Research article Available online www.ijsrr.org ISSN: 2279–0543

International Journal of Scientific Research and Reviews

Experimental Investigation on Mechanical Properties of Natural Hair & Bamboo Reinforced Epoxy Composite

Sk. Salman Basha[*1], Shaik Shashavali[2] and P.Phani Kumar[3]

[1,2,3]Department of ME, Sasi Insitute of Technology & Engineering, Tadepalligudem, Andhra Pradesh 534101

[1]skbasha@sasi.ac.in [2]shaik.shashavali@gmail.com

ABSTRACT:

Composites are combination of two materials in which one of the material as layer act as reinforcing phase and the other material is known as matrix phase. Now a day's lot of human hair (men) is going waste from barber shops and animal (sheep hair) cost is reducing day by day in Andhra Pradesh region. The purpose of this experimental study is utilizing the fibers of natural hair & bamboo with different compositions and studying the mechanical properties of the human hair, animal hair (sheep hair) and bamboo fiber reinforcing epoxy (LY556) composite. The results show better mechanical properties like tensile strength, impact & flexural strength than individual material.

KEYWORDS: Human hair, Sheep hair, Bamboo, Epoxy, Mechanical properties

*Corresponding Author

Sk. Salman Basha

Assistant Professor, Department of ME,

SasiInsitute of Technology & Engineering,Tadepalligudem,

Andhra Pradesh 534101

E Mail - skbasha@sasi.ac.in, shaik.shashavali@gmail.com

I. INTRODUCTION

A composite material is a material made from two or more constituent materials with different properties that, when combined, produce a material with individual components.Composites are made up of several parts or elements combination of two or more materials in which one ofthe material is reinforcing phase (polymer, metal or ceramic) and othermaterial is a matrix phase in which resin is used as a matrix.Among various types of composites, polymers are the most commonlyused composites, due to its many advantages such as simplemaking procedure, low cost and good mechanical properties.Epoxy (LY556) is the most commonly used thermosetting polymer in composites.It has many advantages such as better adhesion to other materials, goodstrength.The use of natural polymer reinforced composite materials are considered asone of the new concept of engineering materials. Natural polymer compositesare rapidly growing both in terms of their industrial applications and research as they are renewable, abundantly available, cheap & biodegradable. In this paper it represents manufacturing of natural hair & bamboo reinforced epoxy composite and mechanical properties like Tensile strength, Charpy impact load and Flexural strength properties are investigated.

II. PREPARATION OF HYBRID COMPOSITES

Hand lay-up technique is one of the method used for the manufacturing of composites. Because it is the simplest method of composite processing compared to spray layup technique.Thin plastic sheets are used at the top and bottom of the mold plate to get good surface finish of the product. Then thermosetting polymer (Epoxy LY556) in liquid form is mixed thoroughly in suitable proportion with a hardener and poured onto the surface of mat already placed in the mould. The polymer is uniformly spread with the help of a roller brush as shown infigure 1. Second layer of mat is then placed on the polymer surface and a roller is moved with a mild pressure on the mat-polymer layer to remove any air trapped as well as the excess polymer present. The process is repeated for each layer of polymer and mat, till the required layers are stacked,then pressure is applied as shown in figure 2. This method is mainly suitable for thermosetting polymer based composites. Capital and infrastructural requirement are less as compared to other methods. The compositions hybrid composites i.e., natural hair (human & sheep), bamboo and epoxy resin as shown in table 1 & 2. The specimens are prepared according to the ASTM standards for testing the mechanical properties on Universal testing machine, Charpy Izod impact testing equipment and Flexural strength testing equipment.

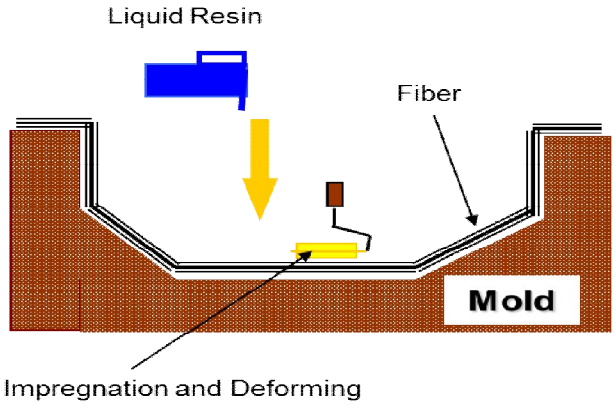

Fig 1: Hand layup technique

Table 1: Composition of Hybrid Composite 1

Sample no.no	Human hair	Sheep hair	Bamboo	Epoxy
1	20%	10%	10%	60%
2	10%	20%	10%	60%
3	10%	10%	20%	60%

Table 2: Composition of Hybrid Composite 2

Sample no.no	Human hair	Sheep hair	Bamboo	Epoxy
1	40%	0%	0%	60%
2	0%	40%	0%	60%
3	0%	0%	40%	60%

Step 1: Take a prepared mould of the required dimensions 220mmx 220mm x 3mm, and clean the inner surfaces with the help of smooth brush to remove dirt and other impurities.

Step 2: Place a thick transparent sheet of plastic on the lower surface of the mold and apply epoxy on the top surface of the transparent sheet.

Step 3: Fiber reinforcements are placed by hand in a mold and epoxy is applied with a roller brush and add epoxy to layer by layer of fibers.

Step 4: Leave for 24hr time until the epoxy is completely dried under 275N load.

Step 5: Specimens are prepared according to ASTM standards and mechanical tests are performed on those samples.

Fig 2: Preparation of mould,weighing & applying epoxy for hybrid composite

Fig3: Human hair-10%, Sheep hair-20% %, Epoxy-60%

Fig 4: Human hair-10%, sheep hair-10%, Bamboo fiber-20 Bamboo fiber-10 %, Epoxy-60%

Fig 5: Human hair–20%, sheep hair – 10%
Bamboo fiber– 10 %, Epoxy – 60%

Specimen Preparation

a) Tensile test- The specimens are made based on **ASTM D638-03**standards to measure the tensile strength of hybrid composite. The specimen's dimensions are

165mm (length), 19mm (width), 3mm (thickness)

b) Flexural test- The specimens are made based on **ASTM D790**standards to measure flexural strength of hybrid composite.The specimen's dimensions are

100mm (length), 12.7mm (width), 3mm (thickness)

c) Izod Impact test- The specimens are making based on **ASTM D256**standards to measure load of hybrid composite.The specimen's dimensions are

65.5mm (length), 12.7mm (width), 3mm (thickness)

Fig6: ASTM standard specimens for testing

III. EXPERIMENTATION

3.1. Tensile strength:Tensile test is performed on newly fabricated hybrid composites in which a sample is subjected to a controlled tension until failure. The tensile tests are performed on BISS Universal testing machine (UTM) of capacity 50KN as shown in figure 7. The experiments are conducted as standard experimental procedure in laboratory.

3.2. Flexural strength:Flexural strength test is also known as transverse test or modulus of rupture test is performed on flexural test machine shown in figure 9. The experiments are conducted according to standard experimental procedure.

3.3. Impact test: Impact test is performed on Izod impact testing machine shown in figure 8. The experiment is meant to measure either the impact strength of the hybrid composites or the notch sensitivity.

Fig 7: UTM

Fig 8: Izod test equipment

Fig 9: Flexural test equipment

IV. RESULTS & DISCUSSIONS

The use of composite materials are increasing day by day in various applications due to their excellent properties compared to ordinary materials. So many scientists and engineers are doing lot of reaserch on different types of artificial and natural fiber composites for finding their unique properties. In present study natural fibers (hair & bamboo) are added to reinforeced epoxy composites to evaluate their properties. The test results for the mechanical properties like flexural strngth, tensile strength & impact test are presented in this paper.

4.1 Tensile strength: The different hybrid composite test specimens are tested in the BSSI universal testing machine and the samples are left to break till the ultimate tensile strength occurs. Stress–strain curves are plotted for the determination of ultimate tensile strength and elastic modulus as shown in Figures 10 to 16. The results show that hybrid composite laminate 2 with 20% bamboo, human hair 10%, Sheep hair 10% & Epoxy (LY556) 60% is having highest tensile strength 23.2 MPa compared to other hybrid composite laminates. The tensile results are depicted in Table 3.

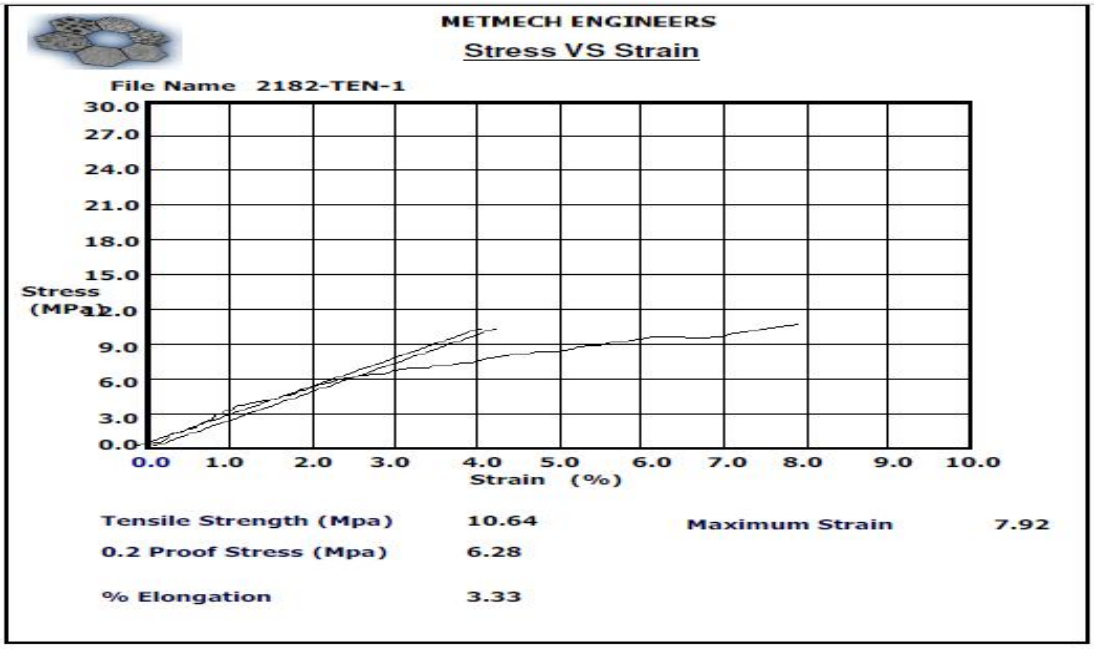

Fig. 10 Stress-strain curve for Laminate 1

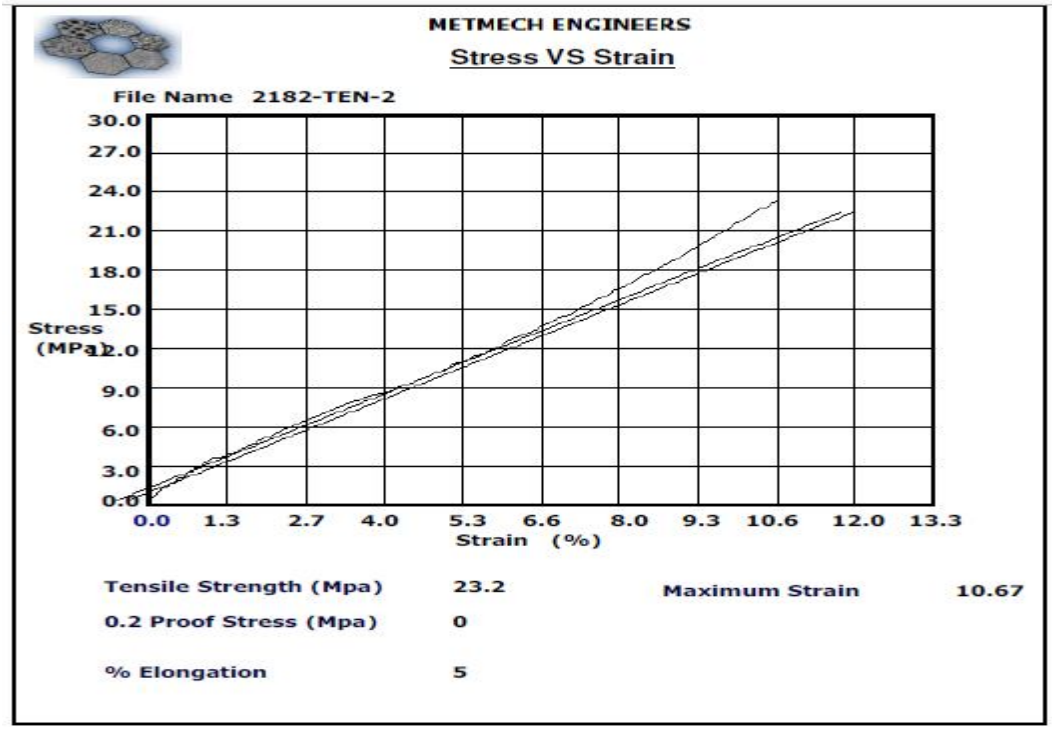

Fig. 11 Stress-strain curve for Laminate 2

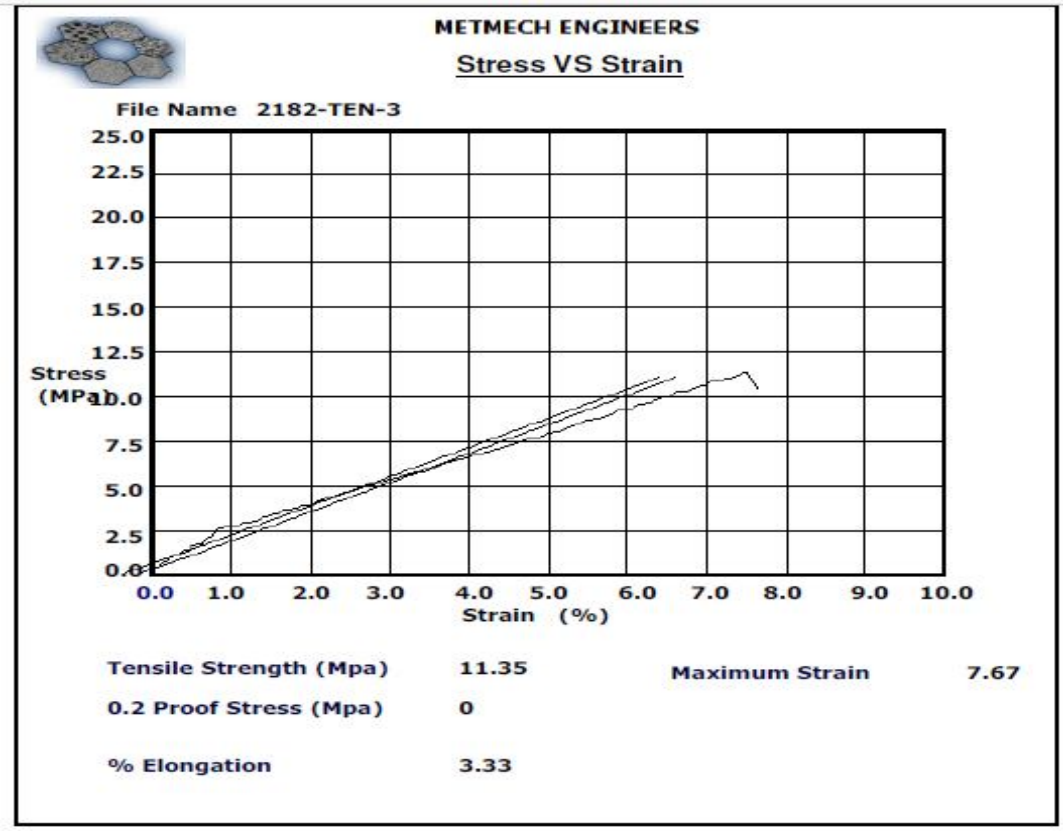

Fig. 12 Stress-strain curve for Laminate 3

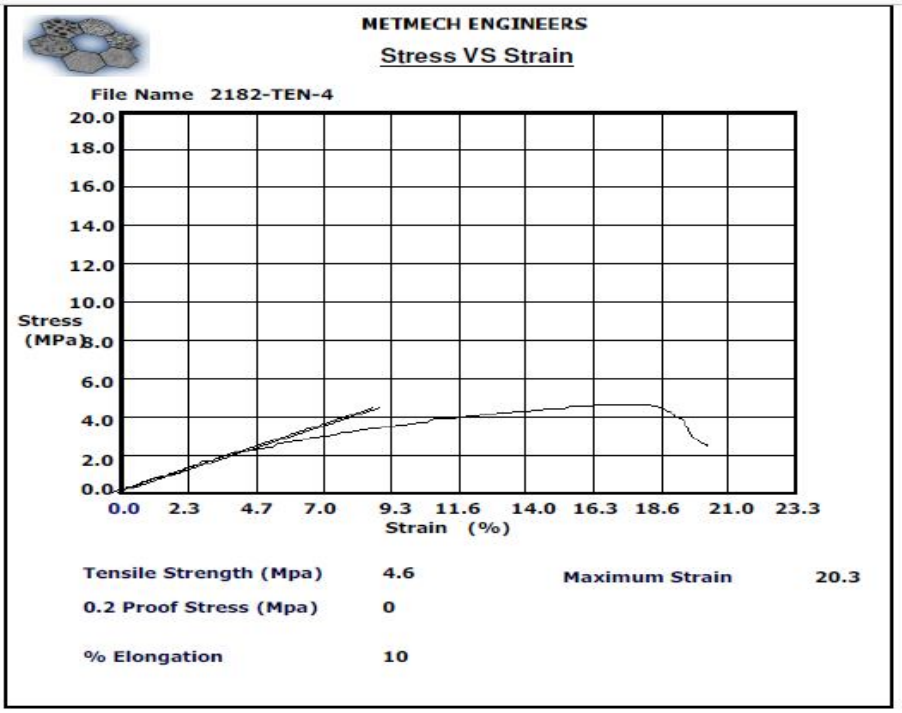

Fig. 13 Stress-strain curve for Laminate 4

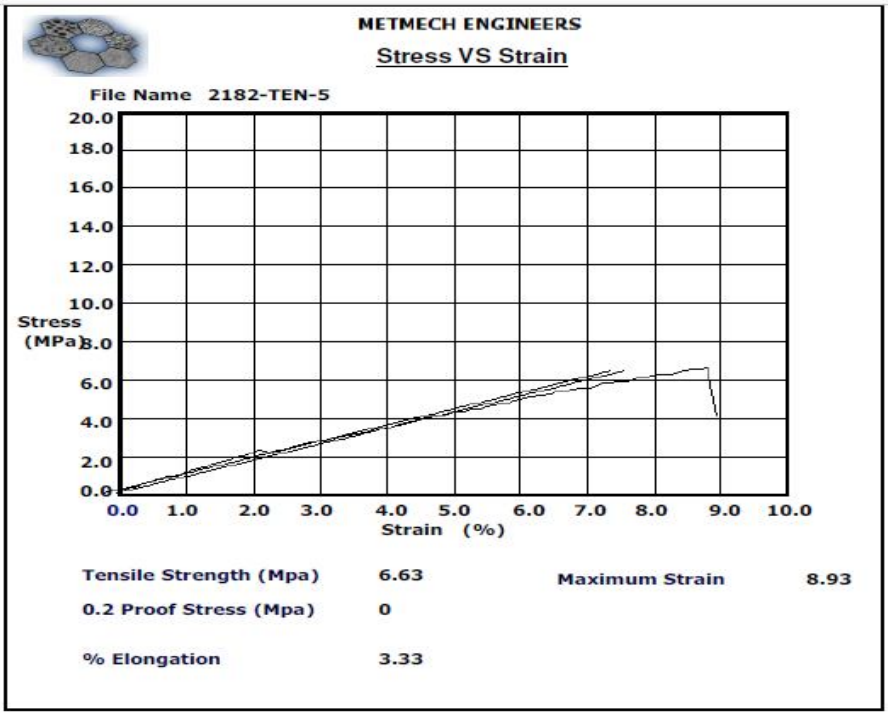

Fig. 14 Stress-strain curve for Laminate 5

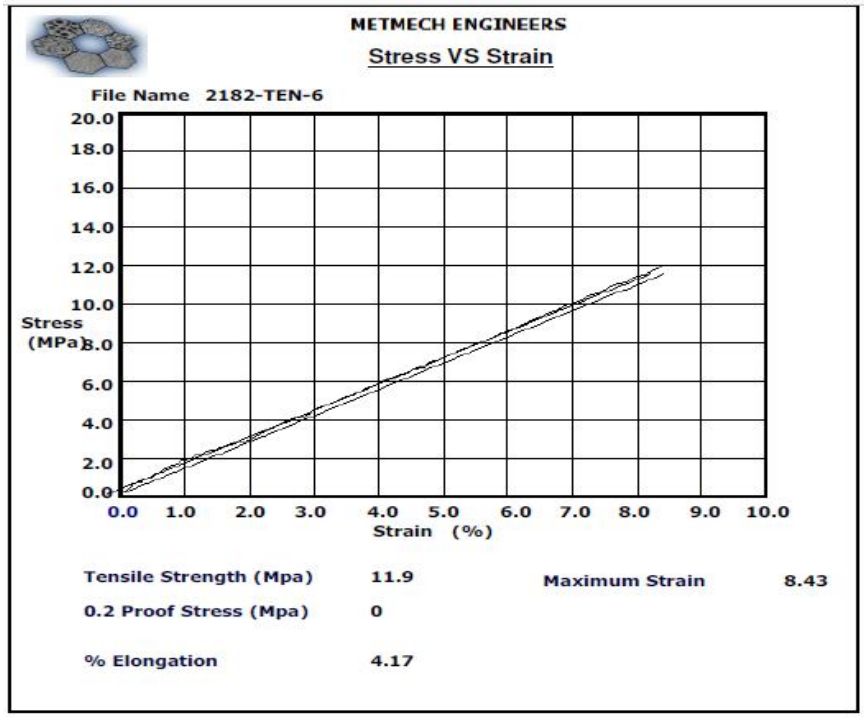

Fig. 15 Stress-strain curve for Laminate 6

Table 3: Tensile test results for different laminates

Laminate No.	Weight ratio			Tensile strength (MPa)	Maximum strain	% of elongation
	Human hair (%)	Bamboo fiber (%)	Sheep hair (%)			
1	20	10	10	10.64	7.92	3.33
2	10	20	10	23.2	10.67	5
3	10	10	20	11.35	7.67	3.33
4	0	0	40	4.6	20.3	10
5	40	0	0	6.63	8.93	3.33
6	0	40	0	11.9	8.43	4.17

4.2 Flexural strength: Three-point bending test is performed accordance to ASTM standard procedure and the test specimens were of rectangular shape with dimensions 100x12.7x3 $mm^{3.}$ The flexural strength is calculated using the below formula 4.1. The obtained results are tabulated in table 3 and for laminate 4 is having highest flexural strength with 78.74 MPacompared to other hybrid composites and laminate 2 also having 72MPa of flexural strength.

Formula to calculate flexural strength, Flexural Strength = $(3PL) / (2wt^2)$ ---------(4.1)

Where, P = Peak Load in KN, L = Gauge Length in mm, w = Width of the Specimen in mm and t = Thickness of the Specimen in mm.

Table 3: Flexural strength results

Laminate No.	Human hair (%)	Bamboo fiber (%)	Sheep hair (%)	Flexural strength (MPa)
1	20	10	10	13.12
2	10	20	10	72.18
3	10	10	20	39.37
4	0	0	40	78.74
5	40	0	0	52.49
6	0	40	0	52.49

4.3Izod impact test: Izod Impact Test was performed to determine the impact properties of the hybrid composite materials with different compositions in the form of laminates. The Izod impact test, also known as the Izod V-notch test, is performed as per the ASTM standard procedure to determine the impact resistance of material. It is found that the lam 6 having high impact strength of 0.4J and lam 2 also having 0.38J of impact strength as shown in table 4 and figure 16.

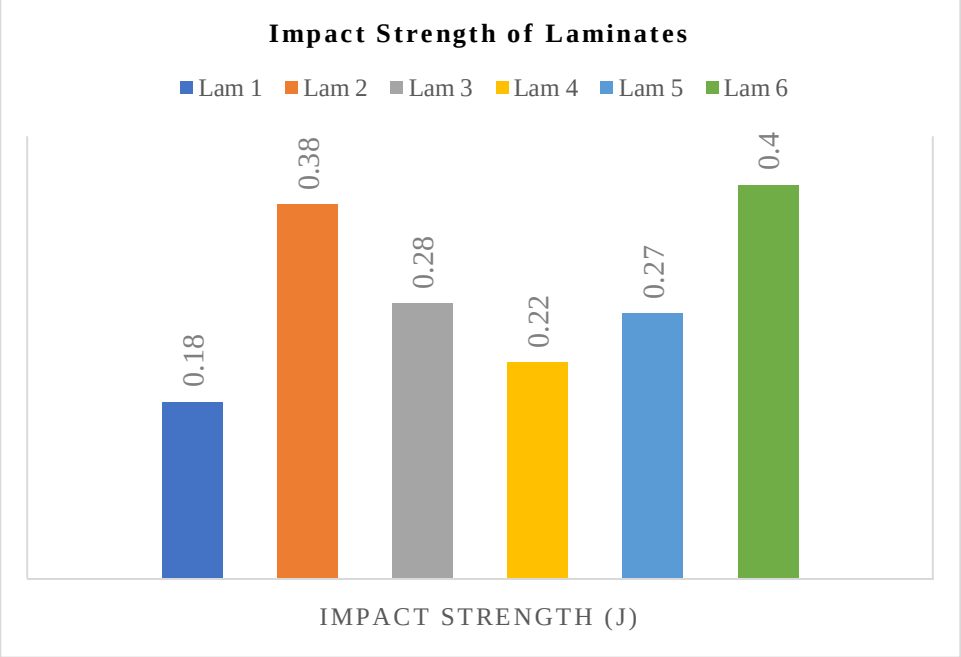

Fig.16 Impact strength of Hybrid composites (Laminates)

Table 4: Impact energy strength results

Laminate No.	Human hair (%)	Bamboo fiber (%)	Sheep hair (%)	Impact Energy (J)
1	20	10	10	0.18
2	10	20	10	0.38
3	10	10	20	0.28
4	0	0	40	0.22
5	40	0	0	0.27
6	0	40	0	0.40

V. CONCLUSIONS

This experimental study on mechanical properties of natural hair (Human hair & sheep hair) and Bamboo Reinforced Epoxy (LY 556) hybrid composites leads to the following conclusions: -

- It has been found that the mechanical properties of the composites such as flexural strength, tensile strength, impact energy of the hybrid composites are also greatly influenced by the laminates.
- From the tensile test it is found that, the maximum tensile strength was for laminate L6 & Laminate L3 (11.9MPa& 11.35MPa respectively) and minimum was for laminate L4 (4.6 MPa).
- From the Flexural test result shows that, laminate L4 & L2 (78.74MPa & 72.12MPa respectively) and minimum was for laminate L1 (13.12MPa).
- The Impact test results shows that,highest impact energy is for the laminate L6 & L2 (0.4J & 0.38J respectively) and laminate L1 has the lowest impact energy (0.18J)

REFERENCES

1. Joseph S, Sreekala M.S, Oommen Z et al.“A comparison of the mechanical properties of phenol formaldehyde composites reinforced with banana fibers and glass fibers”, Composites Science and Technology. 2002; 62:1857-68.
2. Oksman K, Skrivars M, Selin JF. “Natural fibers as reinforcement in polylactic acid (PLA) composites”, Compos Sci. Tech. 2003; 63:1317-24.
3. Jacob Maya, Thomas Sabu, Varghese KT. “Mechanical properties of sisal/oil palm hybrid fibre reinforced natural rubber composites” Compos Sci. Technol. 2004; 64: 955-965.
4. Sapuan, S. M, Leenie, A, Harimi et al. “Mechanical properties of woven banana fibre reinforced epoxy composites”. Materials and Design. 2006; 8: 689-693.
5. Velmurugan R and Manikandan, V. “Mechanical Properties of Palmyra/Glass fibre Hybrid Composites”, Applied science & manufacturing, 2007; 38: 2216-26.
6. ChanakanAsasutjarit, SarochaCharoenvai, JongjitHet al.Materials and mechanical properties of pre-treated coir-based green composites”, Composites. 2009; 40:633–637.
7. Wang Wei, Huang Gu, “Characterisation and utilization of natural coconut fibres composites” Materials & Design. 2009; 2741-44.

8. Sanjay Choudhry and Bhawana Pandey “Mechanical Behaviourof Polypropylene and Human Hair Fibers and Polypropylene ReinforcedPolymeric Composites”, IJMIE 2012; 5:118-121.
9. Ramesh M, Palanikumar K, Hemachandra Reddy K. “Comparative evaluation on properties of hybrid glass fibre- sisal/jute reinforced epoxy composites”, Procedia Engineering. 2013; 51:745-50
10. Panneer Selvan S, Jaiganesh V and Selvakumar K. (2014), “Investigation of Mechanical Properties and Optimization in Drilling of Jute andHuman Hair Hybrid Composite”, International Conference on Advances in Design and Manufacturing, 2014;14:631-636.
11. Achal Agrawal, Abhishek Shrivastava, Siddharth Pastariya, Anant Bhardwaj “A Concept of Improving Strength of Concreteusing Human Hair as Fiber Reinforcement”, IJIRS. 2016; 5:8624-30
12. Thomas Mathew, Vishnu Sajeevan K, Pranav AK et al. “Fabrication & testing of banana-hair reinforced hybrid composite”, IJESC 2017; 7: 6667-70.