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Comparison of the Mechanical Properties of Hemp and Jute Glass Fiber Reinforced With Vinyl Ester Composite Materials

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Abstract:
Now a day the interest in using natural fibers as reinforcement in polymer composite material has increased significantly. Now this natural fiber based composite manufacturing has been a wide area of research and it is the most preferred choice for not only its superior properties like low density, stiffness, light weight and possesses better mechanical properties but also they are renewable, cheap, completely or partially recyclable, and biodegradable. In this study, an attempt has been made to fabricate the jute-glass fiber composite material and hemp-glass fiber composite material with different combination. And compare the mechanical properties such as tensile, flexural and impact by using the universal testing machine and charpy machine. Finally concluded that which material is best among the hemp and jute glass fiber reinforced. Also concludes which combination is best for the application usage.

1.INTRODUCTION

Composite material is composed of reinforcement (fibers, particles, flakes, and fillers) embedded in a matrix (vinyl ester, metals or ceramics). The matrix holds the reinforcement to form the desired shape; while the reinforcement improves the overall mechanical properties of the matrix. When designed properly, the new combined material exhibits better strength than would each individual material. Composites typically have a fiber or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members. In this work, hemp fiber composites and jute fiber composite are fabricated by hand layup method. The flexural strength, tensile strength and impact strength properties are evaluated and reported.

1.1 Composite materials

The Composites are materials consist of two or more chemically distinct constituents on a macro scale having a distinct interface separating them and having bulk properties significantly different from those of any of the constituents. A Composite Material consists of two phases:

(a) Matrix phase

The primary phase having a continuous character is called matrix. Matrix is usually more ductile and less hard. It consists of any of three basic material types vinyl esters, ceramics or metals. The matrix forms the bulk par

(b) Reinforcement

The secondary phase is embedded in the matrix in a discontinuous form. The dispersed phase is usually harder and stronger than the continuous phase and is called reinforcement

1.2 Manufacturing of composite

1. Open Mould Processes- some of the original FRP manual procedures for laying resins and fibers onto forms
2. Closed Mould Processes- much the same as those used in plastic moulding
3. Filament Winding- continuous filaments are dipped in liquid resin and wrapped around a rotating mandrel, producing a rigid, hollow, cylindrical shape
4. Pultrusion Processes- similar to extrusion only adapted to include continuous fiber reinforcement
5. Other PMC Shaping Processes

2. EXPERIMENTAL DETAILS

2.1 Raw materials

Raw materials used in this experimental work are:

(i) Natural fiber =JUTE FIBER (Fiber from JUTE petal)
(ii) RESIN =General purpose vinyl ester.
(iii) CATALYST= Methyl ethyl ketone peroxide
(iv) Accelerator = Cobalt Naphthenate.

2.2FABRICATION OF COMPOSITE FIBER

The composite is prepared by hand lay-up technique:

The fiber piles were cut to size from the JUTE fiber. The appropriate numbers of fiber plies were taken two for each. Then the fibers were weighed and accordingly the resin was weighed. Polyester, catalyst and accelerator were mixed by using spoon. Care was taken to avoid formation of bubbles. Because the air bubbles were trapped in matrix may result failure in the material. The mould box has taken in the size of 30cm*30cm.The wax is applied to the inner surface of moulding box for easy removal of composite plate from the moulding box. Then the required size of fiber has pressed and resin is poured in the moulding box. Moreover load is applied on the moulding box for evenly distribute the resin throughout material surface and for getting required thickness. After 20 minutes the composite plate has removed from the moulding box carefully.

2.3 HAND LAYUP MOULDING PREPARATION

First of all the mould for the composite is prepared. We have to prepare moulds of size 300x300x3 mm for the preparation of required composite. Hand Lay-Up Method Open mould shaping method in which successive layers of resin and reinforcement are manually applied to an open mould to build the laminated FRP composite structure. Labour-intensive. Finished moulding must usually be trimmed with a power saw to size outside edge. Oldest open mould method for FRP

laminates, dating to the 1940s when it was first used for boat hulls.

Figure.2.1 Hand layup mould setup

3. EXPERIMENTAL PROCEDURES

3.1 MANUFACTURING PROCESS

Cut the jute fiber and hemp fiber with the required dimension to fit in the mould which we already prepared. Place the glass sheet first. Then , paste the glass file material by the use of single side cello tape. Cello tape will placed layer by layer it will form a boundary layer. Apply wax on the glass layer. Mix the vinyl ester combination with the required amount of vinyl ester solution (100ml vinyl ester + 5ml accelerator + 5ml promoter +7.5mlcatalyst). Apply the vinyl ester combination into the glass file layer. Place the different combination of natural (jute) and glass fiber by one by one order. Again pour the vinyl ester solution between the different combination. Finally place the glass sheet over the composite combination.
By the use of trowel, we neglect the air bubbles. Then place the weight on the mould. Allow the composite for 24hrs to settle. Then finally we prepare the composite material.

3.2 FORMATION

In this composite material consist of two different fiber the name itself JUTE fiber and glass fiber it may be called natural fiber and glass fiber respectively. The sheet can be made by varies layer of natural fiber and glass fiber, it will be shown below formation.

a. GNGN
b. NGGN
c. GNNG
d. NGNG

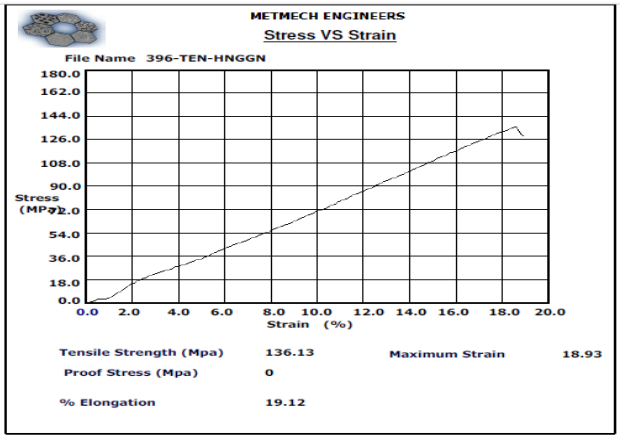
Here
G = Glass fiber
N=Naturalfiber

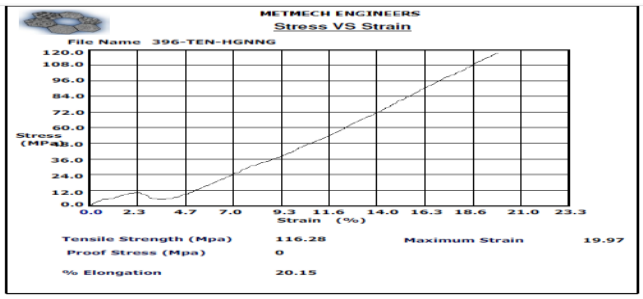
3.3 APPEARANCE OF JUTE –GLASS FIBER AND HEMP-GLASS FIBER REINFORCED VINYL ESTER

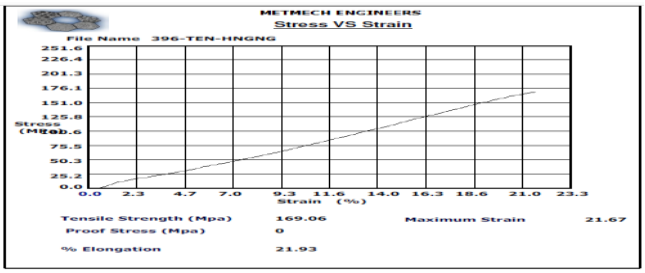
4. RESULT

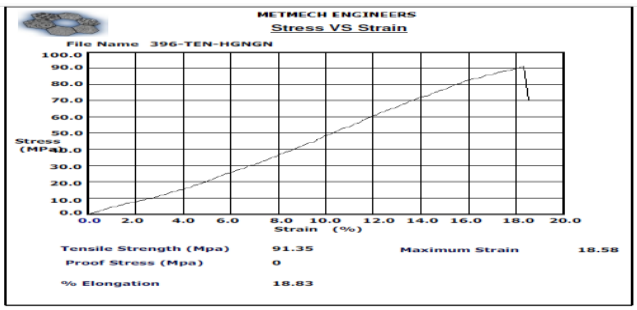
TEST REPORT FOR HEMP -GLASS FIBER COMPOSITE

Tensile test:

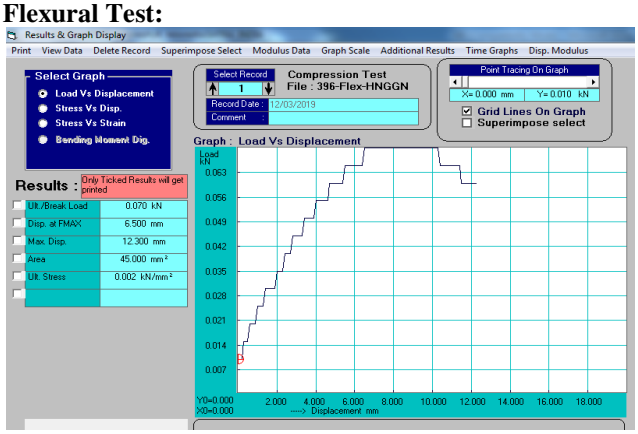


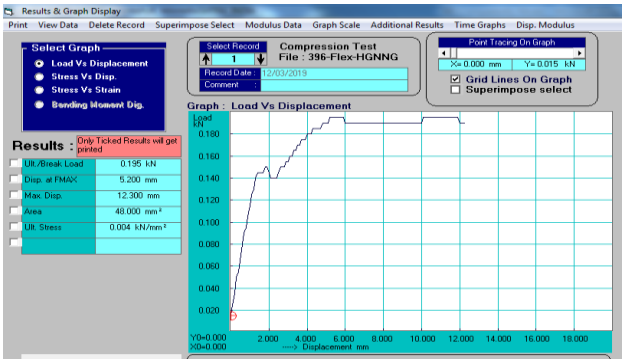


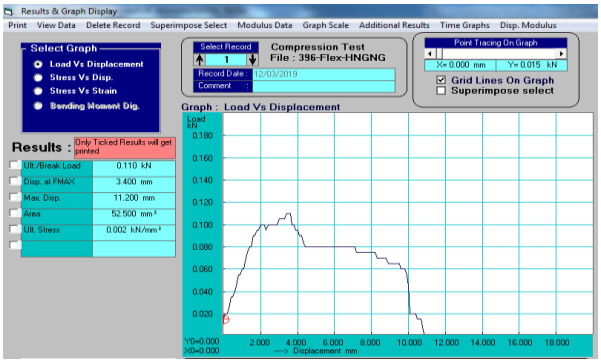


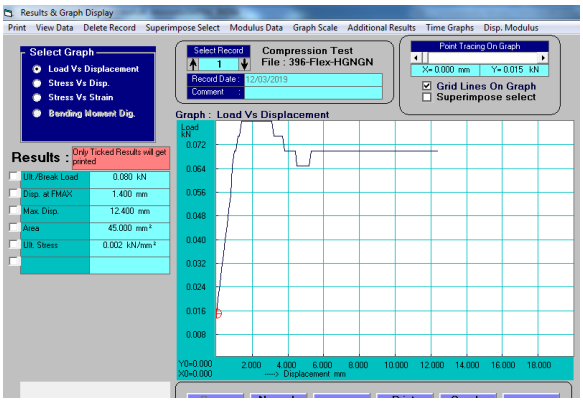


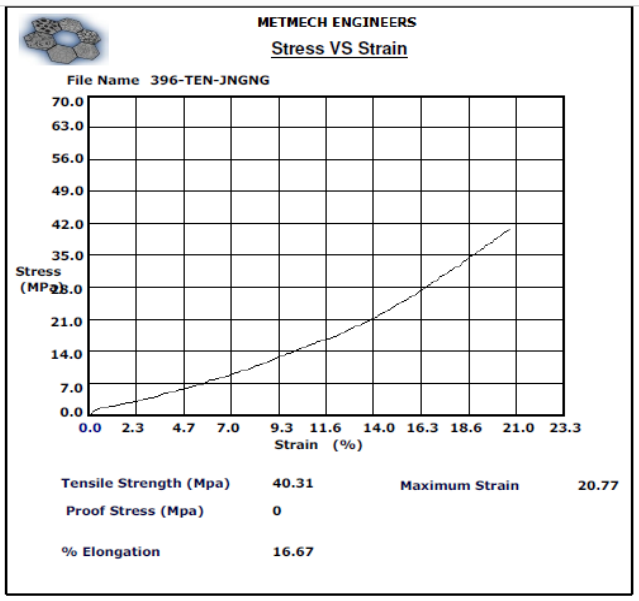
Flexural Test:

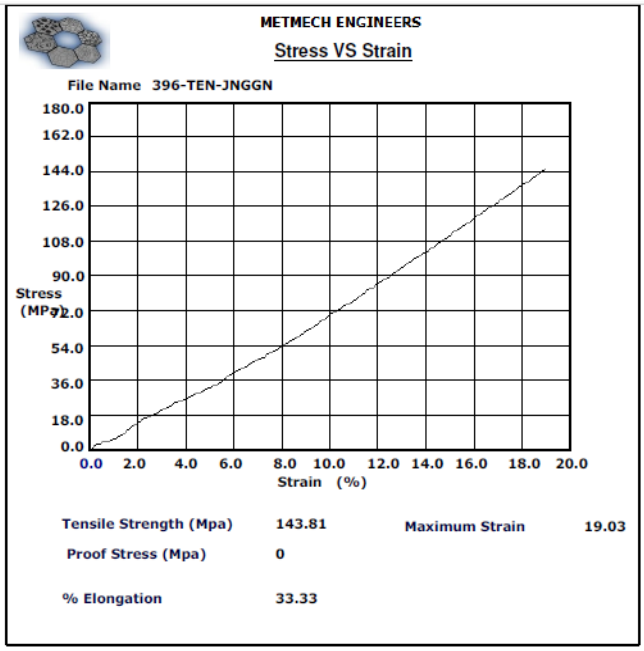










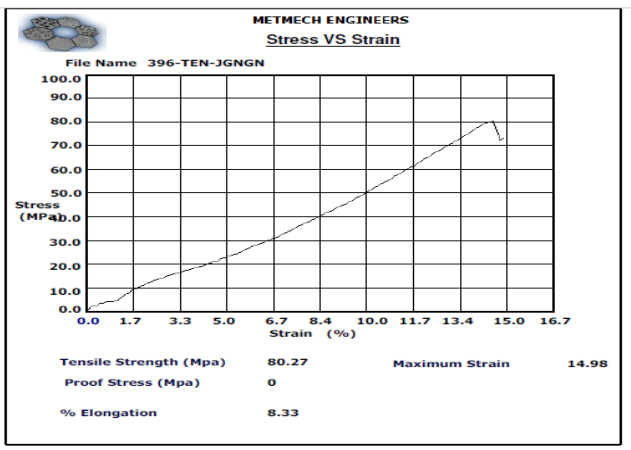


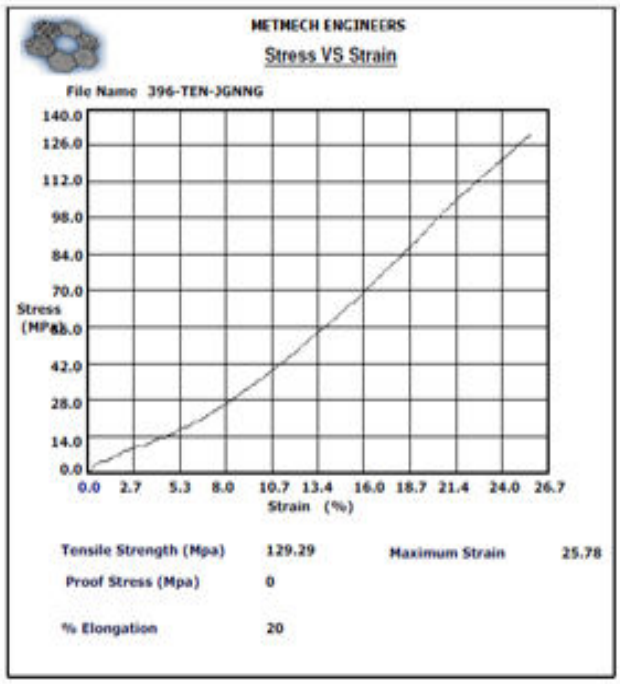
Impact test:

Sample I.D	Joules
HNGGN	4.2
HGNNG	5.1
HNGNG	4.2
HGNGN	5.4

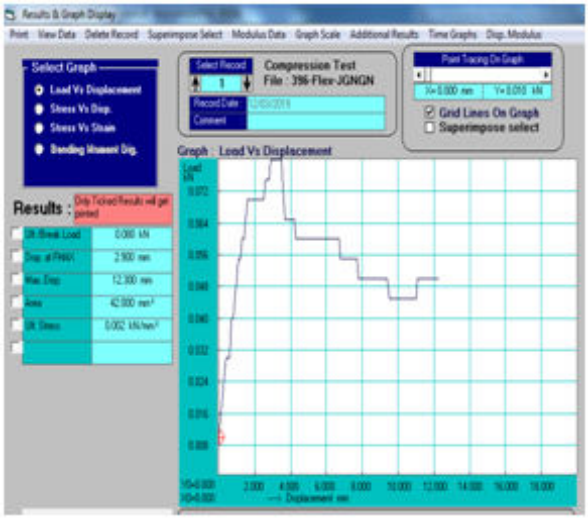
TEST REPORT FOR JUTE-GLASS FIBER COMPOSITE

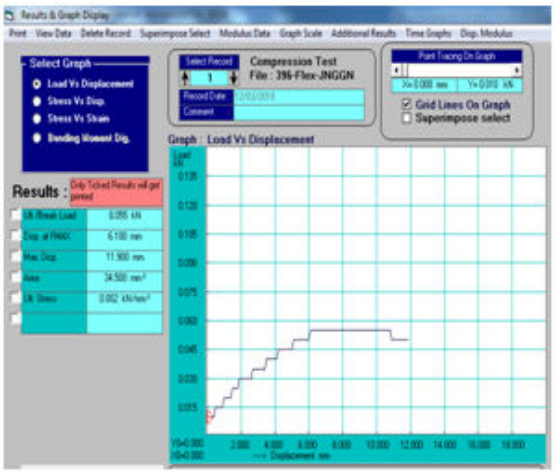
Tensile test:

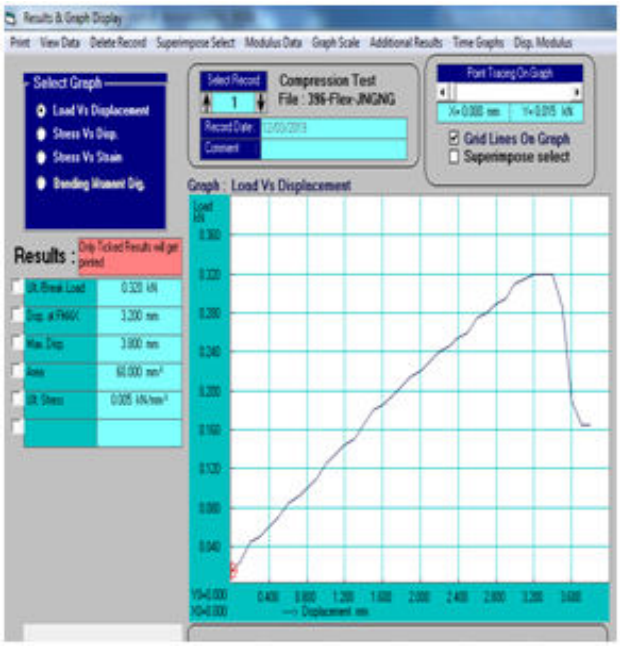


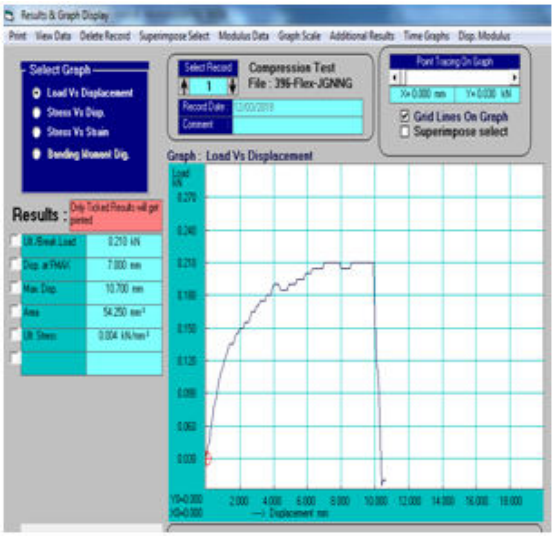


Flexural Test:









Impact test:

Sample I.D	Joules
JGNGN	7.2
JNGNG	2.8
JNGGN	4.1
JGNNG	5.9

4.1 RESULT CALCULATION

COMBINATIO	TENSILE STRENGTH		IMPACT STRENGTH		FLEXURAL STRENGTH					
	JUTE	HEMP	JUTE	HEMP	JUTE			HEMP		
	MPa		GJ/m^2		σ_f MPa	e_f x 10^{-3}	E_F GPa	σ_f MPa	e_f x 10^{-3}	E_F GPa
GNGN	80.27	91.35	120	85	160	25.6	6.25	160	25.83	6.25
NGNG	40.31	169.06	46.6	90	128	7.9	16.2	220	23.33	9.42
NGGN	143.81	138.13	68.33	70	110	24.79	4.43	140	25.62	5.46
GNNG	129.29	116.28	98.33	70	420	22.29	18.84	390	25.62	15.22

5.CONCLUSION

The mechanical behaviours of JUTE and glass fiber composites were evaluated in this investigation. According to the predicted mechanical properties, comparison of experimental values was calculated. The JUTE and glass fiber and HEMP and glass fiber reinforced vinylester resin was successfully fabricated natural composites with the composition ofGNGN, NGGN, GNNG, and NGNG. The JUTE and glass fiber also have high tensile and impact strength, flexural strength properties.

FOR JUTE

1. JUTE and glass fiber reinforced vinylester composites exhibited the maximum value of NGGN tensile strength of 143.81 MPa.

2. JUTE and glass fiber reinforced vinylester composites exhibited the maximum value of GNGN impact strength of 120 KJ/m^2.
3. JUTE and glass fiber reinforced vinylester composites exhibited the maximum value of flexural strength.
A. Stressfor GNNG combination value is 420MPa.
B. Strain for GNGN combination value is 25.6 ×10^-3.
C. Young's modulus for GNNG combination value is 18.24GPa.

FOR HEMP

1. HEMP and glass fiber reinforced vinylester composites exhibited the maximum value of NGNG tensile strength of 169.06 MPa.
2. HEMP and glass fiber reinforced vinylester composites exhibited the maximum value of NGNG impact strength of 90 KJ/m^2.
3. HEMP and glass fiber reinforced vinylester composites exhibited the maximum value of flexural strength.
A. Stress for GNNG combination value is 390MPa
B. Strain for GNGN combination value is 25.83 ×10^-3.
C. Young's modulus for GNNG combination value is 15.22 GPa.

It is clearly observed that the inclusion of natural fibers improves the tensile strength, flexural strength and impact strength of the composite materials. From this study, we can concluded that **HEMP** (NGNG) fiber is better than **JUTE** FIBER in TENSILE STRENGTH. But **JUTE**(GNNG) is best in IMPACT AND FLEXURAL STRENGTH than **HEMP GLASS RENIFORCED FIBER.**

7. REFERENCE

[1]. Enrico Sassoni, StefaniaManzi, Antonio Motori, Matteo Montecchi, Max Canti, Energy and Buildings 104 (2015) 316–322.

[2]. S. Harish, D. Peter Michael, A. Benselyb, D. Mohan Lal, A. Rajadurai, Materials Charaterization 60(2009) 44–49.

[3]. La Mantia, F.P., Morreale, M., Compos. Part-A Appl. Sci. Manuf. 42, 2011, 579–588.

[4]. K.L. Pickering, M.G. AruanEfendy, T.M. Le, Composites: Part A 83 (2016) 98–112.

[5]. Hari Om Maurya, M.K. Gupta, R.K. Srivastava, H. Singh, Materials Today: Proceedings 2 (2015) 1347 – 1355.

[6]. H. Alamri, I.M. Low, Polymer Testing 31 (2012) 620–628.

[7]. Akash, K V SreenivasRao, N S Venkatesha Gupta, and Arunkumar D S, IOP Conf. Series: Materials Science and Engineering 149 (2016).

[8]. D. Ray, B K Sarkar, N R Bose, Composites: Part A 33 (2002) 233-241.

[9]. P. NoorunnisaKhanam, H. P. S. Abdul Khalil, G. Ramachandra Reddy, S. Venkata Naidu, J Polym Environ (2011) 19:115–119.

[10]. Marie Joo Le Guen, Roger H. Newman, Alan Fernyhough, Mark P. Staiger, Composites: Part A 67 (2014) 37–43.

[11]. M. Boopalan, M. Niranjanaa, M.J. Umapathy, Composites: Part B 51 (2013) 54–57.

[12]. H. Kum, H. Wang, N. Pattarachaiyakoop, M. Trada, Composites: Part B 42 (2011) 856–873.

[13]. N. Venkateshwaran, A. ElayaPerumal, A. Alavudeen, M. Thiruchitrambalam, Materials and Design 32 (2011) 4017–4021.

[14]. K. V. SreenivasRao, N. S. Venkatesha Gupta, Akash and Sanjeevamurthy, ARPN Journal of Engineering and Applied Sciences, VOL.11, NO.1, 2016.

[15]. N. Saba, M.T. Paridah, M. Jawaid, Construction and Building Materials 76 (2015) 87–96.

[16]. Paul Wambua .Natural Fibres: can they replace glass in fibre reinforced plastics, Elsevier Science Ltd , Inc., New York 2003: vol.63.

[17]. Monteiro SN, Terrones LAH, D'Almeida JRM. Mechanical performance of coir fiber/polyester composites. Vinylester Testing 2008; vol.27.pp.591– 595.

[18]. Satyanarayana KG, AG. Pillai .Structure Property studies of fibers from various parts of the coconut tree. Composites 1986,vol.17,pp.329..

[19]. Rout J, Misra M, Mohanty AK, Nayak SK, Tripathy SS. The influence of fibre treatment on the performance of coir-polyester composites, Composites Science andTechnology .2001 ; vol .61; pp.1303.

[20].Luis Miguel P.Durao ,DRILLING DELAMINATION OUTCOMES ON GLASS AND SISAL REINFORCED PLASTICS. Compos.Sci$$.Technol. 2009; vol.63, pp.1377–1385.

[21].Harish, S., Peter Michael, D., Bensely, A., Mohan Lal, D. and Rajadurai, A. "**Mechanical property evaluation of natural fiber coir composite**", Materials Characterization, Vol.60, pp. 44-49, 2009.

[22].Felix Prasad, C., Jayabal, S. and Natarajan, U. **"Optimization of tool wear in turning using genetic algorithm**", Indian Journal of Engineering and Material Sciences, Vol. 14, pp. 403-407, 2007.