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Study & Testing Of Bio-Composite Material Based On Munja Fibre

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ABSTRACT: *The incorporation of natural fibres such as munja fiber composites has gained increasing applications both in many areas of Engineering and Technology. The aim of this study is to evaluate mechanical properties such as flexural and tensile properties of reinforced epoxy composites. This is mainly due to their applicable benefits as they are light weight and offer low cost compared to synthetic fibre composites. Munja fibres recently have been a substitute material in many weight-critical applications in areas such as aerospace, automotive and other high demanding industrial sectors. In this study, natural munja fibre composites and munja/fibreglass hybrid composites were fabricated by a combination of hand lay-up and cold-press methods. A new variety in munja fibre is the present work the main aim of the work is to extract the neat fibre and is characterized for its flexural characteristics. The composites are fabricated by reinforcing untreated and treated fibre and are tested for their mechanical, properties strictly as per ASTM procedures.*

Keywords: *Mechanical properties; Epoxy Resine, Natural Composites, Hand-lay-up.*

I. Introduction

Nature created materials is the munja fibres which are abundantly available, eco-friendly and have renewable in their behavior. The cultivation and on growing harvesting and primary processing conditions to extract the fibre will dictate the homogeneity. On one end the natural fibres are light in weight which is extremely advantageous but due to its low density can be disadvantageous in processing since the fibre tends to emerge from the matrix specifically

liquid resins. Moisture absorbing tendency is another bottleneck to the natural fibres which resulted in the delamination of the composites. Hence right extraction method of fibre and suitable processing method to manufacture the composites by reinforcing the fibre are the vital foremost tasks in dealing with NFRPC. Several researchers have put their effort in manufacturing composites using variety of natural fibres (with and without chemical treatment), matrices (thermoplastic, thermosetting plastic etc.) and characterized them for their physical, mechanical, and thermal properties. Out of that a part of authors have focused on making and characterization of the composites reinforced with short palymyra palm fibrous waste, stem, stem long, munja, palm/jute, fibre palm/banana, borassus fruit fibre in *various* matrices and the highlights of the same are described below in the order of borassus fruit, short, short hybrid, long, long hybrid palmyra palm fibre reinforced polymer composites. Sudhakara *et al.* [1], achieved more flexural strength, tensile strength, modulus, modulus and impact strength for alkali treated/MAPP composites by 4.5, 17, 17.2, 9 and 10 % respectively in case of borassus fruit fibre reinforced polyester composites. Dabade ***et al.*** [2], extracted the palmyra palm fibres from stem and also extracted by chemical means (soaking in 1 % NaOH) solution. They have reported that palmyra fibres up to 50 mm length in the polyester composites have shown increasing trend of flexural strength, and is decreasing thereafter. At 50 mm fibre length, the composites exhibited maximum tensile strength of 42.65 MPa and thereafter it is decreasing. The mechanical properties of palmyra/banana fibre reinforced composites have shown optimally increased properties at 2 cm fibre length when compared with 3 cm and was noticed by Venkatesha Gowdagiri Prasanna *et al.* [3]. Fibrous waste formed during separation of palmyra palm leaf, stem base is used by velmurugan [4], to form palm fibrous waste (pfw) reinforced polyester composites. They have also prepared pfw/glass FRP composites to compare and contrast the results of the short fibre composites without hybridization. The addition of pfw resulted in improvement in impact strength but they have unable to achieve the tensile, flexural strength with increase in fibre content in the composites**.** Thiruchitrambalm *et al.* [5], studied the effects of chemical treatment on palmyra palm leaf stalk fibre reinforced polyester composites. They have achieved an improvement in tensile strength by 60 % and modulus by 60 % respectively with the reinforcement of mercerized and benzoyl – treated fibre composites respectively whereas permanganate –

treated fibre composites shown increase in flexural strength**.** Prasad *et al*. [6], shown that out of 00, 450, 900 orientation of palm fibre reinforced unidirectional composites studied by them, the tensile strength of the composites have 00 fibre orientation exhibited increasing trend with increase in fibre volume fraction. Palmyra leaf stalk and jute fibres were reinforced into unsaturated polyester matrix and their static and dynamic mechanical properties were investigated by shanmugham *et al*. [7]. Venkatesha prasanna *et al*, reported that the mechanical properties were optimally increased at 20 % volume content of alkali treated banana – palmyra fibres when compared with 10 % and 30 % volume content of treated fibres and 10 %, 20 %, 30 % volume contents of untreated fibre reinforced composites. Nadendla Srinivasababu *et al*. Introduced Palm Tree Sprout Leaf (PTSL) fibre reinforced polyester composites. The author has characterized the fibre for its tensile properties and morphological study.

II. Materials And Method

A 30% Munja, 49% epoxy (araldite AY-103) and 21% hardner is prepared by using hand lay-up technique. For this purpose, an open mould made of mild steel plate (600 mm long × 300 mm wide × 27 mm thick) has been used. . Firstly, a Mylar sheet is placed on the lower part of mould for a good surface finish and easy withdrawal of bio-composite from the mould in addition to it wax is also used to cover the surface of Mylar sheet for easy withdrawal of bio-composite from Mylar sheet. Munja fibres placed unidirectional on it. Then the matrix (mixture of 30% munja and 49% epoxy and 21%hardner) has been layered on the mould (3 mm) thickness. After removing the entrapped air with the help of metal roller rolled on the layer, thereafter layer of matrix has been poured on the mould. Then upper part of mould is placed on side plates, which placed on both side of lower part of mould. In this way to cast the specimen of size (250 mm × 120 mm × 4 mm) the bio-composite sheet produced single ply having thickness between 4 mm and then left for 48 hours for curing at room temperature (17-29˚C). After 48 hours it is removed from the mould. Then this sheet is used to make Flexural test specimens according to ASTM Standards. Taking out fabricated sheet of bio-composite from the mould and fabricated sheet of bio-composite. Compression test and impact test specimens are required higher thickness, so closed wooden moulds have been used, in which the mould that has been used to make flxural test specimens has different width & thickness. The internal surface of mould is covered with Mylar sheet with wax covered over Mylar sheet to protect matrix piece to stick with Mylar sheet. Then the matrix has been layered on lower part of the mould (40 mm) thickness and a layer of munja fibres placed unidirectional on it. After layer of Munja fibres again matrix layer is applied. Then upper part of mould is placed on lower part of mould and then left for 48 hours for curing at room temperature (17-29˚C). After 48 hours it is removed from the mould. Then flexural test specimens of required dimensions according to ASTM Standards are cut from the fabricated sheet of bio-composite.

Processed bio-composite

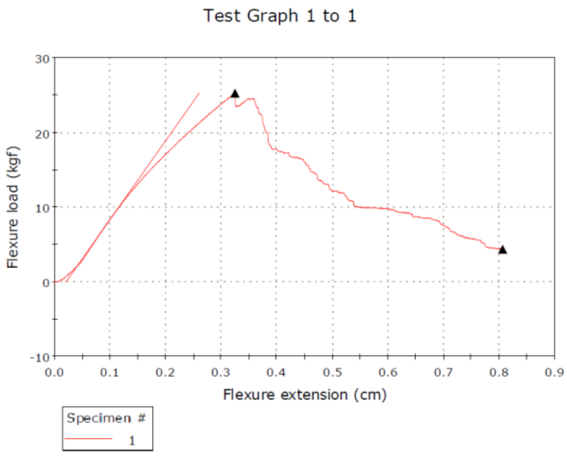
Munja raw materials

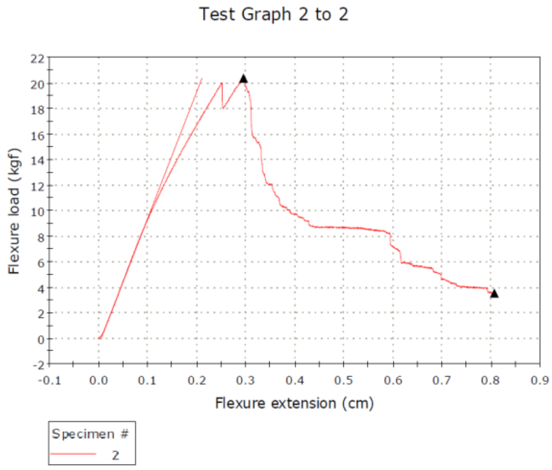
Munja plan

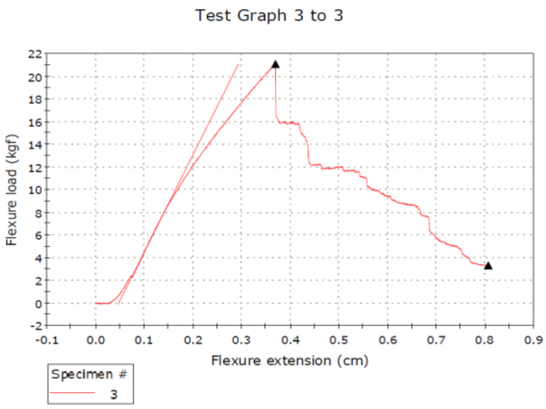
Universal Testing Machine

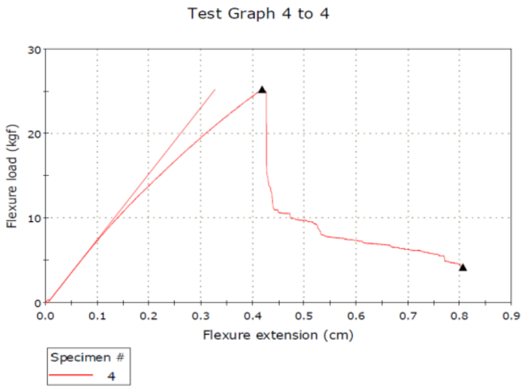
III. Results And Discussion

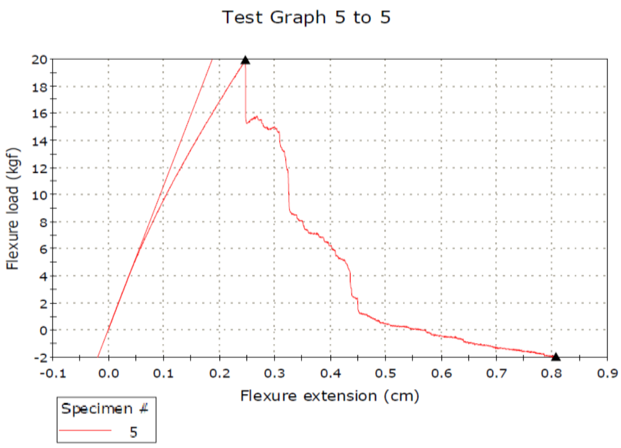
The application munja fibers reinforced bio composite materials are growing day by day in every field of engineering and technology due to its characteristics like eco-friendly, recyclable, bio-degradable and user friendly in nature. Many researchers are working in this field to make the munja composites and to replace metals and alloy materials in the field of engineering and technology without affecting the load carrying capabilities and cost aspects. In the present experimental study, the munja composite laminates. Then the test specimen are prepared from the composite laminates as per ASTM standards and testing of materials has been carried out under flexural and impact loading conditions by using universal testing Specimen fracture Specimen fracture Notch machine and impact testing machine.The experimental results on mechanical properties of the tested composite.











Result of experiments (test)

1. The 1st result – 1020.70 kgf/cm^2 Flexural strength of the specimen tested on dated 06.02.20015 at CIPET LUCKNOW on UTM.
2. The 2nd result – 823.48 kgf/cm^2 Flexural strength of the specimen tested on CIPET LUCKNOW on UTM.
3. The 3rd result -852.35 kgf/cm^2 Flexural strength of the specimen tested on CIPET LUCKNOW on UTM.
4. The 4th result – 1020.95 kgf/cm^2 Flexural strength of the specimen tested on CIPET LUCKNOW on UTM.
5. The 5th result -806.52 kgf/cm^2 Flexural strength of the specimen tested on CIPET LUCKNOW on UTM.

The UTM was fully calibrated on the time of testing.

Width (mm)	Thickness (mm)	Support span (mm)	Speed (mm/min)	Maximum Flexure load (kgf)	Flexure Strength@ Max load (kgf/cm^2)	Flexure Elongation@ Max Load (%)	Flexure load@Brea k (kgf)	Flexure Strengt h@Brea k (kgf/cm ^2)	Flexure Elongation @Break (%)	Modulus (kgf/cm ^2)
15.70	3.78	60.48	1.61	25.24	1,020.70	2.01	4.40	177.88	4.99	68,627.2 4
15.70	3.78	60.48	1.61	20.36	823.48	1.83	3.59	145.04	4.99	64,514.0 4
15.70	3.78	60.48	1.61	21.08	852.35	2.29	3.36	135.85	5.00	55,805.7 7
15.70	3.78	60.48	1.61	25.25	1,020.95	2.59	4.26	172.46	4.99	50,919.1 1
15.70	3.78	60.48	1.61	19.94	806.52	1.53	-1.88	-75.97	5.00	69,271.0 8

IV. Overall Conclusions

Hand lay-up technique is successfully employed in manufacturing munja fibre composites with relative ease and accuracy. The wastage generated during the extraction of the fibre is 30 %. The soaking time for the present chemical composition yields the very good Flexural properties .Which is evidenced from the experimental results. The mechanical properties of the palmyra palm petiole FRP composites given enough confidence to fabricate light weight and reasonably good strength parts for automobile door panels, house hold applications like doors, window frames etc.

V. Suggested Applications

The bio-composites fabricated in my thesis work i.e. the sunnhemp fibre based bio-composites has some applications are given as follows:

- Bio-degradable Packagings
- Automotive Interiors
- Wheel shield
- Bumper, Engine shield
- Rear shelf
- Upholstery, Door covering (racks), cover, electronic device

VI. Research Can Be Carried Out Further

- Also find the characteristics of bio-composites should be studied at different temperatures.
- To observe thermal characteristics of bio-composites.
- Research should be done with for munja fibre reinforced biodegradable composites so that a fully biodegradable material (green composite) may be fabricated which can be used in packaging and home appliances. It will also be good for eco friendly environment.

REFERENCES

[1] Sudhakara, P., Obi Reddy, K., Venkata Prasad, C., Jagadeesh, Dani., Kim, H. S., Kim, B. S., Bae, S. I., Song, J. I., 2013. Studies on Borassus fruit fiber and its composites with Polypropylene, Composites Research, 26, p. 48.

[2] Dabade, B. M., Ramachandra Reddy, G., Rajesham, S., Udaya Kiran, C., 2006. Effect of fiber length and fiber weight ratio on tensile properties of sun hemp and palmyra fiber reinforced polyester composites, *Journal of Reinforced Plastics and Composites*, 25, p. 1773.

[3] Venkatesha Gowdagiri Prasanna, Venkata Subbaiah, K., 2013.Modification of tensile, compressive properties & Chemical resistance of hybrid biocomposites, *International Journal of Nanomaterials and Biostructures*, 2, p. 9.

[4] Velmurugan, R., Manikandan, V., 2005. Mechanical properties of glass/palmyra fiber wate sandwich composites, Indian Journal of Engineering & Material Sciences, 12, p. 563.

[5] Thiruchitrambalam, M., Shanmugam, D., 2012. Influence of pre-treatments on the mechanical properties of palmyra palm leaf stalk fiber– polyester composites, *Journal of Reinforced Plastics and Composites* 31, p. 1400.

[6] Prasad, V. V. S., 2012. Evaluation of mechanical, thermal, elctrical properties of palm fibre reinforced polyester composites, *International Journal of Engineering Science and Technology*, 4, p. 1746.

[7] Shanmugam, D., Thiruchitrambalam, M., 2013. Static and dynamic mechanical properties of alkali treated unidirectional continuous Palmyra Palm Leaf Stalk Fiber/jute fiber reinforced hybrid polyester composites, Materials and Design, 50, p. 533.

[8] Venkatesha Prasanna, G., Venkata Subbaiah, K., 2013.Hardness, tensile properties and morphology of blend hybrid composites, Scholarly *Journal of Engineering Research*, 2, p. 21.

[9] Migneault S, Koubaa A, Erchiqui F, Chaala A, Englund K, Wolcott MP. Effects of processing method and fiber size on the structure and properties of wood–plastic composites. Compos Part A 2009:.40; 80-85.

[10] Wong KJ, Zahi S, Low KO, Lim CC. Fracture characterisation of short bamboo fibre reinforced polyester composites. Mater Des 2010:31;4147–4154.

[11] Gu H. Tensile behaviours of the coir fiber and related composites after NaOH treatment. Mater Des 2009: 30; 3931-3934.

[12] Alves C, Ferrão PM C, Silva AJ, Reis SLG, Freitas M, Rodrigues LB, Alves D E. Ecodesign of automotive components making use of natural jute fiber composites. J Cleaner Prod 2010:18; 313-327.

[13] Carvalho KCC, Mulinari DR, Voorwald HJC, Cioffi MOH. Chemical modification effect on the mechanical properties of hips/ coconut fiber composites. Bio Resources 2010:.5; 1143-1155.

[14] Nadendla Srinivasababu, Suresh Kumar, J., Vijaya Kumar Reddy, K., 2012. "Experimental Characterization of One Year Dried Palm Fruit EFB Fiber and Evaluation of Performance of its Composites", 4th International & 25th All India Manufacturing Technology, Design and Research Conference (AIMTDR – 2012),Kolkata, India, paper #105.

[15] Srinivasababu, N., Murali Mohan Rao, K., Suresh Kumar, J., 2010. Tensile properties of turmeric fibre reinforced polyester composites, *Indian Journal of Fibre & Textile Research*, 585, p. 311.

[16] Maya John J, Sabu Thomas, 2012. Natural Polymers Volume 1: Composites, R S C Publishing, U. K.

[17] Shanmugam, D., Thiruchitrambalam, M., 2013. Static and dynamic mechanical properties of alkali treated unidirectional continuous Palmyra Palm Leaf Stalk Fiber/jute fiber reinforced hybrid polyester composites, Materials and Design, 50, p. 533.

[18] Venkatesha Prasanna, G., Venkata Subbaiah, K., 2013.Hardness, tensile properties and morphology of blend hybrid composites, *Scholarly Journal of Engineering Research*, 2, p. 21.

[19] Venkatesha Prasanna, G., Venkata Subbaiah, K., 2013. Modification, flexural, impact, compressive properties & chemical resistance of natural fibers reinforced blend composites, *Malaysian Polymer Journal*, 8, p. 38.