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Mechanical Properties Evolution of Jute and E-glass Fiber Hybrid Polymer Matrix Composites

Chanikya Kavvuru[1], Dr. M. L. S. Devakumar[2]

[1]MTech Student, Advanced Manufacturing Systems, Department of Mechanical Engineering, JNTUCEA, Ananthapurmu, Andhra Pradesh, India

[2]Professorand Officer In charge of MBA & Prof. of Mechanical Engineering, JNTUACEA, Ananthapuramu, Andhra Pradesh, India

ABSTRACT

Now a day's Natural Fibres Composites owing importance due to its Bio degradability, Light weight & Strength etc., This project aims to investigate Mechanical Properties evaluation of Jute fibre Eglassfiber, without chemical treatment and applied an compression load on the Jute fibre layers to be in uniform and Bidirectional. To evaluate the mechanical properties and weights of specimens are2 and 3 layers taken, Epoxy& Hardener constant for all specimens. The Specimens prepared by Hand layup technique and specimen cuts with Manual Hacksaw frame and applied smooth filing to avoid notches during cutting. Testing's for Mechanical properties evaluation used are tensile, and 3-Point Flexural testing's on computerized UTM (INSTRON 3369). Hardness and Impact tests also performed per the ASTM standards.

Keywords : Jute Fiber, Eglass Fiber, Hand Layup Technique, Mechanical Properties

I. INTRODUCTION

Reinforcement provides strength and rigidity, helping to support structural load. The matrix or binder (organic or inorganic) maintains the position and orientation of the reinforcement. Significantly, constituents of the composites retain their individual, physical and chemical properties; yet together they produce a combination of qualities which individual constituents would be incapable of producing alone. The reinforcement may be platelets, particles or fibers and are usually added to improve mechanical properties such as stiffness, strength and toughness of the matrix material. Long fibers that are oriented in the direction of loading offer the most efficient load transfer. This is because the stress transfer zone extends only over a small part of the fiber-matrix interface and perturbation effects at fiber ends may be neglected. In other words, the ineffective fiber length is small. Popular fibers available as continuous filaments for use in high performance composites are glass, carbon and aramid fibers. If the fibres are derived from natural resources like plants or some other living species; they are called natural fibres. 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 more research interests.The modern method for producing glass wool is the invention of Games Slayter working at the Owens-Illinois Glass Co. (Toledo, Ohio). He first applied for a patent for a new process to make glass wool in 1933. The first commercial production of glass fiber was in 1936. In 1938 Owens-Illinois Glass Company and Corning

Glass Works joined to form the Owens-Corning Fiberglas Corporation. When the two companies joined to produce and promote glass fiber, they introduced continuous filament glass fibers. Owens-Corning is still the major glass-fiber producer in the market today.

II. METHODS AND MATERIAL

a. Materials

The following table shows the details of Raw materials used in the present work. The material goods purchased fewer from local sources, and matrix purchased from authorized dealers.

Table 2.1 List of raw materials used in the present work

Description	Raw materials
Matrix	Epoxy resin (LY556)
Hardener	Hardener(HV951)
Reinforcing agent	Jute fiber , 7Mil E glass fiber
Mould releasing agent	OHP sheet & Wax
Casting	Wooden Moulds

The fibre properties depends on factors could change characteristics majority factors such as maturity of processing adopted for the extraction of the fibre . The above table shows Mechanical properties of Jute fibre showed in Table. 2.2

Table 2.2 Jute & E glass fiber Mechanical properties [15]

Fibre	Young's modulus (GPa)	Density (g/cm^3)	Elongation at break (%)	Tensile strength (MPa)
Jute fiber	26.5-42	1.3	1.5-1.8	393-773
E Glass fiber	40.28-65	1.03	4.7-4.9	725-985

b. Matrix Materials

The purpose of Matrix material in Composite is to make Strength in between the Fibres and Layers. Due to its bondage with fibres the Composites will gain more strength.

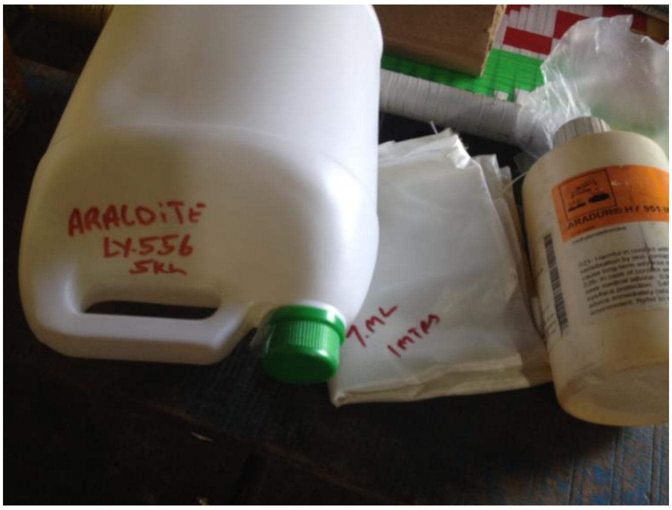


Fig 2.1 Matrix Material of Epoxy and Hardener

In present work the Epoxy resin [10] (LY556). It is obtained from Authorized dealer SreeInustrail Composite products, Invoice number 10121 & Date 13th October 2017 for Araldite (HY951) Huntsman, Ciba- Geigy India Ltd Company, Mumbai.

c. Mould preparation

The Matrix (Epoxy and Hardener) weighed with the Jewelry Weighing machine (make: BOLT MH Series200g/0.01g). The 50 grams of Epoxy and 5grams of Hardener mixed in Ultrasonicator. The mould has prepared [17] with A4 wooden sheet of 8mm in thick used. A polythene OHP sheet (for easy removal) is placed on the surface [18] of the wooden sheet and Nails used to fit the boarders which are having thickness of 3mm. The mould preparation has bee displayed in the following Figure 2.5. The bottom side 8mm thick wooden sheet placed. Then and HP sheet it, then afterwards around borders were fixed with the help of nails, for the preparation of glass mould on the OHP sheet fevi quick used. Then on the top side of borders also covered with 1mm glass plate placed. Then the approximate load has been applied up to required thickness to be obtained.

Fig 2.1 Mould Making

Removing the mould here borders are covered with 3mm glass flakes, about 130mm in length.

3.1 Tensile Test

The Tensile test specimens after breakage are shown in figure 3. The specimens all having same dimensions (due to shaking while Capturing image) and having standard dimensions which listed in figure 2 (a) the same dimensions are taken for all 4 specimens.

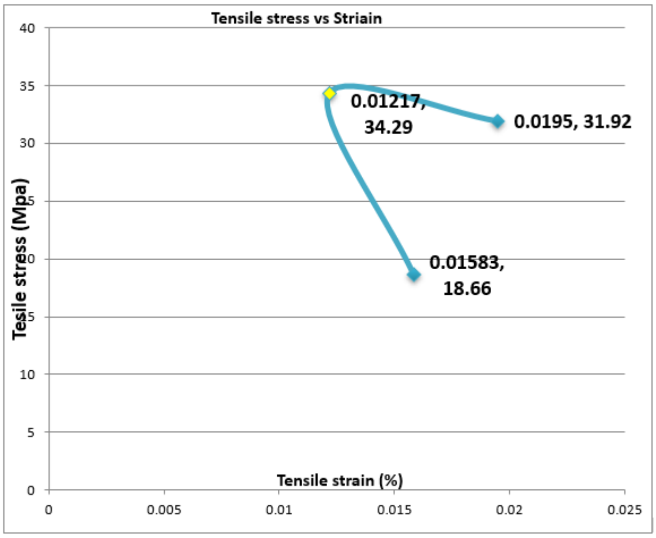
Fig 2.2 Tensile specimens after Tests

The tensile tests shows Table.4 results table properties of Jute fibre composites reinforced composites with Eglassfiber, it is observed that peakstress in specimen E1J2 was 34.29, also is it is noticed that specimen E2J1which contain synthetic fiber shown lean properties comparatively specimen contain more densit of Natrualfiber i.e. Jute.

Table 2.3 Tensile Specimens Results

Sl. No	Specimen Name	Tensile strain %	Tensile Stress (Mpa)
1	E1J1	0.01583	18.66
2	E1J2	0.01217	34.29
3	E2J1	0.01950	31.92

The following graph drawn corresponding to the table Tenile table2.5it is alsexpressing intnd here we can observe that Rapid increase stress from specimen E1J1 to E1J2 but the stress was only higher when comparing with Specimen E2J1. Specimen E1J2was shown lower strain and peak stress.



Graph 2.1 Tensile Test Graph

The above Graph.2.1 displays Tensile stress & Tensile strain

3.2 3-Point Flexural Test

The Flexural test specimens after breakage are shown in figure 3. The specimens all having same dimensions (due to shaking while Capturing image) and having standard dimensions which listed in figure 2 (a) the same dimensions are been taken for all 3 specimens.

Fig 2.3 3-Point Flexural Specimens after test

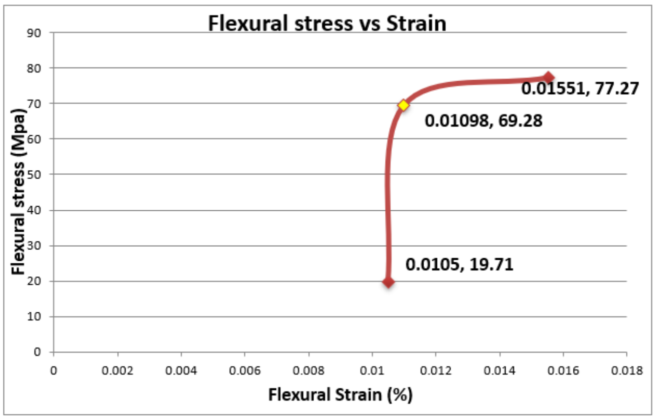
The following table 2.4 shows the Results of 3 point flexural test.

Table 2.4 3-Point Flexural test

Sl.No	Specimen Name	Flexural strain %	Flexural Stress (Mpa)
1	E1J1	0.0105	19.71
2	E1J2	0.01098	69.28
3	E2J1	0.01551	77.27

The flexure properties for different composites are displayed in following Graph.2 Flexural stress were increased with deflection initial stage deflection & slope gradually follows until the failure point.

Graph 2.2 3-Point Flexural Test or 3-Point Bending Test



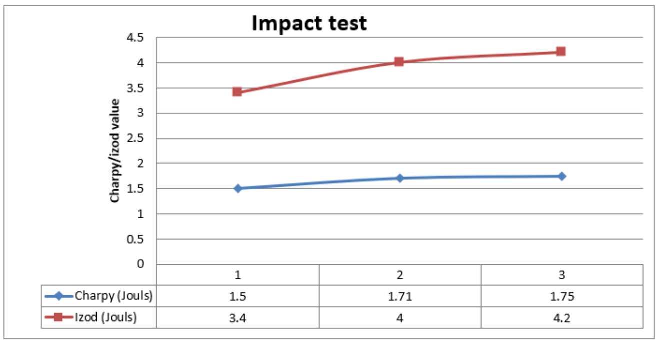
3.3 Impact Test

The specimen 1J1 shown lower strength comparatively specimens E1J2,E2J1. And the specimen E1J2 which was increased layers up to 3 layers the specimen shown medium properties of impact test and also it is observed that properties of specimen 1J2,E2J1 are almost became near to each other.

Table 2.5 Evaluation Impact property

Impact	Charpy (Jouls)	Izod (Jouls)
E1J1	1.5	3.4
E1J2	1.71	4
E2J1	1.75	4.2

Graph 2.3 Impact Test



But the specimen which was made of two glass layers the shown relevant strength to specimen E1J2. It is noticed that increased layers may be glass/jute fibers showing similar properties.

3.4 Hardness test

The following table 2.8 shows the BHN values for each sample.

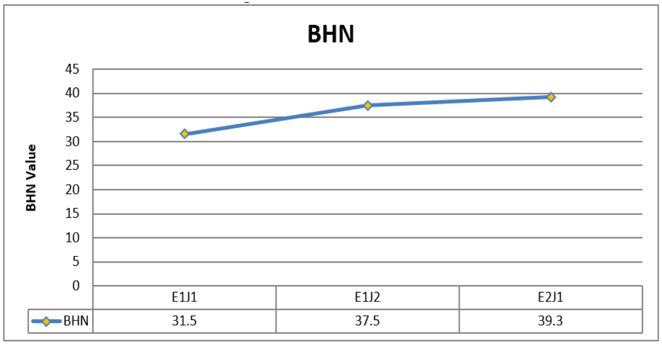
Table 2.6 Hardness results

Hardness	BHN
E1J1	31.5
E1J2	37.5
E2J1	39.3

The brinell test was conducted in machine name. E1J1 shown BHN value of 31.5, and following E1J2,E2J1 shown near values with difference of 1.8.

the increase in layers doesn't shown effect much on the hardness factor.

Graph 2.4 Hardness test



The above Hardness test graph shows graph drawn as per the results from table 2.8 the BHN value keep on increasing from E1J1,E11J2,E22J1 respectively. According to ASTM D 785 standards for composites, the specimens were prepared for Rockwell-B hardness test, the specimen is of 10mm sq. and a length of 20mm.Fiber configuration and volume fraction are two important factors that affect the properties of the composite. In this test, the configuration is limited to unidirectional and continuous fibers equal to the length of the specimen.The hardness properties of the composites are studied by applying indentation load normal to fibers diameter and normal to fiberlength.The effect of fiber loading and post curing time on Rockwell hardness is illustrated in Figures 3 and 4. Generally, fibers that increase the moduli of composites increase the hardness of the composite. This is because hardness is a function of the relative fiber volume and modulus.

III. REFERENCES

[1]. K. Pickering, Aruan efendy, m.g.,le, t.m., A review of recent developments in natural fibre composites and their mechanical performance, composites: Part A https://doi.org/10.1016/j.compositesa.2015.08.038

[2]. Hoi-yan Cheung, Mei-po Ho, Kin-tak Lau, Francisco Cardona, David Hui,Natural fibre-reinforced composites for bioengineering and environmental engineering applications,Composites Part B: Engineering,Volume 40, Issue 7,2009,Pages 655-663,ISSN 1359-8368,https://doi.org/10.1016/j.compositesb.2009.04.014.

[3]. S. J. S. DA, Book: .Chap.1, On the recyclability of a cyclic thermoplastic composite (2005) 1–10

[4]. S. A. R. L. F. M. R. L. A. D. Alves C, Ferrao P.M.C, Ecodesign of automotive components making use of natural jute fibre composites, L.B, Alves, Rodrigues. https://doi.org/10.1016/j.jclepro.2009.10.022

[5]. Polymer matrix composites and technology Ru-Min Wang, Shui-Rong Zheng and Ya-Ping Zheng Woodhead Publishing ISBN 978-0-85709-221-2 (print)

[6]. Organoplastics, Soviet Advanced Composites Technology Series ISBN-13:978-94-010-4229-1001:Page220 https://doi.ORG/10.1007/978-94-011-0515-6

[7]. S. A. R. L. F. M. R. L. A. D. Alves C, Ferrao P.M.C, Ecodesign of automotive components making use of natural jute fibre composites, L.B, Alves, Rodrigues. https://doi.org/10.1016/j.jclepro.2009.10.022

[8]. S.M. Sapuan, K.F. Tamrin, Y. Nukman, Y.A. El-Shekeil, M.S.A. Hussin and S.N.A. Aziz, 1.8 Natural Fibre-Reinforced Composites: Types, Development, Manufacturing Process, and Measurement, In Comprehensive Materials Finishing, edited by MSJ Hashmi,, Elsevier, Oxford, 2017, Pages 203-230, ISBN 9780128032497, https://doi.org/10.1016/B978-0-12-803581-8.09183-9.

[9]. Ming Cai, Hitoshi Takagi, Antonio N. Nakagaito, Yan Li, Geoffrey I.N. Waterhouse,Effect of alkali absorption test on interfacial bonding in abaca fibre-reinforced composites,Composites Part A: Applied Science

and Manufacturing,Volume 90,2016,Pages 589-597,ISSN 1359-835X,https://doi.org/10.1016/j.compositesa.2016.08.025.

[10]. Araldite DBF / HY 951 Page.3, Mix Ratio, February 2005 2/6

[11]. R. A. Braga, P. A. A. Magalhaes, Analysis of the mechanical and thermal properties of jute and glass fibre as reinforcement epoxy hybrid composites, Vol. 2015. https://doi.org/10.1016/j.msec.2015.06.031

[12]. Characterization on the Properties of Jute Fibre at Different Portions, International Journal of Polymer Science Volume 2015 (2015), http://dx.doi.org/10.1155/2015/262348 Sweety Shahinur,1,2 Mahbub Hasan,2 Qumrul Ahsan,3 Dilip Kumar Saha,4 and Md. Saiful Islam5

[13]. Processing and Characterization of Jute Fibre Reinforced Thermoplastic Polymers A. C. Karmaker & G. Hinrichsen Pages 609-629 | Published online: 22 Sep 2006 Download citation https://doi.org/10.1080/03602559108019223

[14]. International Journal of Textile Science 2012, 1(6): 84-93 DOI: http//doi.org/10.5923/j.textile.20120106.05 Jute Composites asWood Substitute Debiprasad Gon1,*, Kousik Das2, Palash Paul2 , SubhankarMaity2 1Indian Jute Industries' ResearchAssociation, 17, Taratala Road, Kolkata-88 2Panipat Institute of Engineering, Technology , Samalkha, Panipat, Haryana

[15]. Ming Cai, Hitoshi Takagi, Antonio N. Nakagaito, Yan Li, Geoffrey I.N. Waterhouse,Effect of alkali treatment on interfacial bonding in abaca fibre-reinforced composites,Composites Part A: Applied Science and Manufacturing,Volume 90,2016,Pages 589-597,ISSN 1359-835X,https://doi.org/10.1016/j.compositesa.2016.08.025.

[16]. Processing of Polymer Matrix Composites P. K. Mallick William E. Stirton Professor of Mechanical Engineering University of Michigan-Dearborn ISBN :-13: 978-1-4665-7822-7 (Hardback) Page No 120-126 4.1 CURE CYCLE FOR THERMOSETTING POLYMERS, 5.3 LAYUP TECHNIQUES 6.8 COMPRESSION MOLDING PARAMETERS 6.9 MOLD DESIGN CONSIDERATIONS

[17]. Josh Kelly, Mohsen Mohammadi,Uniaxial tensile behavior of sheet molded composite car hoods with different fibre contents under quasi-static strain rates,Mechanics Research Communications,Volume 87,2018,Pages 42-52,ISSN 0093-6413,https://doi.org/10.1016/j mechrescom.2017.12.007

[18]. R. Sothornvit, C.W. Olsen, T.H. McHugh, J.M. Krochta, Tensile properties of compression-molded whey protein sheets: Determination of molding condition and glycerol-content effects and comparison with solution-cast films, Journal of Food Engineering, Volume 78, Issue 3, 2007, Pages 855-860, ISSN 0260-8774, https://doi.org/10.1016/j.jfoodeng.2005.12.002.

[19]. M.V. de Sousa, S.N. Monteiro, J.R.M. d'Almeida, Evaluation of pre-treatment, size and molding pressure on flexural mechanical behavior of chopped bagasse–polyester composites, Polymer Testing, Volume 23, Issue 3, 2004, Pages 253-258, ISSN 0142-9418, https://doi.org/10.1016/j.polymertesting.2003.09.002.

[20]. Ki-Taek Kim, Jin-Ho Jeong, Yong-Taek Im, Effect of molding parameters on compression molded sheet molding compounds parts, Journal of Materials Processing Technology, Volume 67, Issues 1–3, 1997, Pages 105-111, ISSN 0924-0136, https://doi.org/10.1016/S0924-0136(96)02827-0.

[21]. M.J. Cawood, G.A.H. Smith, A compression moulding technique for thick sheets of thermoplastics, Polymer Testing, Volume 1, Issue 1, 1980, Pages 3-7, ISSN 0142-9418, https://doi.org/10.1016/0142-9418(80)90022-7

[22]. Standard Practice for Compression Molding Thermoplastic Materials into Test Specimens, Plaques, or Sheets Annual Book of ASTM Standards, Vol 08.01. Designation: D 4703 – 03

[23]. Ram Krishna Adhikari, B.S. Keerthi Gowda,Exploration of mechanical properties of banana/jute hybrid polyester composite,Materials Today: Proceedings,Volume 4, Issue 8,2017,Pages 7171-7176,ISSN 2214-7853,https://doi.org/10.1016/j.matpr.2017.07.043.

[24]. Mekala P., Kunuthur M.R., Chandramohana Reddy B. (2019) Evaluation of the Mechanical Properties of Recycled Jute Fiber–Reinforced Polymer Matrix Composites. In: Vasudevan H., Kottur V., Raina A. (eds) Proceedings of International Conference on Intelligent Manufacturing and Automation. Lecture Notes in Mechanical Engineering. Springer, Singapore http://doi.org/10.1007/978-981-13-2490-1_26

[25]. Radhika Londhe, Ashok Mache, Aparna Kulkarni, An experimental study on moisture absorption for jute-epoxy composite with coatings exposed to different pH media, Perspectives in Science, Volume 8, 2016, Pages 580-582, ISSN 2213-0209,https://doi.org/10.1016/j.pisc.2016.06.026.

[26]. T. Alomayri, I.M. Low, Synthesis and characterization of mechanical properties in cotton fibre-reinforced geopolymer composites, Journal of Asian Ceramic Societies, Volume 1, Issue 1, 2013, Pages 30-34, ISSN 2187-0764, https://doi.org/10.1016/j.jascer.2013.01.002.

[27]. Pruttipong Pantamanatsopa, Warunee Ariyawiriyanan, Tawatchai Meekeaw, Rattiyakorn Suthamyong, Ketsara Arrub, Hiroyuki Hamada, Effect of Modified Jute Fibre on Mechanical Properties of Green Rubber Composite, Energy Procedia, Volume 56, 2014, Pages 641-647, ISSN 1876-6102, https://doi.org/10.1016/j.egypro.2014.07.203.

[28]. P. Deepak, R. Vignesh Kumar, S. Badrinarayanan, H. Sivaraman, R. Vimal, Effects of Polyamide and/or Phenalkamine Curing Agents on the Jute Fibre Reinforcement with Epoxy Resin Matrix, Materials Today: Proceedings, Volume 4, Issue 2, Part A, 2017, Pages 2841-2850, ISSN 2214-7853, https://doi.org/10.1016/j.matpr.2017.02.164.

[29]. A.B. Maslinda, M.S. Abdul Majid, M.J.M. Ridzuan, M. Afendi, A.G. Gibson, Effect of water absorption on the mechanical properties of hybrid interwoven cellulosic-cellulosic fibre reinforced epoxy composites, Composite Structures, Volume 167, 2017, Pages 227-237, ISSN 0263-8223, https://doi.org/10.1016/j.compstruct.2017.02.023.

[30]. Zengshe Liu, Brent H. Tisserat, Coating applications to natural fibre composites to improve their physical, surface and water absorption characters, Industrial Crops and Products, Volume 112, 2018, Pages 196-199, ISSN 0926-6690, https://doi.org/10.1016/j.indcrop.2017.12.002.

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