Hybrid Reinforced Composite Material from Garbage to Biomaterials

S.Dineshkumar, S.Mohamed Haris, R. Mujeebur Rahaman, K.Balamurali

Abstract*: *A hybrid reinforced composite material which fundamentally contains horticulture squander materials like banana stem outer layer (Musa sepientum) modified to powder form, egg shell modified to fine powder ,the said powders (powder have a size in a range of 10 to 50 microns) being mixed in a matrix of bio epoxy resin using a catalyst to effect complete mixing of the said powdered fibers to yield the said hybrid reinforced composite, the said hybrid composite capable of being molded to any geometrical object, the said composite having a low water retention property with retention being in a range of 14-23% with a soaking time of 120 hrs. Before and after chemical treatment in both with and without moisture, the youngs modulus varies from 12321.5241 N/mm2 to 25779.2532 N/mm2 , the flexural values varies from 17.4 N/mm2 to 25.5 N/mm2 ,impact strength varies from 12.6 J to 20.9 J , % of elongation varies from 5.6% to 10.1%. The composite has negligible change in tensile properties up to a load of 270 Kg also flexural properties and impact strength of the composite were not be affected by under moisture conditions.

Key words*: *Hybrid composites; Mechanical properties; Musa sepientum; Egg shells.

I. INTRODUCTION

Composite materials have been in use for many a variety of applications and have been developed in a variety of configurations [1]. Such materials show some extraordinary properties in terms of mechanical strength, thermal properties etc [2]. The environmental aspects of these materials still pose a challenge in the form of disposability of the finished product if it breaks or gets damaged [3]. Some attempts have been made in recent years to incorporate natural products from plants in the form of fibers. However, composites purely from all ingredients being natural source from plants or bio waste is still not a reality [4-5].

Reference may be made to a US patent publication US2004/0234803 to Catherine Joyce [27]. The innovator reveals a multi fiber composite comprising of a combinant structure of cellulosic wood or polymeric strands blended with non-stringy materials [28-31]. The divulgence identifies with financial and natural efficiencies to wood, non-woods paper making and other polymeric tasks. The disclosed invention also provides application to various categories of products like automotive, construction, food and non-food items [32]. And personal care items. However, the said disclosure is not clearly stating use of any other natural fiber other than wood. This still is not a beneficial use as wood means deforestation and hence threat to environment. The fiber of the invention may also nit have bio degradability property [6]. In yet another patent publication US 2009/0118396 , to Stephan .J Faehner and Michael . J Pisczor, the invention relates to enhancement of cellulosic properties to wood by adding natural fibers. The common strands utilized incorporate horse feed, bagasse, bamboo, coconut husks, cornstalks, cotton, cotton gin squander, flax, hemp, kenaf, oat frames, nut bodies, rice structures, sisal, switch grasses, wheat stalks or different kinds of cellulosic materials. The measure of characteristic strands utilized in the alteration of wood powder is in a scope of 5-95%.The exposure is restricted to adjustment of wood just by including normal filaments recorded [7]. Banana fiber and silica powder fortified composite material dependent on the epoxy gum. Banana strands are all around scattered in the gum framework and expansion of fiber expands the modulus of versatility and diminishes a definitive rigidity of the epoxy [34-36]. Furthermore, further expansion of silica additionally expands the modulus of versatility lessens a definitive elasticity. Expansion of banana very decreases yield quality and expansion of silica gives preferable outcomes over banana fortified composites yet at the same time having yield quality exceedingly diminished. Banana strengthened improve the effect quality of epoxy materials. Expansion of filaments builds the limit of water ingestion. Expansion of banana fiber lessens bowing quality and expansion of silica with banana has not given preferred twisting quality over banana fiber fortified composites. Various blends of silica particles, banana fiber epoxy pitch were set up by mechanical mixing at 3000 rpm [8]. The pretreatment of the egg-shell to make it in fine powder. After the treatment, it is added to the polymer in various weight part (5, 10, 15, 20, 25) wt. % utilizing blender 600 instrument joined to Haake Rehochard meter with blending time 15 min; blending temperature 1750C ; blending speed 32 RPM.

The ductile modulus fluctuated between 450 to 340 for egg shell weight proportion between 5 to

Revised Manuscript Received on July 08, 2019.

S.Dinesh Kumar, Department of Mechanical Engineering, St Peter's Institute of Higher Education and Research, Chennai, Tamil Nadu 600 054, India.e-mail: dinesh.15mech@gmail.com; Mob:9600022797.

S.Mohamed Haris, Department of Mechanical Engineering, St Peter's Institute of Higher Education and Research, Chennai, Tamil Nadu 600 054, India

R. Mujeebur Rahaman, Department of Mechanical Engineering, St Peter's Institute of Higher Education and Research, Chennai, Tamil Nadu 600 054, India.

K.Balamurali Department of Mechanical Engineering, St Peter's Institute of Higher Education and Research, Chennai, Tamil Nadu 600 054, India

25%. The expansion of egg shell powder causes an increment in the flexibility which prompts lessen the quality of the material; increment of the extension break with the expanding filler stacking shows the capacity of the filler to help the pressure move from polymer filler to framework. The expansion of the egg shell expanded the firmness of the HDPE steadily with expanding filler content. Hardness diminishes with expanding filler content. The expansion of egg shell filler has brought about some improvement in the mechanical properties of HDPE. The rigidity, modulus of versatility and hardness prolongation at break of (HDPE/egg shell powder) composite were marginally diminished with the consolidation of the filler. Extension at break and the effect quality increment continuously with expanding filler content [9]. The arrangement of egg shell powder and the planning of the LDPE based composites from it. The egg shells were washed, dried and ground to a powder utilizing the blender. A sifter was utilized to acquire a normal molecule size of 63 µm. The egg shell powder with a normal molecule size of 63 m was treated with an answer of 10% NaOH [10]. .

II. EXPERIMENTAL

A. Materials

Agricultural /biological wastes used in this invention: The composite which fundamentally contains horticulture squander materials like banana stem outer layer (Musa sepientum) & Egg shell and resin used in this research are plant-based materials were significantly better for the environment [11-12]. Geo-graphical location from Tamilnadu, India, Agricultural by-products / biological wastes used in this invention [13-14]

B. Chemical Treatment of said natural fibres

Strands were treated by 1% NaOH + 99% of refined water is included and an answer is made and in this way drying of the filaments in typical concealing for 3 to 4 hours, the strands were taken and absorbed the above said arranged arrangement and with various time interims splashing was completed [15-16]. .

C. Fibre ratio for mechanical testing

Specimen 1 = Fiber 5% and Resin 95% ; Specimen 2 = Fiber 10% and Resin 90% and Specimen 3 = Fiber 15% and Resin 85%

D. Characterization

Tensile test: According to ASTM D638 utilizing Universal Testing Machine, 5569 An, Instron. The speed to test was 5 mm/min [17-19].

Flexural test: According to ASTM D790 utilizing Universal Testing Machine, 5569 An, Instron. The range length was 50 mm and speed to test 2 mm/min [20-21].

Izod effect test (both indented and un-scored): According to ASTM D256 utilizing Impactor II, Ceast. The 5.5 J pendulum was utilized for the test [22-23].

Water Absorption: according to ASTM D5229 Specimen estimate (mm) were 100 X 100 and ingestion test time of 120 hrs [24-26]

III. RESULTS AND DISCUSSION

From the Fig.1 Water absorption test results it is observed that , the said composite having a low water retention being in a range of 14-23% with a soaking time of 120 hrs.

From the Fig.2 Tensile test results it is observed that Before and after chemical treatment in both with and without moisture, the young's modulus varies from 12321.5241 N/mm2 to 25779.2532 N/mm^2.

From the Fig.3 Flexural rigidity test results it is observed that flexural values of composites varies from 17.4 N/mm^2 to 25.5 N/mm2.

From the Fig.4 Impact test results it is observed that impact strength of composites varies from 12.6 J to 20.9 J.

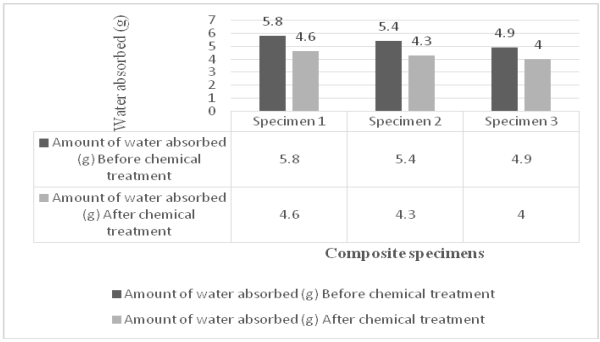

Fig.1 Water absorption test results

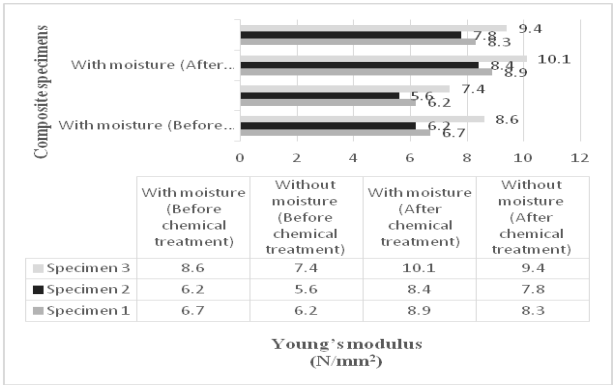

Fig.2 Tensile test results

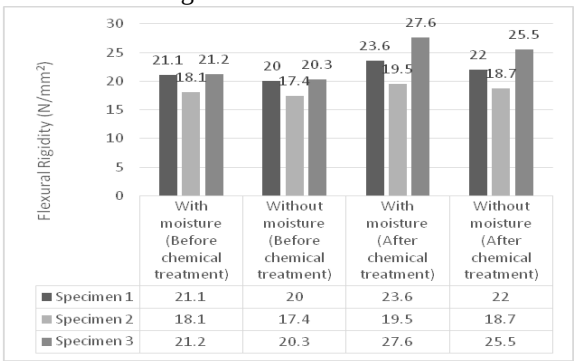

Fig.3 Flexural rigidity test results

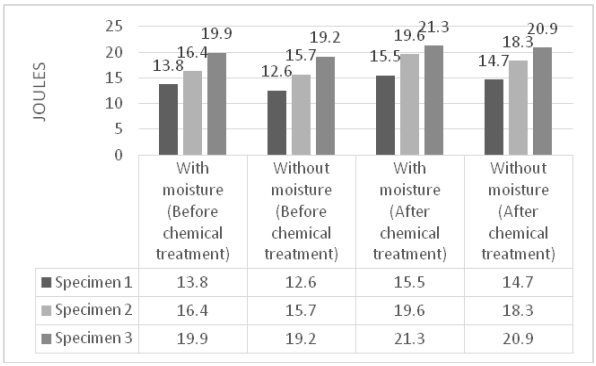

Fig.4 Impact test result

IV. CONCLUSION

From the test results (when concoction treatment) crossover of 3 distinctive example have great mechanical properties and there is no huge diverse in both with and without dampness test outcomes. The said half and half composite fit for being shaped to any geometrical article, the said composite having a low water maintenance property with maintenance being in a scope of 13.3% with a splashing time of 120hrs. The composite has irrelevant switch in ductile properties up to a heap of 270 Kg likewise flexural properties and effect quality of the composite were not be influenced by under dampness conditions. The revelation incorporates the procedure to make the composite and subsequently can be utilized for manufacture of prostheses/fake limp and bone joining substitutes (outer obsession).

REFERENCES

1. Chandramohan, D and John Presin Kumar A. Experimental data on the properties of natural fiber particle reinforced polymer composite material, Data in Brief,13, pp. 460-468,2017.
2. Chandramohan, D. and Marimuthu, K., "Contribution of Biomaterials to Orthopaedics as Bone Implants – A Review", International Journal of Materials Science, Vol.5, No.3,445-463,2010
3. Chandramohan, D, et.al., "Applications of CT/CAD/RPT in the Futurestic Development of Orthopaedics and Fabrication of Plate and Screw Material from Natural Fibre Particle Reinforced Composites for Humerus Bone Fixation – A Future Drift", Malaysian Journal of Educational Technology, Vol.10,No.12,73-81,2010.
4. R.Prasannasrinivas and Chandramohan.D., "Analysis of Natural Fiber Reinforced Composite Material for the Helmet Outer shell", International Journal of current Research, Vol.4,No.3,137-141,2012.
5. B.Murali and Chandramohan.D., "Fabrication of Industrial Safety Helmet by using Hybrid Composite Materials", Journal of Middle East Applied Science and Technology, 15,584-587,2014.
6. Catherine Joyce, Absorbent composites: manufacture of pseudo-fibertm natural fibers and forming of multi-fiber compsites for strength, insulation, sound, fluids and odor absorbency, US 2004/0234803 A1, Nov. 25, 2004.
7. Chandramohan.D., "Analysis On Natural Fiber Bone Plates", European Journal of Experimental Biology, 4(2):323-332,2014
8. Singh V. K, , Gope P. C, Chauhan Sakshi, Bisht Deepak Singh. Mechanical Behavior of Banana Fiber Based Hybrid Bio Composites. J. Mater. Environ. Sci. 3 (2012) 185-194.
9. Chandramohan, D et al. Mechanical, Moisture Absorption, and Abrasion Resistance Properties of Bamboo–Jute–Glass Fiber Composites. Journal of Bio- and Tribo-Corrosion (2019) 5:66. DOI: https://doi.org/10.1007/s40735-019-0259-z
10. Chandramohan, D and John Presin Kumar A. Fibre reinforced composites: A promising material for artificial limp. Data-Enabled Discovery and Applications. 1-9. 2017. DOI: https://doi.org/10.1007/s41688-017-0010-1.
11. Chandramohan, D., Bharanichandar, J., Karthikeyan, P., Vijayan, R., Murali, B. ,Progress of biomaterials in the field of orthopaedics, American Journal of Applied Sciences, 11 (4),623-630,2014.
12. Chandramohan, D., Marimuthu, K. Applications of natural fiber composites for replacement of orthopaedic alloys, Proceedings of the International Conference on Nanoscience, Engineering and Technology, ICONSET 2011,6167942, pp. 137-145,2011.
13. S. Dinesh kumar and K. Purushothaman (2018): Enhancement of thermal conductivity in a plate heat exchanger by using nano particles CNT, Al2O3,surfactant with De-ionised water as coolant, International Journal of Ambient Energy, DOI:10.1080/01430750.2018.1562979.
14. D Chandramohan, K Marimuthu, Bio composite materials based on bio polymers and natural fibers-contribution as bone implants, International Journal Of Advanced Medical Sciences And Applied Research, Vol No. 1, Issue No. 1, 009 – 012,2011.
15. Murali, B., Chandra Mohan, D., Nagoor Vali, S.K., Muthukumarasamy, S., Mohan, A. Mechanical behavior of chemically treated jute/polymer composites, Carbon - Science and Technology,6(1), pp. 330-335.
16. Murali, B., Chandra Mohan, D. Chemical treatment on hemp/polymer composites, Journal of Chemical and Pharmaceutical Research,6(9), pp. 419-423.
17. Chandramohan.D., and A.Senthilathiban. Effects of chemical treatment on jute fiber reinforced composites, International Journal of Applied Chemistry, 10 (1),153-162,2014.
18. Chandramohan, D.and Marimuthu, K., Natural fibre particle reinforced composite material for bone implant, European Journal of Scientific Research, Vol.54, No.3,384-406,2011.
19. K Gurusami, K Shanmuga Sundaram, D Chandramohan, S Dinesh Kumar,P Vasantha Srinivasan & T Sathish (2019): A Comparative Study on Surface Strengthening Characterization and Residual Stresses of Dental Alloys using Laser Shock Peening, International Journal of Ambient Energy, DOI: 10.1080/01430750.2019.1614987.
20. Sathish, T and Chandramohan, D, *Teaching methods and methodologies used in laboratories*, International Journal of Recent Technology and Engineering Volume 7, Issue 6, March 2019, Pages 291-293.
21. Chandramohan, D., Rajesh, S., Increasing combusting resistance for Hybrid composites, International Journal of Applied Engineering Research,9(20), 6979-6985,2014.
22. Chandramohan, D., Bharanichandar, J. Impact test on natural fiber reinforced polymer composite materials, Carbon - Science and Technology,5(3), pp. 314-320,2013.
23. Sathish, T and Chandramohan, D, *Experimental study and model development for on-line drill wear monitoring system using lab view*, International Journal of Recent Technology and Engineering Volume 7, Issue 6, March 2019, Pages 281-286.
24. Chandramohan, D., Rajesh, S,Study of machining parameters on natural fiber particle reinforced polymer composite material, Academic Journal of Manufacturing Engineering12(3),72-77,2014.
25. Chandramohan, D., Murali, B., Machining of composites - A review, Academic Journal of Manufacturing Engineering,12(3), 67-71,2014.
26. Pandyaraj, V., Ravi Kumar, L., Chandramohan, D. Experimental investigation of mechanical properties of GFRP reinforced with coir and flax, International Journal of Mechanical Engineering and Technology,9,pp. 1034-1042,2018.
27. Sathish, T., and Karthick, S. "HAIWF-based fault detection and classification for industrial machine condition monitoring", Progress in Industrial Ecology, vol. 12, no. 1-2, pp. 46-58, 2018
28. T. Sathish, and J. Jayaprakash, "Meta-Heuristic Approach to Solve Multi Period Disassembly-To-Order Problem of End-Of-Life Products using Adaptive Genetic Algorithm", International Journal of Mechanical & Mechatronics Engineering IJMME-IJENS, Vol. 15, No. 3, pp. 59-67, 2015.
29. T. Sathish, "Experimental investigation on degradation of heat transfer properties of a black chromium-coated aluminium surface solar collector tube", International Journal of Ambient Energy, Taylor and Francis Publishers, Vol. 39, doi: https://doi.org/10.1080/01430750.2018.1492456.
30. T. Sathish, "Heat Transfer Analysis of Nano-Fluid Flow in a converging Nozzle with different aspect Ratios", Journal of New Materials for Electrochemical Systems, Vol. 20, pp. 161-167, 2017.
31. Sathish, T. "Performance measurement on extracted bio-diesel from waste plastic", Journal of Applied Fluid Mechanics, vol. 10, pp. 41-50, 2017.
32. Sathish, T., Jayaprakash, J. "Optimizing Supply Chain in Reverse Logistics", International Journal of Mechanical and Production Engineering Research and Development, Vol. 07, pp. 551-560, 2017.

33. Sathish, T., Periyasamy, P. “Modelling of HCHS system for optimal E-O-L Combination section and Disassembly in Reverse Logistics”, Applied Mathematics and Information science, Vol. 13, No. 01, pp. 1-6, 2019.
34. Sathish, T., Muthulakshmanan, A. “Design and simulation of connecting rods with several test cases using AL alloys and high Tensile steel”, International Journal of Mechanical and Production Engineering Research and Development, Vol. 08,Issue 1, pp. 1119-1126, 2018.
35. Vijayan, V., Parthiban, A., Sathish, T., Siva Chandran, S., Venkatesh, R. “Performance Analysis in End Milling operation”, International Journal of Mechanical Engineering and Technology, Vol. 09, Issue. 11, pp. 2263-2271, 2018.
36. Venkatesh, R., Vijayan, V., Parthiban, A., Sathish, T., Siva Chandran, S. “Comparison of Different Tool path in Pocket Milling”, International Journal of Mechanical Engineering and Technology, Vol. 09, Issue. 12, pp. 922-927, 2018.