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Study, testing & analysis of composit material based on munja fibre

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---ABSTRACT---
The use of natural fibers as reinforcement in polymeric composites for technical applications has been a research subject of scientists during the last decade. There is a great interest in the application of munja fiber as substitutes for glass fibers, motivated by potential advantages of weight saving, lower raw material price, and ecological advantages of using green resources which are renewable and biodegradable. There was an improvement in the tensile strength of the treated fiber composites. Recently the interest in composite materials reinforced with natural fibers has considerably increased due to the new environmental legislation as well as consumer pressure that forced manufacturing industries to search substitutes for the conventional materials, e.g. glass fibers. This way, the objective of paper was evaluate the mechanical properties of munja fibre composites. These fibers were mixed with the Epoxy and Hardener compositions with 5 to 25 wt% of fibers were obtained. The mechanical properties were evaluated by means of tensile tests. In addition, fracture analysis via SEM (secondary electrons mode) was performed. Results showed improve the tensile properties.

KEYWORDS: *Munja fibers; Composites; Fatigue; Interfacial bonding, tensile strength, Mechanical properties.*

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I. INTRODUCTION

The use of natural fibers as reinforcements for composite has attracting more interest of industries. Fibers reinforced polymer composites have many applications as class of structural materials because of their ease of fabrication, relatively low cost and superior mechanical properties compared to polymer resins .For example in the automotive industry, the effort to reduce weight in order to improve fuel economy and to comply with tighter governmental regulations on safety and emission has led to the introduction of increasing amounts of plastics and composites materials in place of the traditionally used steels . Natural fibers have different origins such as wood, pulp, cotton, bark, bagasse, bamboo, cereal straw, and vegetable (e.g., munja, flax, jute, sunnhemp, sisal, banana, pineapple and ramie). These fibers are mainly made of cellulose, hemicelluloses, lignin and pectin's, with a small quantity of extractives. Compared to glass fiber and carbon fibers, natural fibers provide many advantages, such as, abundance and low cost, biodegradability, flexibility during processing and less resulting machine wear, minimal health hazards, low density, desirable fiber aspect ratio, and relatively high tensile and flexural modulus**.**The effect of fibre length on mechanical properties of composite was presented by Rashed *et al.(*2006).Along with holding the fibre together, the matrix has the chief function of transferring applied load to the fibres. Failure of specimen takes place may be due to insufficient length of fibre for stress distribution. An optimum length of 5mm was considerd for present experimentation.The effect of fibre weight fraction and concentration of alkaline medium for surface modification of fibre on mechanical properties of FTR composites were studied by H.Anuar *et al*.(2012), Norshahida sarifudin *et al*.(2012), Dmitri shumigin *et al*.(2011), Rong *et al*.(2001),Huda *et al*.(2008), soeng OK Han *et al*.(2012), Zhaoqian li *et al*.(2011)and Ruihua Hu *et al*.(2007).

Mulinari *et al.* studied bleaching of cellulose fibers from sugarcane bagasse and evidenced an improve interfacial of the fibers and matrix. The objective of this paper was to evaluate the effect of chemical modification on mechanical properties of cellulose pre-treated sugarcane bagasse fibers/PP composites. The modification the fibers were evaluated by techniques scanning electron microscope (SEM), X-ray diffractometry (XRD) and Fourier Transformed Infrared (FTIR). These fibers were mixed with the polypropylene in a thermokinetic mixer, and compositions with 5 to 25 wt% of fibers were obtained**.** Jochen Gassan et.al improved the mechanical properties of jute epoxy composites by the use of NaOH treatment process. Alkali treatment was done by treating the fiber samples with different solutions with NaOH at concentrations up to 28% by weight for a maximum of 30 min at a temperature of 20°C followed by washing ofapproximately 30% and 50% respectively, lower than comparable glass fiber epoxy composites. Use of fibers and of higher fiber contents, both led to a decrease in fatigue behaviour and progress in damage in the composites**.** Varada Rajulu et.al reinforced short natural fiber belonging to the species Hildegardia Populifolia in styrenated polyester matrix. The mechanical properties of the composites reinforced with alkali treated fibers were determined and compared with untreated fibers. The fracture surfaces of these composites were investigated by SEM. Tensile modulus is measured using Instron UTM model: 1175 (UK).Alkali treatment of the fibers enhanced the tensile modulus by 3.5% and compressive strength by 7.5%.Munikenche Gowda T et.al evaluated mechanical properties of woven jute fabric reinforced composites. Specimens are prepared by hand layup technique according to ASTM-D standard 3039. Fibers are reinforced with commercially available general purpose polyester resin. From results concluded that the mechanical properties of strength and moduli as high those of conventional composites. Since the reinforcing material is eco-friendly, nontoxic, low cost and easily available as compared to conventional fibers; the composites are a good substitute for wood in indoor applications. Mohan Kumar G C *et.al* studied the mechanical properties of the fibers extracted from areca is determined and compared it with other known natural fiber coir. Areca fibers chemically modified by alkali treatment and effect of the treatment on fiber strength studied. Composite laminates are prepared with different proportions of phenol formaldehyde and fibers. Tensile test, moisture absorption test and biodegradable tests on these laminates were carried out. Bio degradability tests show the degradability of areca fibers is low hence better and long life for composites.

II. METERIALS & ANALYSIS

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. Munj fibres placed unidirectional on it. Then the matrix (mixture of 30% munj 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 × 5 mm) the bio-composite sheet produced single ply having thickness between 3 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 tensile 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 tensile 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 Tensile test specimens of required dimensions according to ASTM Standards are cut from the fabricated sheet of bio-composite.

Physical, chemical and mechanical properties of epoxy resin (Araldite AY - 103) and hardener (Aradur HY - 951)

Properties	**Epoxy (Araldite AY - 103)**	**Hardener(Aradur HY - 951)**
Colour	Clear Amber	Colorless
Odour	Mild	Ammonia
Physical State	Liquid	Liquid
Solubility in Water	Insoluble	Insoluble
Specific Gravity	1.14 (water = 1)	0.98 (water = 1)
Boiling Point	> 300°F (> 149 °C)	>200 °C
pH value	Not Determined	Approx. 13
Flash Point	> 250°F (> 121 °C)	110°C
Percent Volatile	Negligible	Negligible
Shear Strength	8.9 ± 0.6 MPa	-
Young's Modulus	13.2 ± 0.6 GPa	-
Deformation at Break	0.23 ±0.03 %	-
Tensile Strength	31.74 MPa	-
Source: *Huntsman Advanced Materials Americas Inc. (EL), P.O Box 4980, Woodlands.*		

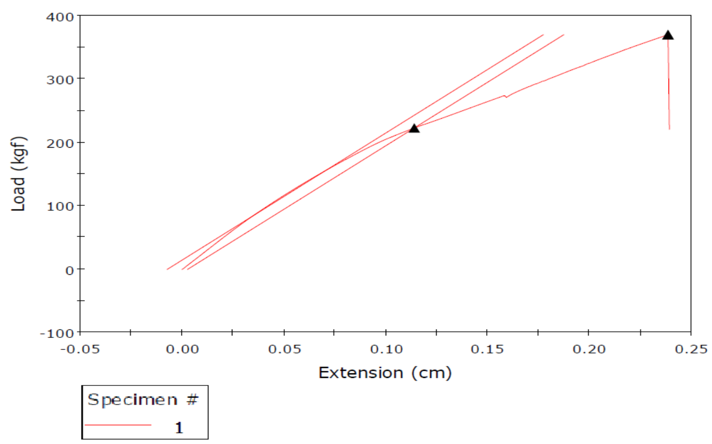

Processed fibre composite Munja Raw Material


Munja Plant Universal testing Machine

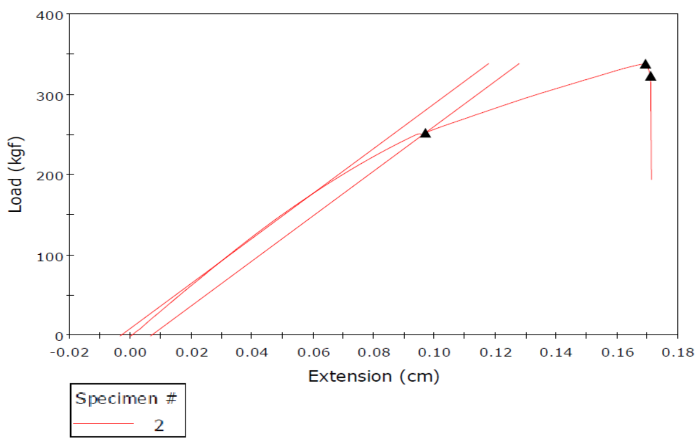
III. CONCLUSION

The manmade fibre composite materials were tested for mechanical properties and were tested using Instron Testing machine as per ASTM standard. The optained and tested materials is shown in graph. The sample were tested in tensile testing machine with different load cell with cross head speed of 5 mm/min as per ASTM standard D638. The application of natural and manmade fibers reinforced bio composite materials are growing day by day in every field of engineering due to its characteristics like eco-friendly, recyclable, bio-degradable and user friendly in nature.

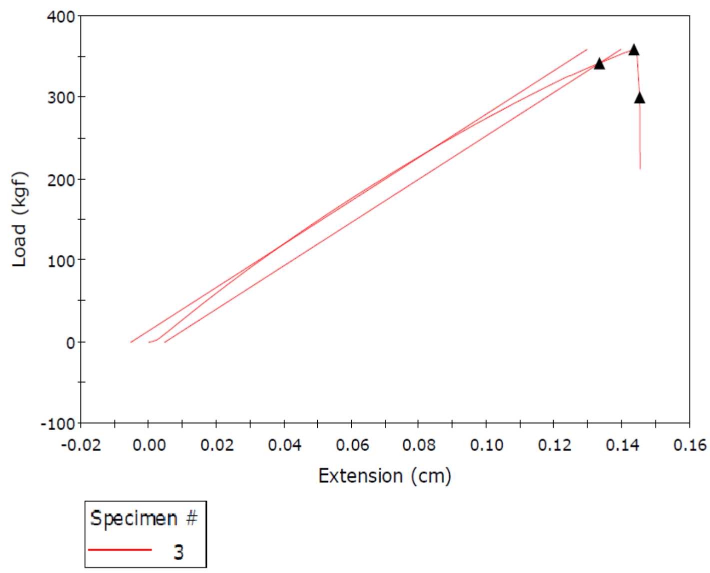
TEST GRAPH 1 to 1

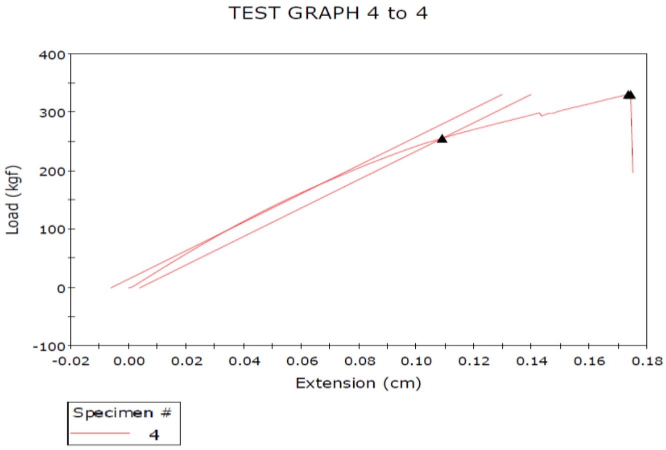


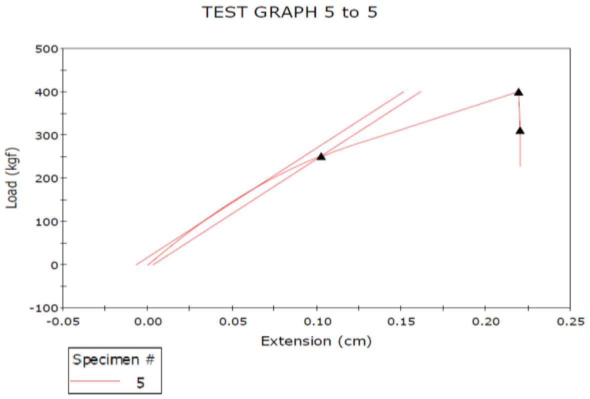
TEST GRAPH 2 to 2



TEST GRAPH 3 to 3







<u>Result of experiments (test)</u>

1. The 1st result – 672.64 kgf/cm^2 Tensile strength of the specimen tested on dated 06.02.20015 at CIPET LUCKNOW on UTM.

2. The 2nd result -617.45 kgf/cm^2 Tensile strength of the specimen tested on CIPET LUCKNOW on UTM.

3. The 3rd result -521.57 kgf/cm^2 Tensile strength of the specimen tested on CIPET LUCKNOW on UTM.

4. The 4th result – 527.24 kgf/cm^2 Tensile strength of the specimen tested on CIPET LUCKNOW on UTM.

5. The 5th result -595.85 kgf/cm^2 Tensile strength of the specimen tested on CIPET LUCKNOW on UTM.

The UTM was fully calibrated on the time of testing.

	Width (mm)	Thickness (mm)	Area (cm^2)	Speed (mm/min)	Maximum Load (kgf)	Tensile stress at Maximum Load (kgf/cm^2)	Elongation @Max Load (%)	Load at Yield (kgf)	Elongation@ Yield (%)	Tensile Strength@Yield (kgf/cm^2)
1	14.10	3.90	0.55	5.00	369.9	672.64	4.77	222.86	2.28	405.26
2	17.46	3.14	0.55	5.00	338.5	617.45	3.38	252.46	1.94	460.49
3	16.70	4.12	0.69	5.00	358.9	521.57	2.87	341.87	2.66	496.88
4	14.26	4.40	0.63	5.00	330.8	527.24	3.47	255.74	2.18	407.59
5	17.00	3.96	0.67	5.00	400.5	594.85	4.38	251.61	2.05	373.76

Overall conclusion

Natural fibres are fourth and promising fibre is coming future of composite materials sectors. They have the potential to compete with traditional fibre in all mechanical properties, future modification in fibre. The present work displayed the tensile properties of munja fibre composite materials and the result was well appreciated. More modification of the fibre could have an added advantage in the mechanical analysis.

SUGGESTED APPLICATIONS

The bio-composites fabricated in my thesis work i.e. the jute fibre-rice and natural rubber latex based bio-composites has some applications are given as follows:

- Floor coverings –New Linoleum
- Furniture industry–conventional boards, flame retardant composites, non-wovens
- Building industry – conventional boards, insulatind boards, flame retardant composites

SUGGESTIONS FOR FURTHER WORK

- It is suggested that find the biological properties and effect of natural munj fibre.
- Also find the characteristics of munj fibre should be studied at different temperatures.
- Also use wheat, rice husk, wheat starch, corn starch, soy protein, etc. in fabrication of bio-composites.

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