears the maximum load of 1396.69 N with Young's modulus of 3459.66 MPa.

B. Flexural Properties of Specimen Sheets

The 3-point bending test measures the métier required to crook a beam by three-point loading conditions. Flexural modulus is used as material's stiffness [5] when arched. Subsequently the corporeal behavior of numerous materials can vary liable on room temperature,

Flexural properties of all the four different specimens are tested by using "Jinan Chenda 20kN Computer Control Electronic Testing Machine" and the results are plotted as follows:

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Specimen Label	Max Load (kN)	Max Stress (MPa)	Flex Modulus (MPa)
Jute + Coir	0.07	36.99	2132.41

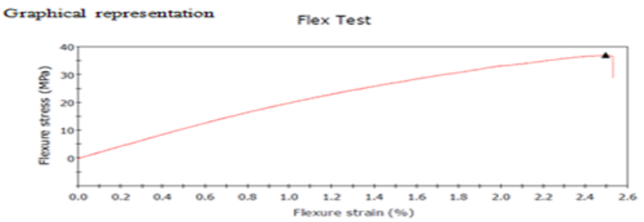

Fig 5 : Graphical Representation of Flexural Properties of Specimen Sheet – 1

The above composite material specimen sheet -I shown in Fig 5 consists of Jute and Coconut fiber bears an extreme load of 0.07 kN having maximum stress and flex modulus as 36.99 MPa and 2132.41 MPa respectively. Another composite specimen sheet-2 shown in Plot 4 consists of Jute and Coconut fiber and Graphite powder as additional reinforcement bears an extreme load of 0.13 kN having maximum stress and flex modulus as 72.15 MPa and 4027.04 MPa, respectively.

Specimen Label	Max Load (kN)	Max Stress (MPa)	Flex Modulus (MPa)
Jute + Coir + Graphite powder	0.13	72.15	4027.04

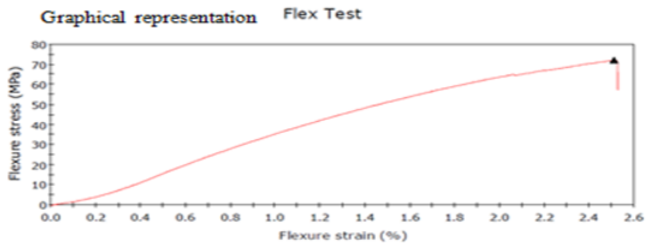

Fig 6: Graphical Representation of Flexural Properties of Specimen Sheet – 2

Table.4 Comparison of Ductile, Flexural Strength

Specimen samples	Tensile strength (Mpa)	Flexural strength (Mpa)
SS-1	42.74	36.99
SS-2	46.56	72.15

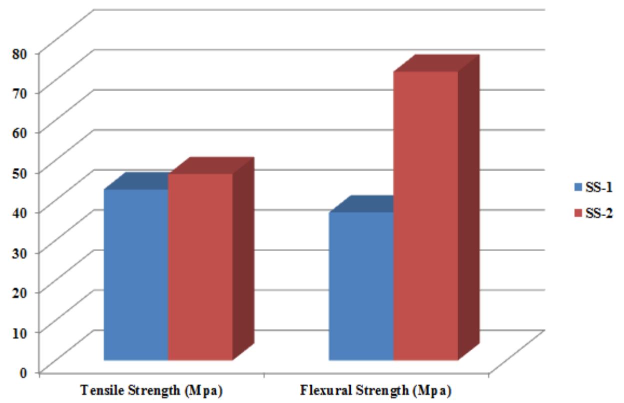

Fig.7 Flexural & Ductile Properties of Specimen Sheet – 1 & 2

V. CONCLUSION

This work shows the fabrication of Hybrid grit armored composites with different combination of reinforcements like Graphite powder and Sawdust by by means of manual technique. It is observed that the mechanical behaviour of the composites for instance ductile strength, bending strength of the composites are momentously prejudiced by the Graphite powder. In this present work it is institute out that jute, coconut and 5grams of graphite powder with standard epoxy resin resulted the best values of ductile strength, bending strength. 46.56 MPa, 72.15MPa respectively.

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