Processing and Characterization of Hybrid Composites using Jute and E-Glass

Dr. Keerthi Prasad. K. S
Prof & Head Dept of Mech Engg
Vidya Vikas Institute of Engg & Tech
Mysore Karnataka India

Girish. T. R.
Asst.Prof Dept of Mech Engg
K.S. Institute of Technology
Bangalore Karnataka India

Nataraj. B
PG student
K.S. Institute of Technology
Bangalore Karnataka India

***Abstract* :- Fiber reinforced composites are finding applications in automobile industries, civil industries, aerospace industries and chemical industries respectively and also in marine applications in recent years.**

The term hybrid composite refers to the materials which consist of more then two constituents which are at nano level. Basically one of these compounds are organic and inorganic in nature. Hybrid composite materials are different from any other composite materials which are at macroscopic level. Paints are the first most hybrid materials which are prepared from organic and inorganic components. The organic polymers, rubber is used as inorganic material .

In this project work an attempt has been made to develop a hybrid composite material using Jute and E-glass fiber with Epoxy as matrix for different orientations such as 30˚, 45˚and 90˚ is fabricated using the Hand-Lay up technique. Different mechanical properties such as tensile, bending and compression were studied by preparing the specimen according to ASTM D 638 standards .

A comparative study of results for three different orientation of fiber is obtained and it was found that ply's with 90˚ orientation is having better mechanical properties than the other two orientations.

The tribological behavior for the above said material has been assessed with a computerized pin-on disc wear machine by operating in dry condition and with varying loads, and constant speed, length and time has been done. It has been found that for 90˚ orientation the co-efficient of friction is high compared to other two orientations also the material or weight loss was found to be less.

Keywords: Laminates, Hand lay-up technique, Mechanical Properties, E-Glass, Jute.

I 1.1 INTRODUCTION

The development of composite materials and their related design and manufacturing technologies is one of the most important advances in the history of materials. Composite material comprise of strong load carrying material (known as reinforcement) imbedded with weaker materials (known as matrix).The primary functions of the matrix are to transfer stresses between the reinforcing fibers/particles and to protect them from mechanical and/or environmental damage whereas the presence of fibers/particles in a composite improves its mechanical properties like tensile strength, flexural strength, impact strength, stiffness etc.

The composite material used in this research was manufactured using plain weave mat of E-glass fabrics of 0.3mm thickness as synthetic reinforcement. Jute fibers were used as natural reinforcement. The matrix material was Epoxy (Lapox L12) resin and hardener(K6) was supplied by Atul Ltd Valsad Gujarat India.

Fig 1 Finished material of hybrid composite.

2 COMPOSITEMANUFACTURINGMETHOD.

There are many techniques available in industries for manufacturing of composites such as compression molding, vacuum molding, pultruding etc. The hand lay-up process of manufacturing is one of the simplest and easiest methods for manufacturing composites. A primary advantage of the hand lay-up technique is to fabricate very large, complex parts with reduced manufacturing times. All composite specimens were manufactured using hand lay-up process. The prepared material is shown in Figure 1.

2.1 Experimental Procedure and Apparatus.

All experimental tests were carried out at Composite technology park (CTP) Bangalore India.

2.1.1 Tensile Test

Tensile testing, also known as **tension testing**, is a fundamental materials science test in which a sample is subjected to a controlled tension until failure. The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces.

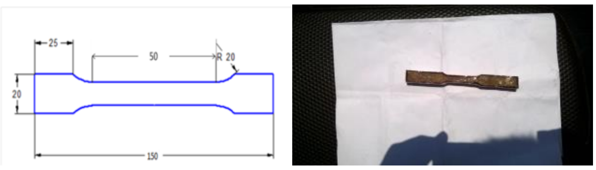

Fig 2 Tensile test specimen

Tensile tests were carried out on rectangular specimens of dimensions (150 × 20 × 6)mm at room temperature, by the method described in ASTM D638. Composite specimens were tested in Universal Testing machine and a tensile load has been applied until it has failed.

2.1.2 Flexural Test

Flexural strength, also known as modulus of rupture, bend strength, or fracture strength a mechanical parameter for brittle material, is defined as a materials ability to resist deformation under load. The transverse bending test is most frequently employed, in which a specimen having either a circular or rectangular cross-section is bent until fracture or yielding using a three point flexural test technique. The flexural strength represents the highest stress experienced within the material at its moment of rupture.

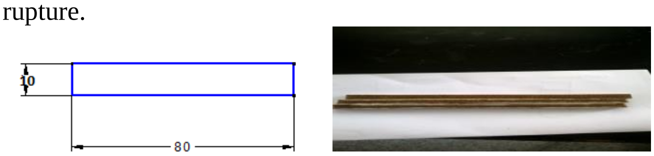

Fig 3 Bending test specimen

Flexural testing commonly known as three-point bending testing was also carried out in Universal testing machine as per ASTM D638.

2.1.3 Compression Test

Compressive strength is a key value for design of structures. Compressive strength is often measured on a universal testing machine; these range from very small table-top systems to ones with over 53 MN capacity Measurements of compressive strength are affected by the specific test method and conditions of measurement.

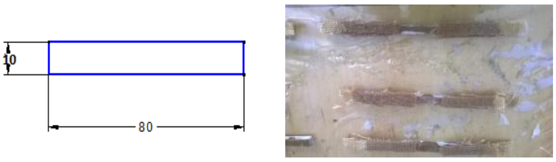

Fig 4 Compression Test specimen

Composite specimens of dimensions(80 × 10×6)mm were horizontally placed on two supports and load was applied at the centre.
Compressive test is also performed in Universal testing machine as per ASTM D638 with additional ribs for the support.

3 RESULTS AND DISCUSSIONS

All experimental tests were repeated three times to generate the data.

Sl No	Orientation	Tensile Strength MPa	Bending Strength MPa	Compressive Strength MPa
1	30^0	65.66	6.2	36
2	45^0	68.66	6.85	37
3	90^0	70.32	7.1	40

Table1Shows the experimental results for testing of the material

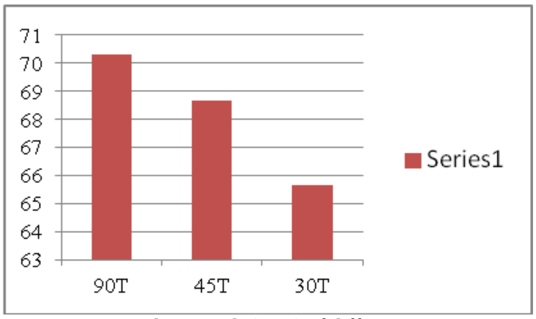

Figure 5 Tensile strength (Mpa) of different orientations

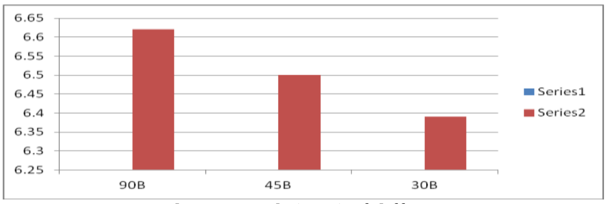

Figure 6 Bending strength (Mpa) of different orientations

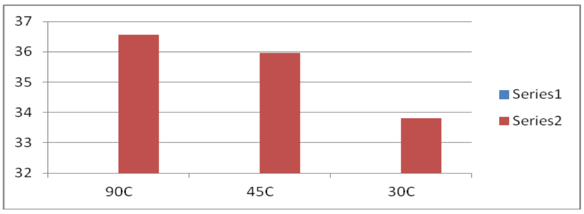

Figure 7 Compressive strength (Mpa) of different orientations

3.2 Wear Test

The performance of prepared composites under dry sliding condition, wear tests were carried out in a pin-on-disc wear test rig[DUCOM]. The test rig is shown in fig8. Prior to testing the pins and disc surface were cleaned with acetone. All of the tests were performed on hybrid composite of various orientations with applied loads of 10,20 and 30N.

Figure 8 Pin on disc Wear testing machine and specimen

Test Rig Specifications

Sl.No	Description	Details
1	Speed (rpm)	200 to 2000
2	Normal load (N)	5 to 200
3	Frictional force (N)	0.1 to 200
4	Wear (mm)	± 2
5	Wear track diameter (mm)	10 to 100
6	Sliding speed (m/sec)	0.5 to 10
7	Preset timer (hr/min/sec)	99/59/59
8	pin size (mm)	Ø3,4,5,6,8,10 & 12
9	Wear disc	EN 31 Steel
10	Pin Heating	Ambient to 600 Deg C
11	Software	Winducom 2010
12	Software Interface	Comport RS 232 serial port

Table 2 shows the details of pin on disc test rig

Sl no	Item	Specifications
1	Test rig	Pin On Disc Tester TR-20-PHM-CHM-600
2	Controller	Electronics controller
4	Software	Winducom 2010
5	Computer	Pentium 4,512MB RAM, 2GB, 17"color monitor

Table 3shows the instrument and specifications

Test Parameters

Test parameters for varying load test
Load 10N,20N and 30N at 300 rpm
Test duration = 15 minutes , Mass measured after completion of all load cases
Wear track dia = 80mm,
Test condition = lubricant condition & at Ambient temperature
Environment = open to atmosphere , Humidity = 51.5%Rh, temperature = ambient room temperature

Table 4 shows the test parameters for varying load test.

Test results

SAMPLE ID	DEGREES	LOAD IN N	INITIAL WT(gm)	FINAL WT(gm)	WT LOSS	TEST NO
JUTE +EPOXY	90	10	2.06143	2.06074	0.00069	1
		20	2.07134	2.0708	0.00054	2
		30	1.88927	1.88833	0.00094	3
	45	10	2.29759	2.29618	0.00141	4
		20	2.47403	2.4717	0.00233	5
		30	2.568	2.56531	0.00269	6
	30	10	1.64598	1.64425	0.00173	7
		20	1.9485	1.94637	0.00213	8
		30	1.79196	1.78923	0.00273	9

Table 5 Shows the weight loss of the material for different orienation

The following graphs show the variation of co-efficient friction for different loading and orientations.

Fig 9 shows the variations in wear, co-efficient of friction, frictional force for 90^0 orientation for 10N load.

Fig 10 shows the variations in wear, co-efficient of friction, frictional force for 90^0 orientation for 20N load.

Fig 11 shows the variations in wear, co-efficient of friction, frictional force for 90^0 orienation for 30N load.

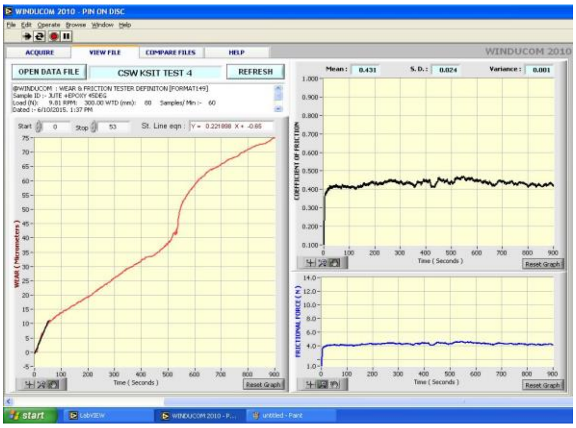

Fig 12 shows the variations in wear, co-efficient of friction, frictional force for 45^0 orienation for 10N load.

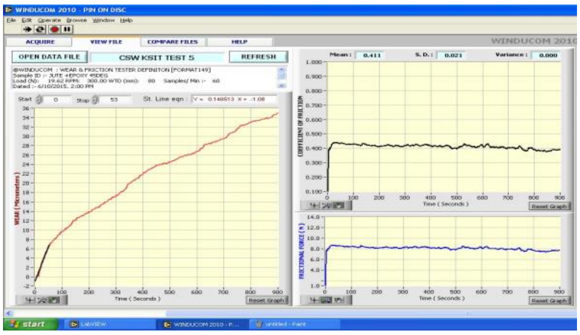

Fig 13 shows the variations in wear, co-efficient of friction, frictional force for 45^0 orienation for 20N load.

Fig 14 shows the variations in wear, co-efficient of friction, frictional force for 45^0 orienation for 30N load.

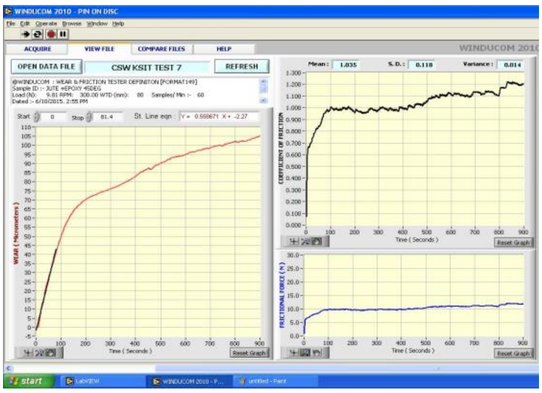

Fig 15 shows the variations in wear, co-efficient of friction, frictional force for 30^0 orienation for 10N load.

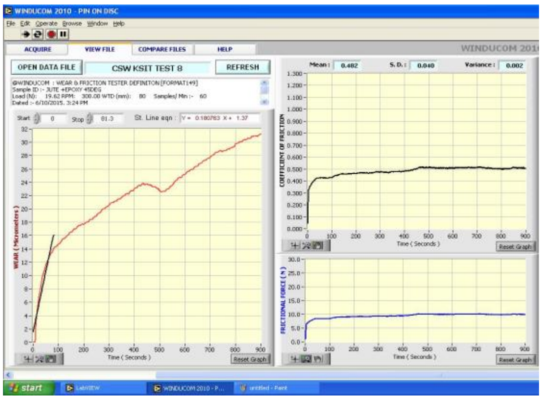

Fig 16 shows the variations in wear, co-efficient of friction, frictional force for 30^0 orienation for 20N load.

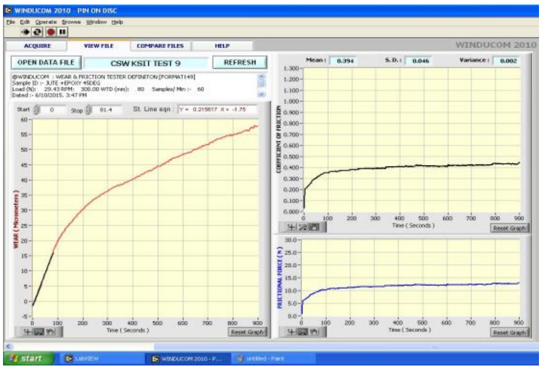

Fig 17 shows the variations in wear, co-efficient of friction, frictional force for 30^0 orienation for 30N load.

4 CONCLUSION

The effect of jute fiber on mechanical properties of glass fiber reinforced polyester composite was studied and it showed that by incorporating the proper orientation the some of the mechanical properties of the hybrid composite can be increased.
The specimens fabricated at 90˚ orientation have better mechanical properties than the other two orientations.
Also by analyzing the graphs from the wear tests conducted for varying load of 10N, 20N and 30N for different orientation of fiber we observe that for 45˚ orientation the co-efficient of friction is high compared to other two orientations also the material or weight loss was found to be less in case of 90˚ orientation.

REFERENCES

[1] Hinrichsen, G.,Khan, M.A. and Mohanty, A.K.,2000, “Composites”: Part A, Elsevier Science Ltd, 31:pp.143–150.
[2] Joseph,P.V., Kuruvilla J, Thomas S. 1999,“Composites Science and Technology”; 59(11): pp.1625-1640.
[3] Mukherjee,P. S. & Satyanarayana, K. G., 1986,“Structure and properties of some vegetable fibers-II. Pineapple leaf fiber,” J. Material Science21 (January), pp. 51–56.
[4] Mohan R and Kishore .Jute glass sandwich composites.Journal of Reinforced Plastic Composite, 1985; 4: 186–194.K Acharya, P Mishra & S C Mishra. 2006, Effect of environment on the mechanical properties of fly ash-jute-polymer composite. Indian journal of engineering & material science 2008; 15:483-488.

[5] M. Ramesh, K. Palanikumar, K. Hemachandra Reddy, Mechanical property evaluation of sisal–jute– glass fiber reinforced polyester composites, elsevier, composites: Part B 48 (2013) 1–9.
[6] M. Muthuvel, G. Ranganath, K. Srinivasan, characterization study of jute and glass fiber reinforced hybrid composite material, International Journal of Engineering Research & Technology (IJERT) Vol. 2 Issue 4, April - 2013 ISSN: 2278-0181.
[7] John K and Naidu S.V. Tensile properties of unsaturated polyester-based sisal fiber–glass fiber hybrid composites. Journal of Reinforced Plastic Composite 2004; 23: 1815.