Journal of Material Science and Mechanical Engineering (JMSME)
Print ISSN: 2393-9095; Online ISSN: 2393-9109; Volume 2, Number 5; April-June, 2015 pp. 483-485

http://www.krishisanskriti.org/jmsme.html

Fabrication and Mechanical behavior of Banana Nano Fibre Reinforced Epoxy Composite

P. Surya nagendra[1], VVS Prasad[2] and Koona Ramji[3]

[1]Research Scholar, Department of Marine Engineering, Andhra University, Visakhapatnam 53003.India
[2]Department of Marine Engineering, Andhra University, Visakhapatnam 53003, India
[3]Department of Mechanical Engineering, Andhra University, Visakhapatnam 53003, India
E-mail: [1]psn.mech@gmail.com, [2]prasadau@gmail.com, [3]ramjidne@gmail.com

Abstract—*The development of new composite materials and their related design and manufacturing technologies is one of the most important advances in the history of materials. Composites are the material used in various fields (having exclusive mechanical and physical properties) are developed for particular application. Advanced composites like fibre-reinforced polymer are being favored for certain aerospace, military, marine and automotive applications. Among all reinforcing fibres, natural fibres have gained great significance as reinforcements in polymer matrix composites. Depending upon the source of origin, natural fibres are classified as plant, animal and mineral*
fibres. Recently, due to the growing global energy crisis and ecological risks, natural fibres reinforced polymer composites have attracted by technocrats and scientists for more research in this areas. Polymer nano composites containing layered banana nano fibre (BNF) have attracted much attention. Five different combinations of composites with banana nano Fibre are prepared by using Hand-layup-technique and their mechanical properties were measured. The results showed that the tensile strength and the impact strength increased considerably. A plausible explanation for the increase in these properties is also discussed.

Keywords: *Nano-Banana fibres, hand-lay-up, Mechanical properties*

1. INTRODUCTION

FRPs offer numerous advantages over steel, including high strength to weight ratios, resistance to electrochemical corrosion, ease and speed of application. Material tests are being conducted to characterize the mechanical properties of these materials. 'Nano technology is the understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where unique phenomena enable novel applications'. In fibre reinforced composite materials, the inherent mechanical properties of the matrix material are modified by the introduction of the reinforcing fibres. The mechanical properties of composite material depend on the material properties of the two consistent components of their interface, as well as the amount of reinforcing materials of its geometrical arrangement within the matrix. The amount of reinforcements and their arrangement are determined by the composite fabrication process (Zak et al 2000). The advantages offered by the fibre-reinforced polymer composites such as lightness, resistance to corrosion, resilience, translucency and greater efficiency compared with the more conventional materials, make it an obvious choice. Today, composite materials, including laminated and fibre-reinforced systems, play significant roles in many scientific and engineering realms, primarily due to their unique physical and mechanical response characteristics, such as strength, impact (Oberoi and Goenka 2005) polymers. Therefore, a composite with improved properties at low particle concentration is desired (Garcia et al 2004).

2. PREPARATION OF COMPOSITES/LAMINATES

Laminates are prepared by using hand lay-up technique, by varying weight percentage of Nano fibers 0,2,4,6 and 8. Specimens are prepared as per ASTM standards, in the combination of nano powder, polyester resin and Glass fibre material of 3mm thickness with a setting period of 18–24 h.

3. TEST PROCEDURE

Tensile test measures the force required to break a specimen and the extent to which the specimen stretches or elongates to that breaking point. Tensile test produces stress-displacement diagram and load-displacement diagram, which are used to determine tensile Stress. ASTM Standard specimens are placed in the grip of the Universal Testing Machine at a flat grooved grip separation and pulled off until it failed at a test speed of 50 mm/min for measuring strength. Impact tests are designed to simulate the response of a material to a high rate of loading. The Charpy tests involve the measurement in the test Specimens. A pendulum swinging down from a specified height h_0 to fit the test piece and fracture it. The height 'h' to which the pendulum rises after striking and breaking the test piece is a measure of the energy used in breaking. If no energy were used the pendulum would swing up to the same height h_0 it started from, i.e. the potential energy mgh_0 at the top of the pendulum swing before and after the collision would be the same. The greater the energy used in the breaking, the greater the loss of energy and so the lower the height to which the pendulum rises. If the pendulum swings up to a height h after breaking the test piece then the energy used to break it is $mgh_0 - mgh$.

4. RESULTS AND DISCUSSION

Table 1 shows various combinations of polyester resin, Glass fibre (310g) and nano banana powder in wt. %. The Base composite were prepared in combination with polyester resin and Glass fiber. Samples A, B, C and D were prepared by optimizing the polyester resin and change the wt. % of Glass fibre and nanopowder. These specimens were prepared as per ASTM D638, ASTM D256 standards. These samples are tested in computerized universal testing machine in constant speed of 50 mm/min. at room temperature.

Table 1: Specimens of polyester resin, Glass Fibre and Banana nanopowder.

SPECIMEN	COMBINATIONS	%	WEIGHT (G)
Base Composite	Polyester resin	70	1050
	Glass Fibre	30	450
A	Polyester resin	70	1050
	Glass Fibre	28	420
	Banana Nanopowder	2	30
B	Polyester resin	70	1050
	Glass Fibre	26	390
	Banana Nanopowder	4	60
C	Polyester resin	70	1050
	Glass Fibre	24	360
	Banana Nanopowder	6	90
D	Polyester resin	70	1050
	Glass Fibre	22	350
	Banana Nanopowder	8	120

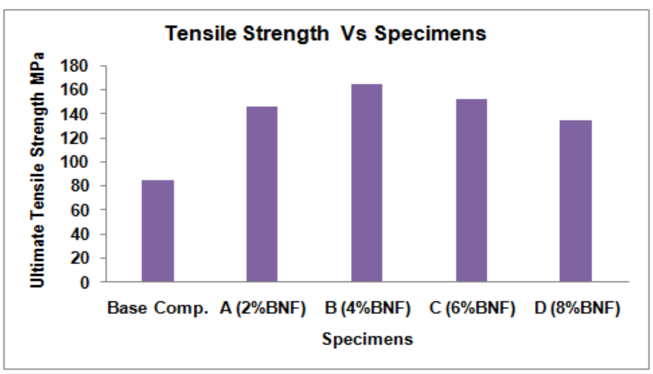

Fig. 1: Tensile strength for various specimens of BNF composites

Fig 1 illustrates the plots of ultimate tensile strength (UTS) in MPa versus specimens of various combinations. It is seen that the specimen, Base Composite yielded 85 MPa for 30% of fibre, Specimen A yielded 146 MPa for the increment of 2% nanopowder, B yielded 164 MPa for the reduction of 4% fibre and increment of 4% Banana nanopowder. Almost 71% Tensile Strength increased because of the good bonding strength due to increasing of nanopowder. Specimen C yielded 152 MPa with a further reduction of 6% fibre and 6% increment of nanopowder. D yielded 135 MPa in reduction of 8 wt % of fibre, increment of 8% of nanopowder. Ultimate tensile strength has been reduced to 7%, due to reduction of fibre specimen which can loose its strength and yielded the 4% reduction of fibre and increment of nanopowder. Almost it reduced by 7% of ultimate tensile strength due to reduction of fibre; addition of nanopowder has been reducing the bonding strength.

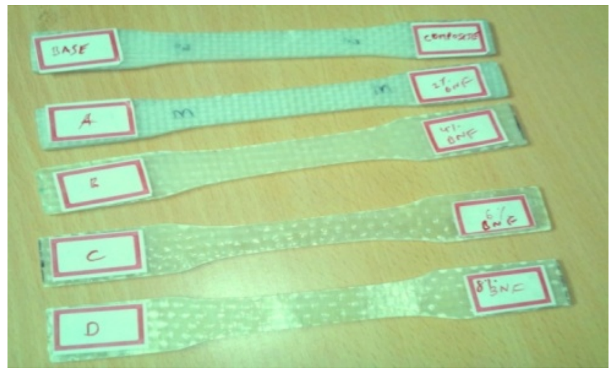

Fig. 2: Test Specimens

Fig 3 illustrates the plots of impact strength in KJ/m^2 vs different specimens. For 30 wt% increment of fibre in Specimen Base composite yielded 2.56 KJ/m^2 , A yielded 2.74 KJ/m^2. For the decrement of 2 wt% of fibre and increment of 2 wt% of nanopowder. Specimen B yields 3.18 KJ/m^2 for 4 wt% reduction of fibre and 4 wt% increment of nanopowder. C yields 2.94 KJ/m^2 for 6 wt% reduction of fibre and 6 wt% increment of nanopowder. Specimen D yielded 2.68 KJ/m^2 When nanopowder is added in this fibre reinforced plastic, it increased the impact strength of material.

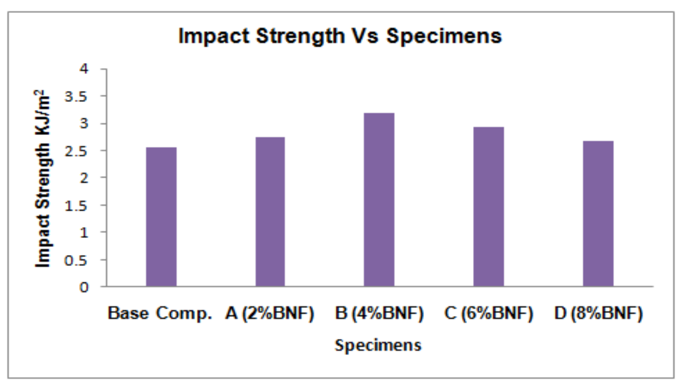

Fig. 3: Impact strength for various specimens of BNF composites.

In this study, the tensile strength and impact strength of an experimentally produced Banana nanocomposite in various combinations of polyester resin, fibre and nanopowder was investigated at room temperature. The results are summarized as follows. The nanocomposite fibre reinforced polymer has sufficiently high ultimate tensile strength and 48% improvement of Tensile Strength at 4 wt% increment of nanopowder. Impact strength increases to 3.18 KJ/mm^2, an addition of 4 wt% of Banana nanopowder. The above two parameters of this study which can predict the influence of nanoparticle in FRP greatly increase tensile strength, and impact strength.

5. CONCLUSIONS

In this present work, different combination of fiber composites are fabricated with nano sized banana fiber. All the composite specimens have the weight fraction; mechanical properties like tensile strength and impact strength are investigated, It has better increment at optimum weight of 4% BNF at values of 146 MPa and 3.18KJ/m^2. Further, increasing the nano fiber content results in poor interface due to the agglomeration of nano fibers, which decrease the mechanical properties of the composites.

REFERENCES

[1] Zak G, Haberer M, Park C B and Benhabib B 2000 Rapid Prototyping J. 6 107

[2] Oberoi Sharad V and Goenka Akash 2005 Fibre-reinforced polymer composite structures, A review, proceedings composite (Kharagpur: Indian Institute of Technology) p. 135

[3] Garcia M, Van Vliet G, Jain S, Schrauwen B A G, Sarkissov A, Van Zyl W E and Boukamp B 2004 J. Adv. Mater. Sci. 6 169

[4] Kumar. A. and Gupta, R. “Fundamentals of Polymer Engineering”. Marcel Dekker Inc, New York, 2003.

[5] Bledzki, A.K. and Gassan,J.. “Composites Reinforced with Cellulose Based Fibers”, prog Polym Sci, Vil.24, 221-274, 1999.

[6] Berthelot, J.M. “Composite Materials: mechanical Behavior and Structural Analysis”, Springer Publications, New York, 1999.

[7] Chakraborty A., M Sain, MK Ortschot, S Cutler (2007). J. Biobased Materials and Bioenergy 1: 71.

[8] Helbert, W.; Cavaille, J.Y. & Dufresne, A. Thermoplastic nanocomposites filled with wheat straw cellulose whiskers. Part I: Processing and mechanical behavior. Polymer Composites 1996, 17(4), 604-11.

[9] Thiruchitrambalam, M.; Alavudeen, A.; Athijayamani, A.; Venkateshwaran, N.; Perumal, A.E. Improving mechanical properties of banana/kenaf polyester hybrid composites using sodium laulryl sulfate treatment. Mater. Phys. Mech. 2009, 8, 165–173.

[10] Debabandya Mohapatra, Sabyasachi Mishra and Namita sutar, Banana and its product utilization, an overview, journal of scientific and industrial research vol-29,May-2010, pp-323-329.

[11] Boopalan,M., Umapathy, M.J. and Jenifer,P. “ A comparative study on the mechanical properties of jute and sisal fiber reinforced polymer composites”, Springer-Silicon, DOI: 10.1007/s 12633-012-9110-6, 2012.

[12] C. Parida,S.K. Dash, S.C. Das, Effect of fibre treatment on mechanical properties of luffa cylindrica-resorcinol composites, international journal of fibre and textile research, universal research Publications 2013; 3(1),13 - 17