International Journal of Research in Advent Technology (IJRAT) Special Issue
"ICADMMES 2018"
E-ISSN: 2321-9637
Available online at www.ijrat.org

Mechanical Behaviour of Reinforced Epoxy Composite of Coconut Shellcharcoal

Avishan Raz Gaurav and Dr. Rashmi Dviwedi
Department of Mechanical Engineering
Sagar Institute of Science and Technology, Bhopal, Madhya Pradesh, India
avishangaurav@gmail.com

Abstract: In this study focus on the use of ecofriendly bio-fiber raw material like coconut shell charcoal powder as a filler material combine with epoxy resin and hardener to form composites. Carbonized Coconut shell charcoal composites as natural fiber composite that is replacing traditional material like aluminum alloy because excellent mechanical properties high bending and tensile strength, light weight give superior tribological performance erosion wear behavior. Agricultural waste coconut shells clean and dry in the sunlight, then break into small pieces and make powder. Carbonize process for making charcoal at a particular constant temperature in closed furnace burner without oxygen, epoxy and hardener are mixed in the ratio 10:2, coconut shell charcoal powder are 0, 5, 10% mix all raw material properly, avoid air bubbles. Mold specimen provides that the standard size of specimen and examine compressive test, bending test and tensile test on universal testing machine, tensile test specimen size is length 70mm,14mm diameter, bending test specimen size is length 200mm, diameter 24mm that is cylindrical shape. Result observed that increasing tensile, compressive and bending strength of specimen in terms of increasing coconut shell charcoal powder with epoxy polymer due to good interface bonding was observed, and brittleness properties increase by 0% to 10% fiber composite. Young's modulus for tensile and compressive increase in increasing weight percentages of bio-fiber.

Keywords: coconut shell charcoal, hardener, epoxy, composites

1. INTRODUCTION

In this research main focus and highlight the use of biodegradable carbon fiber like jute, cotton, bamboo, banana, sisal, coconut shell as raw material of composite that is bio waste or agricultural waste product naturally occur in an environment so encourage the industry makes the product which is eco-friendly because worldwide big issues about environment problem and global warming. Composites consist of individual or additional discontinuous phases set in in a continuous phase. The discontinuous and continuous phases are expression matrix and reinforcement, respectively. The nature and geometry of the reinforcement present strength of the matrix, and the resulting composite expand properties such as high stiffness, high specific strength, and hardness, which are many additional than the individual components. [2] The matrix is the pack in of two or more than two materials. The material may be a different metal or other material. As at smallest amount three materials are current, it describes a hybridcomposite It is tough hard, and little weight materials.Matrix composite is a mixture of at smallest amount two materials this material mixed each other, give exclusive properties its result on mechanical properties such as tensile strength thermal strength specific density flexibility. If we use a metal such as Aluminum, Magnesium, Titanium, Copper, superalloy for the mixture, then we say metal matrix composite. Carbon fibers usually apply in the material matrix to make composites include high strength. [3] The reinforcement is one type of matrix, the reinforcementmaterial is mixed into the matrix. The reinforcement used to modify physical and mechanical properties,tribologicalperformance, such as wear behavior, friction coefficient and thermal conductivity. The reinforcement can be also continuous or discontinuous. [3-4] the expression "natural fibre" face a large variety of vegetable, animal and mineral fibers. However, in the composite industry, it is usually referred to as wood fibre and Agra-based west, leaf, seed, and stem fibers. These fibers regularly supply deeply to the structural performance of the plant and, when used in plastic, composites can provide significant reinforcement. [5] Composite material there is a minimum 5 % fiber, 5%matrix or if they're 90% matrix, then at least 5% reinforcement must be their ratio of fiber to resin is very important and depending upon the application we will see how the properties can be tailored as we have seen one of the advantages that how much resin should be there and how much fiber should be there.

2. LITERATURE SURVEY:

The literature review is a part of discursive writingwhich performed on basic data on the topic to be measured in the latest research work and to center the importance of the present lessons.

Onkar v. Potadar 2018: To study specific characteristic fiber-based epoxy composite and readiness and testing of composite material from groundnut shell and coir fiber. Composite materials are high, Elasticity, Flexural Strength, Moisture Absorption Test performs in view of 1mm, 1.5mm and 2mm grain estimate groundnut and coir fiber. Epoxy tar is included 70: 30 proportion of Wt. to fiber. Coir fiber hitter, at that point groundnut fiber composite, especially thinking about mechanical properties

Merve. (2017), To study the yield strength of natural epoxy composite and completed in the temperature scope of 300^{o}c. Elasticity, hardness and Electric conductivity test in light of 10%, 30%, half of wt. PET fiber. Hardness, Electric conductivity of natural epoxy PET charcoal composite increment with increment rate of PET. This is so for all chars produced at each studied pyrolysis temperature (i.e., 300, 500 and 700°C).

Abdul Khalil (2010): To study the get ready bamboo stem, coconut shells and were acquired by pyrolysis of fibers at 700 C, portrayed and utilized as filler in epoxy composites. The results obtained showed that the Flexural Strength, thermal stability increase by adding carbon black as a filler in composite. Filled composites were desirable to modify the polymer matrix. The expansion of fillers to polymer grid is a quick and modest technique to adjust the properties of the base materials, utilization of this bio-asset based Carbon dark for composites that require high quality or electrically conductive materials, Flexural and warm properties made strides.

Ajith Gopinatha(2014): To study the mechanical and physical properties and composites were synthesized in 18:82 fiber-resin weight percentages.Tensile Strength, Flexural Strength, hardness & Impact Test on 5% & 10% ratio of Wt. Of jut epoxy composite. The5% jute fiber reinforced natural composites appearrd to have a superior tensile strength than 10% fiber reinforced natural epoxy composite by 18.67 % & Flexural Strength, hardness & Impact Test on 5% to 10% increasing.

Muhammad Khairy Bin Bakri (2015):Studies the developments of reinforced untreatedand treated oil palm fiber epoxy composites. Acoustical Analysis for sound ingestion coefficient, morphological Analysis and Tensile Strength test at 5%, 10%, 15%, 20% proportion of Wt. of palm charcoal composite. Increased in the amount of fiber increases the average tensile and yield strength of the oil palm epoxy composites, caused a higher sound absorption coefficient of fiber composites.

Hari Om Maurya (2015): Synthetic fibers are replaced by natural fibers for polymer composite due to their several benefits naturalfiber has unique properties such as low density, environmentally friendly, low cost and high specific mechanical performance.

Sunil Kumar (2016): This article suggests an alternative in the form of carbon/ glass fiber hybrid composites. On the study of flexural behavior and hardness of the specimens of glass and carbon fiber reinforced hybrid epoxy composites, were prepared by different adding graphite filler of 5 %, 10 %, 15 %. Three sets of specimens with dissimilar filler content aged by boiling at dissimilar temperatures of 40 °C, 60 °C and 80 °C and observed hardness test and flexural test.

F.A.O fernandes 2017 study and focused fiberglass and epoxy resin, tested in quasi-static, dynamic conditions analysis bending test, impact test and mechanical properties complete against synthetic materials because the natural material is eco-friendly recycling the material.

3. EXPERIMENT WORK

3.1 Mold Preparation

Preparation of Specimen for Tensile Testing

After the casting of the specimen, the composite specimen found and has a cylindrical shape having a 25mm diameter and 270 mm length. For the tensile test on the UTM (universal testing machine), specimen required specific size on the basis of ASTM its desired shape should be a length equal to five multiply in diameter i.e. **L= 5×D**

Therefore, this desired shape made by turning operation on the lathe shown in the figure.

Figure 3.4. Turning operation on lathe

3.2 Tensile and Compressive Strength Testing

The capacity of a composite material to withstand powers that force it separated and in addition the ability of the material to extend before failure. The regularly utilized examples in the ductile test are the pooch bone type and the straight side write with end tabs. The estimation of measure length (L), diameter (d) of the tensile test example utilized as a part of the experimentation as 70 mm, 14 mm respectively and the compressive test example utilized as a part of the experimentation as 10mm, 24 mm respectively. The tests were performed with a steady strain rate of 3 mm/min.

Tensile or Compressive stress was found by $\sigma = \frac{F}{A}$	Tensile or compressive modulus and modulus of elasticity were resolved as: $E = \frac{FL}{A\Delta L}$

3.3 Bending Strength Testing

Bending strength is the capacity of the composite material to withstand bending power connected in the lateral direction. The between shear stress is the most extreme shear pressure existing between layers of covered material. Bending test was performed utilizing 3-point.

The examples were tried at a crosshead speed of 0.5 mm/min. The testing arrangement is given below in the figure. The estimated length (L), and diameter (D) in mm of specimen 110 mm and 25 mm.

Bending stress was found by $\sigma_{max} = \frac{8FL}{\pi D^3}$	**B**ending modulus was determined as: $E = \frac{4FL^3}{3\pi D^4 \delta}$

4. RESULT AND DISCUSSION

4.1. Tensile Strength

The specimen used for example geometries are showing (fig 1.II.b) and straight description in end tables. specimen length for the test is 70 mm and diameter is 14mm. The tensile type of test is performed on all universal testing machine (UTM).The test was done with a crosshead speed of 10mm/min.

The outcome obtained from the tests of raw charcoal composites exists in Table

% Volume of charcoal	**Ultimate Load (N)**	**Tensile Strength in (MPa)**
0%	**5000**	**32.48**
5%	**5450**	**35.40**
10%	**5620**	**36.50**

Table 4.1 Ultimate Tensile Strength of the various volume of natural fibre

% Volume of charcoal	**Yield Load (N)**	**Yield Strength (MPa)**	**Young's Modulus (GPa)**
0%	**3114**	**20.228**	**2.36**
5%	**3213**	**20.87**	**3.34**
10%	**3175**	**20.625**	**4.79**

Table 4.2 Yield Tensile Strength and Modulus of the various volume of natural fibre

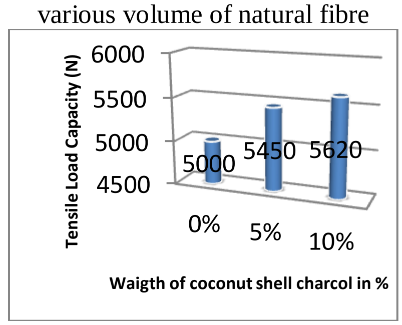


Fig. 4.4 TensileLoad v/s Wt. of coconut shell charcoal % with coconut shell

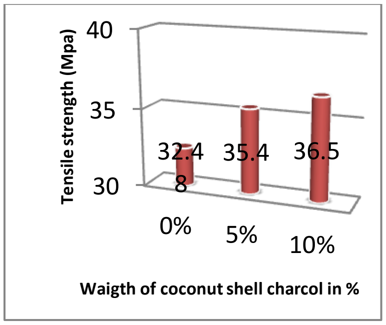


Fig. 4.5.Tensile Strength v/s Wt. of charcoal % with coconut shell charcoal % with different fiber pleased

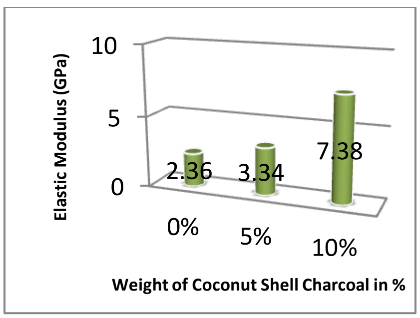


Fig. 4.6. Elastic Modulus v/s Wt. of
different fiber pleased different fiber pleased

Compressive Test

The cylindrical specimen in examples is used for the Compressive test. The specimen used, for example geometries are showing (fig 1.II.b) and straight description in end tables. Specimen length of the test is 10 mm and diameter is 24 mm.The outcome obtained from the tests of raw char composites exists in Table

Diametre 24mm, Area = 452.39 mm^2

% Volume of charcoal	Ultimate Load (N)	Compressive Strength (MPa)
0%	**13900**	**30.72**
5%	**14240**	**31.62**
10%	**16700**	**36.91**

Table 4.6. Ultimate Compressive Strength of the various volume of natural fibre

% Volume of charcoal	Yield Load (N)	Yield Strength in (MPa)	Young's Modulus (GPa)
0%	**2545**	**5.983**	**47.3**
5%	**3038**	**6.71**	**55.13**
10%	**3053**	**6.749**	**76.69**

Table 4.7 Yield Compressive Strength of the various volume of natural fibre

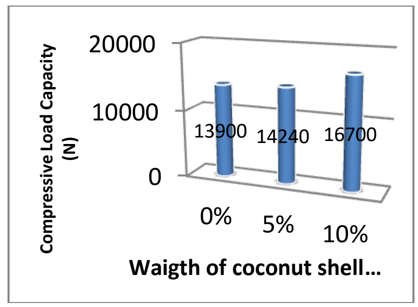


Fig.4.10. Compressive Load v/s Wt. of with of coconut shell charcoal % with Modulus v/s Wt

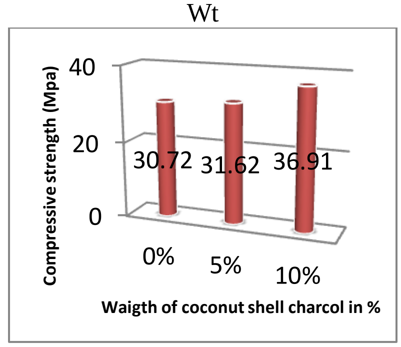


Fig 4.11. Compressive Strength v/s Wt. coconut shell charcoal %. Of coconut shell
different fiber pleased different fiber pleased

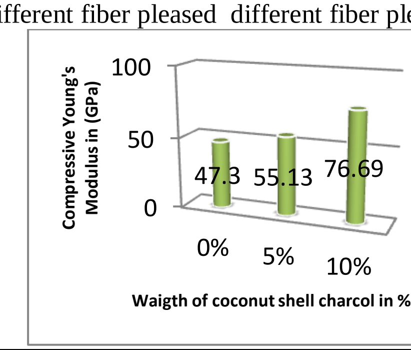


Fig. 4.12. Compressive Young's
charcoal % with different fiber pleased

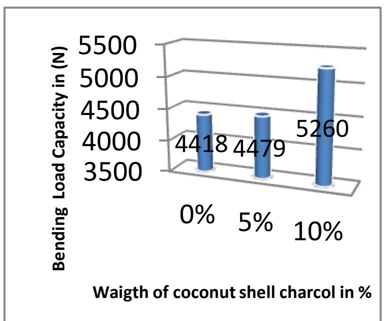
5. 2. Bending testing

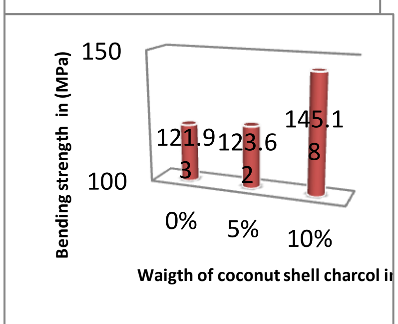
Bending test was going to on D2344-84. Examples of 20mm wide and 150mm long were slashed and were overloaded with three-point twisting with a given cross to the Dept.

Bending strength of different carbon fiber

% Volume of charcoal	Ultimate Load (N)	Bending Stress (MPa)	Bending Modulus (GPa)
0%	4418	121.93	4.65
5%	4479	123.62	5.525
10%	5260	145.18	3.456

Table 4. 11





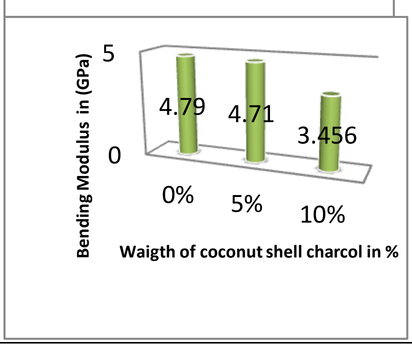


Fig. 4.16. Bending load v/s Wt. of coconut shell charcoal % with different fiber pleased

Fig. 4.17. Bending strength v/s Wt. of coconut shell charcoal % with different fiber pleased

Fig. 5.18. Bending modulus v/s Wt. of coconut shell charcoal % with different fiber pleased

Density of coconut shell charcoal fiber specimen

During density term of measurement of coconut shell charcoal fiber specimen dimension 115mm length, 16mm width and 16 mm thickness having weight 35gm by using weight machine.

Given Data

Mass = 35gm

Volume = 11.5×1.6×1.6 = 29.44 cm^3

$$Density = \frac{\text{Mass}}{\text{Volume}} = \frac{35}{29.44} = 1.188 \text{ gm/cm}^3$$

Specific Strength

$$\text{Specific strength} = \frac{\text{Ultimate tensile strength}}{\text{Density}}$$

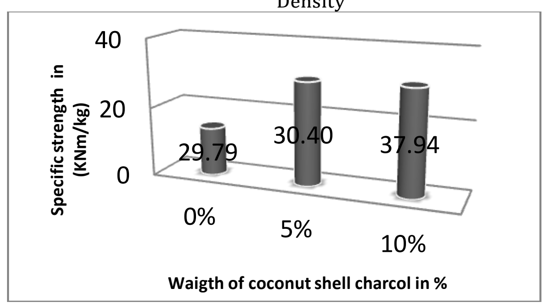


Fig. 4.19. Specific Strength v/s Wt. of coconut shell charcoal % with different fiber pleased

6. CONCLUSIONS

- The experimental Mechanical testing was performed on coconut shell charcoal fiber composite specimen of 0%, 5%, 10% Wt. ratio tensile, compressive and bending strength increases.
- It is clear that in higher percentage reinforcement give more strength and brittleness properties improve.
- Composite manufacturing has been a wide area of research and it is the preferred choice due to its superior properties like low density, stiffness, lightweight and possesses better mechanical properties so wide applications in aerospace, automotive, marine and sporting industries.
- With these result we have found that accelerator pedal can be made by coconut shell charcoal epoxy composite because maximum applied force range of 200N-250N and our result found maximum load 5620 N and yield load 3213 N, Therefore we can replaced metal accelerator

pedal to coconut shell charcoal epoxy composite material.

REFERENCE

[1] Onkar V. Potadar, Ganesh S. Kadam (2018) "Preparation and Testing of Composites using Waste Groundnut Shell and coir Fiber", Procidia Manufacturing 20 (2018) 91-96

[2] MerveSogancioglu, Alize Yucel, EsraYel (2017), "production of the epoxy composite from the pyrolysis charcoal of washed PET wastes" Energy Procedia 118 (2017) 216-220

[3] Abdul Khalil, Bakare, I.O., H.P.S., Firoozian, P., Akil, H.Md. and Noor, A.Md.(2010). Exploring biomass-based carbon black as filler in epoxy composites:: Flexural and Thermal properties [Online]. Available athttp://www.sciencedirect.com/science/article/B6TX5

[4] Ajith Gopinatha, Senthil Kumar.Mb, Elayaperumal Ac, (2014), "Experimental Investigations on Mechanical PropertiesOf Jute Fiber Reinforced Composites with Polyester and Epoxy Resin Matrices", Procedia Engineering 97 (2014) 2052 – 2063

[5] Muhammad Khairy Bin Bakri, ClamaranJayamani, Soon Kok Heng and Sinin Hamdan (2015), "Reinforced Oil Palm Fiber Epoxy Composites: An Investigation on chemical Treatment of Fibers on Acoustical, Morphological, Mechanical and Spectral Properties", Materials Today: Proceedings 2 (2015) 2747 – 2756

[6] Hari Om Maurya, M.K. Gupta, R.K. Srivastava, H. Singh (2015), "Study on the mechanical properties of the epoxy composite using short sisal fibre".Material today: proceedingsVolume 2, Issues 4–5, 2015, Pages 1347-1355

[7] Sunil Kumar Sa*, Neelakantha V Londea, Saviraj A Sa, VikranthKannantha (2017), "Effect of Accelerated Ageing on Hardness and Flexural Behaviour of Woven fabric Glass/ Carbon Hybrid Epoxy Composites", Materials Today: Proceedings 4 (2017) 10751–10756

[8] F.A.O. Fernandesa,*, J.P. Tavaresa, R.J. Alves de Sousaa, A.B. Pereiraa, J.L. Esteves, (2017), " Manufacturing and testing composites based on natural materials", Procedia Manufacturing 13 (2017) 227–234

[9] Shakuntala Ojha1, G. Raghavendra2 and S.K. Acharya3 "Effect of Carbonized Coconut Shell Particles on Mechanical Properties of Bio-Based Composite", Journal of Mineral Metal and Material Engineering, 2016, 2, 6-10

[10] [10]. M. Jawaid, H.P.S. Abdul Khalil (2011),"Cellulosic/synthetic fibre reinforced polymer hybrid composites: A review", Carbohydrate Polymers 86 (2011) 1– 18

[11] Defang Zhaoa, Kai Maoa, YuqiuYangb*, Hiroyuki Hamadaa (2017) "Flexural behaviour evaluation of needle-punched glass/jute hybrid mat reinforced polymer composites ", Procedia Engineering 200 (2017) 10–17

[12] Milene M. E. Costaa,b*, Santino L. S. Meloa, João Victor M. Santosa, Eduardo A. Araújoa, George P. Cunhaa, Enio P. Deusa, Nicolas Schmittb, (2017), "Influence of physical and chemical treatments on the mechanical properties of bamboo fibers", Procedia Engineering 200 (2017) 457–464

[13] Nina Graupner a, David Labonte b, JörgMüssig (2017)," Rhubarb petioles inspire biodegradable cellulose fibre-reinforced PLA composites with increased impact strength", Composites: Part A 98 (2017) 218–226

[14] N. Saba, M.T. Paridah, K. Abdan, N.A. Ibrahim, (2016) "Dynamic mechanical properties of oil palm nanofiller/kenaf/epoxy hybrid nanocomposites", Construction and Building Materials 124 (2016) 133–138

[15] Rahul Shrivastavaa, Amit Telangb Mechanical Properties of Coir/ G Lass Fiber Epoxy Resin Hybrid Composite, MaterialsToday:Proceedings4(2017)3477–3483