International Journal of Mechanical Engineering Research and Development (IJMERD)

ISSN Print: 2248-9347
ISSN Online: 2248-9355

Volume 1 Issue 1, January-April (2016), pp 25-31
Copywright@PRJ:www.prjpublication.com/ijmerd.asp

IJMERD

© PRJ PUBLICATION

MATERIAL CHARACTERIZATION ANALYSIS ON CFRP/GFRP, BANANA FIBER,SISAL FIBER HYBRID COMPOSITE MATERIAL

A. Vijayakumar, ME.,
Lecturer, Department of Mechanical Engineering,
CIT Sandwich Polytechnic College, Civil Aerodrome Post,
Coimbatore-641014
(Email : vivabava@gmail.com).

ABSTRACT

The main objective of this project is the Fiber matrix composite materials with various natural fibers and synthetic fibers in various weight compositions, In this current research glass fiber, carbon fiber, sisal fiber, banana fibers are laminated in various compositions, 3 laminated hybrid composite material is prepared and material characterized in experimental tests, better strength of the material can be identified in this research

Keywords: CFRP, GFRP, Banana fibre, Sisal fibre, material characterization

1. INTRODUCTION

Hybrid composites applications are very eager for the industrial supports, The panel making in the automobile, aircraft interior structures natural fibers are mostly used for weightless and finishing purposes, natural fibers are weightless, very cheap in material cost bio degradable. Compared to other structural fibers, carbon fibers are utilized when fatigue resistance, moderate strength and electrical conductivity are needed and when weight savings are crucial. Recently, nanofilament forms of carbon reinforcement, such as carbon nanotubes (CNTs) and carbon nanofibers [3], have gained growing interest in the composites community, due to their attractive mechanical properties. However, researchers have attempted to incorporate CNTs in polymer matrices and have met limited success, due to the extreme difficulty in uniformly dispersing CNTs in polymeric matrices, because of the large surface area of CNTs [4]. The high-aspect ratio CNTs tend to entangle and form agglomerates when dispersed into a viscous polymeric matrix. Sonication [3] and calendaring [5] have been employed extensively to mitigate this problem, but both techniques are not feasible beyond ~3.0 wt% CNT, due to the formation of aggregates [6]. A combination of dispersion and extrusion techniques have been reported in the literature for producing CNT composites [6] with a tailored microstructure, e.g., aligned CNTs. However, in both dispersion and extrusion techniques, producing uniform and well-dispersed CNT composites is difficult, due to the phase separation stemming from the stronger van der Waals interactions amongst the CNTs bundles compared with that between the CNTs and the polymer matrix [7]. Furthermore, excessive sonication of CNTs toward better dispersion might result in breaking them into shorter tubes, thus reducing their aspect ratios [8] and, consequently, negatively affecting their derived composite mechanical performance. One viable alternative to prevent nanofilaments agglomeration is to anchor one end of the nanofilament to the substrate, thereby creating a stable multiscale structure. This approach can be implemented by physically growing the nanofilaments directly on the surface of the substrate (in this study, the substrate is micro-scale carbon fiber bundles). Carbon nanotubes have been grown on most substrates, such as silicon, silica and alumina [9]. However, there are fewer reports discussing CNT growth on carbon materials; in particular, yarns and fabrics [10]. Two challenges face CNT growth on carbon substrates, namely: (i) the transition metals that catalyze the CNTs growth can easily diffuse into the carbon substrates and; (ii) different phases of carbon materials are able to form on the graphite substrates, because the CNT growth conditions are identical to the graphite or diamond-like carbon growth [11].

2. MATERIALS AND METHODS

2.1. CFRP

Carbon fiber reinforced polymer (CFRP) is a type of composite materials consist of carbon fiber and polymer. The carbon fiber provides the strength and stiffness while the polymer acts as cohesive matrix to protect and held the fibers together. CFRP materials possess good rigidity, high strength, low density, corrosion resistance, vibration resistance, high ultimate strain, high fatigue resistance, and low thermal conductivity. They are bad conductors of electricity and are non-magnetic.

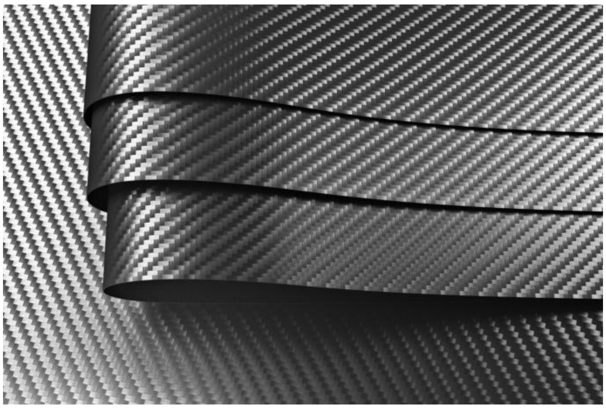

Figure 1 Carbon Fibre

2.2. GFRP

Glass fiber reinforced plastic (GFRP) commonly known as fiberglass is a synthetic amalgamated material made up of plastic and extremely fine fibers of glass. It is the largest segment in the composite industry. GFRP composite material is a relatively low-cost composite material as compared to carbon and other metal fiber composites. From last few decade, this synthetic composite material is in demand for its high strength, light weight, corrosion resistance quality. GFRP products are in high demand in the industries such as wind energy, aerospace, and defense, construction, automotive, etc. for its light weight and corrosion resistant property.

Figure 2 Glass Fibre

2.3. Banana Fibre

Banana fiber is a lingo-cellulosic fiber, which obtained from the pseudo-stem of banana plant. Banana fiber is a bast fiber with relatively good mechanical properties. Banana fiber has good specific strength properties comparable to those of conventional material, like glass fiber.

Figure 3 Banana fiber

2.4. Sisal Fibre

Sisal fibre is species of Agava sisilana. The material is mainly used for applications like rope manufacture in marine and construction industry. As it possesses high strength compared to other fibre materials, this fibre is selected for the present research work.

Figure 4 Sisal Fiber

3. EXPERIMENTAL METHODS

3.1. Hand layup method of composite manufacturing

The hand layup method is used for this hybrid composite material, LY556 resin and HY951 hardner is used for this manufacturing process, paraffin wax is used as a releasing agent, the arrangement of the composite plate is bottom carbon fibre, banana fibre, glass fibre, sisal fire, carbon fibre this is arrangement 1, bottom glass fibre, carbon fibre, sisal fibre, banana fibre, carbon fibre, glass fibre this is combination 2, bottom carbon fire, glass fibre, banana fibre, sisal fibre, glass fibre, carbon fibre this is arrangement 3. The 3 composite laminate sheets are prepared in the dimensions of 300mmX300mm.

4. MATERIAL TESTING

4.1. Tensile Testing

Tensile test of the composite material followed by the ASTM Standards size of 250mm X 25mm X 5mm and dog bone neck shapes, the tensile testing done in UTM machine the testing's done for the same procedure for 3 types of arrangement of the fibers

4.2. Water absorption test

The water absorption test done for the fiber materials with the use of weight balancing machines, the test done in distilled water with 24 hours of processing time before weight and after weight of the fibers calculated and water absorptions calculated through the weight balances

4.3. Flexural Testing

The flexural testing done in the form of tensile testing machine UTM machine, the 3 point bending methods fiber specimens placed in the bed and knife edge load is applied on the middle of the fiber plates the entire tests done in the UTM Machine, the specimen size for the flexural test is 250mm X 25mm X 5mm.

4.4. Impact Testing

The impact test are done in charphy test procedures with the specimen dimensions of 65mmX10mmX10mm the charphy test results, the 3 fiber specimens are under gone with the same procedures only

5. RESULTS AND DISCUSSION

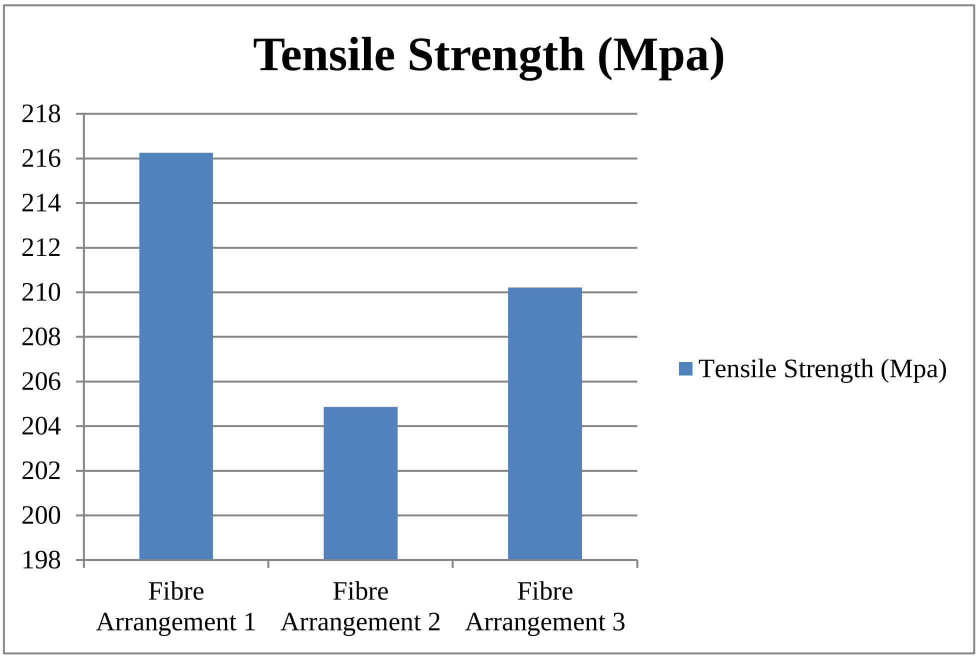

Figure 5 Tensile Test Results for fibre composites

Tensile test results indicates the three different fiber tensile strength, comparison of results fiber arrangement 1 give the higher strengths fiber arrangement 2 give the very low strength, fiber arrangement 3 give the medium level of the fiber strengths

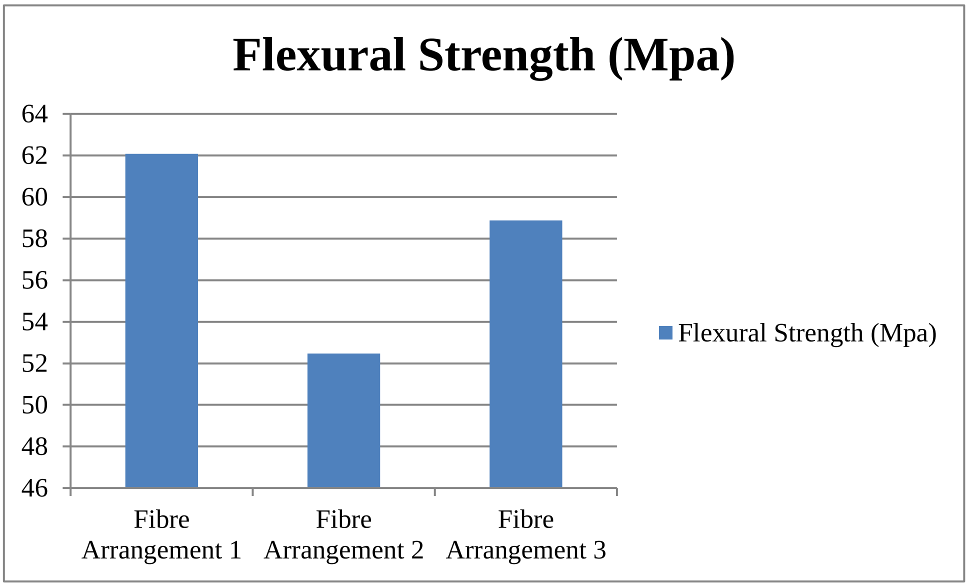

Figure 6 Flexural Test Results for fibre composites

Flexural test results indicates the three different fiber fiber strength, comparison of results fiber arrangement 1 give the higher strengths fiber arrangement 2 give the very low strength, fiber arrangement 3 give the medium level of the fiber strengths

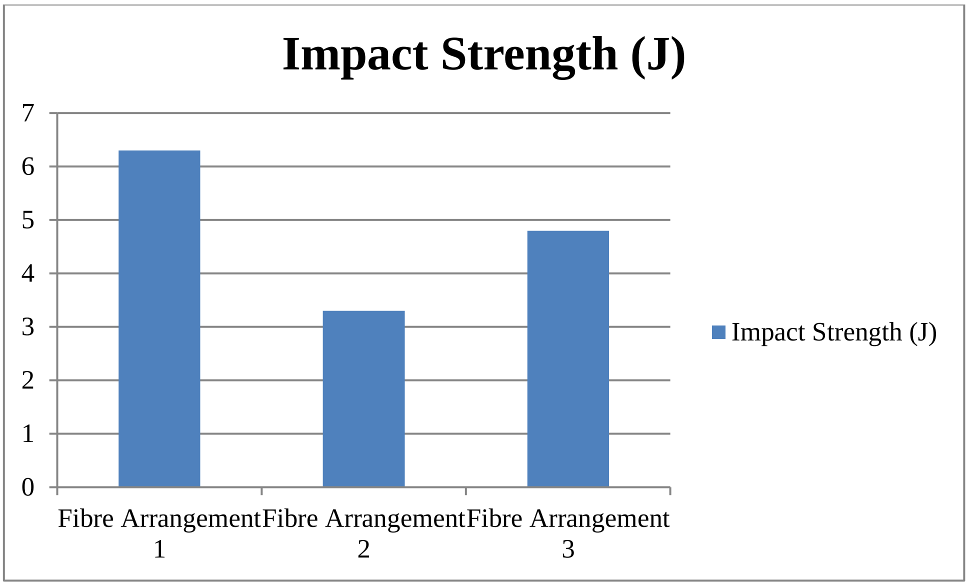

Figure 7 Impact Test Results for fibre composites

Impact test results indicates the three different fiber impact strength, comparison of results fiber arrangement 1 give the higher strengths fiber arrangement 2 give the very low strength, fiber arrangement 3 give the medium level of the fiber strengths

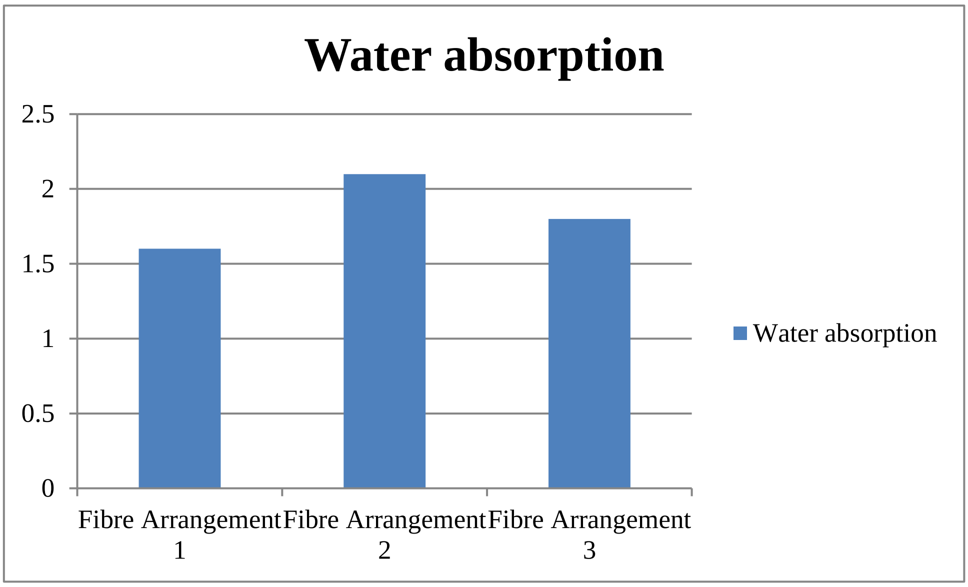

Figure 8 Water absorption test results for fibre composites

Water absorption test results indicates the three different water absorption, comparison of results fiber arrangement 1 give the lower water absorption rate fiber arrangement 2 give the higher water absorption rate, fiber arrangement 3 give the medium level of the water absorption rate

6. CONCLUSION

The material comparative results of the hybrid composite materials done in the research work, the arrangement of the composite plate is bottom carbon fibre, banana fibre, glass fibre, sisal fire, carbon fibre this is arrangement 1, bottom glass fibre, carbon fibre, sisal fibre, banana fibre, carbon fibre, glass fibre this is combination 2, bottom carbon fire, glass fibre, banana fibre, sisal fibre, glass fibre, carbon fibre this is arrangement 3. from the overall comparisons fiber arrangement 1 give the better tensile, flexural, impact and water absorption test results

REFERENCES

1. Samuel, O.D., Agbo, S., and Adekanye, T.A. (2012) Assessing Mechanical Properties of Natural Fibre Reinforced Composites for Engineering Applications. Journal of Minerals and Materials Characterization and Engineering, 11,780-784. http://dx.doi.org/10.4236/jmmce.2012.118066
2. 2. Satyanarayana KG, Sukumaran K, Mukherjee PS, Pavithran C, Pillai SGK (1990) J CemeConc Compos 12(2):136.
3. 3. Towo AN, Ansell MP. (2008) Fatigue evaluation and dynamic mechanical thermal analysis of sisal fiber-thermosetting resin composites, Journal of Composite Science and Technology. 2008; 68(9):25–32.
4. 4. Shah DU, Schubel PJ, Clifford MJ, Licence P. (2013)Fatigue life evaluation of aligned plant fiber composites through S–N curves and constant-life diagrams, Composite Science and Technology. 2013; 74:139-49.
5. 5. Kim, W., Argento, A., Lee, E., Flanigan, C., Houston, D., Harris, A., and Mielewski, D.F. 2011. High strain-rate behavior of natural fiber-reinforced polymer composites. Journal of Composite Materials 46:1056–1065.
6. 6. Margemi FM, Monteiro SN, Bravo Neto J, Rodriguez RJS, and Soares BG. (2010). The dynamic-mechanical behavior of epoxy matrix composites reinforced with ramie fibers. Revista Matéria. 15:164-171.
7. 7. Paiva Júnior CZ, De Carvalho LH, Fonseca VM, Monteiro SN, and D’Almeida JRM. (20