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Performance Analysis on Various Properties of Jute Fiber Composite

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Abstract: *A simple plate made from using jute fiber, epoxy resin (AY-105) and hardener (HY-951).The density and dynamic viscosity of epoxy at 25℃are 1.109 g/cm3 and 11789 mPa.s respectively.The various test perform on plate of jute fiber and with the help of this find out the strength of jute fiber.Our purpose is to compare jute fiber with regular fiber composite. Surface treatment was performed on jute fibers to produce effective jute reinforced fiber epoxy composites. An improvement has been observed in physical appearance of the jute fiber while analyzing with the bleaching agent. There was no significant enhancement observed in the mechanical properties by adopting this surface treatment. At three different temperature conditions silane treatment was performed on the bleached jute fibers. The mechanical properties showed an enhancement due to silane treatment. Also liquid retaining capacity of the treated fibers increased which indicates better wetting properties of the jute fibers. The gel point also showed better pseudo elastic properties in case of silane treated jute fiber.*

Keywords: *Dynamics viscosity, Hardener, Density, Epoxy resin*

I. Introduction

Nowadays the keen interest of scientists and technologists on natural fibers is increasing due to its various advantages over conventional fibers. The important characteristics of natural fiber are economic, low density, high specific properties and unlike other reinforcing materials they are biodegradable and nonabrasive. A crucial advantage associated with natural fibers as compared to synthetic fiber is that the easy disposal at the end of use by recovery of their calorific value in furnace. Jute fiber is economic, found in abundance and having higher strength and modulus than plastic. As day by day our environment got polluted, the need of replacing synthetic fibers with the natural fiber for composite fabrication increasing. Jute fiber reinforced polymer composites are suitable for the primary structural applications, indoor elements in housing, temporary outdoor applications. Low-cost housing for rehabilitation and transportation are the best example. The insulating characteristics of jute make it useful in automotive door, ceiling panels and panel separating the engine and passenger compartments. Investigated the effects of process parameters such as fiber size, fiber condition and wt.% on tensile strength of jute fiber reinforced thermoplastic composites. The many author suggested that tensile strength increases with increase in the fiber size and fiber percentage; however, after a certain size and percentage, the tensile strength decreases again. The aim of this project work is to increase the mechanical as well as physical properties by using various treatments.

The thermoplastic polypropylene (PP), used as matrix material, was supplied by the Polyolefin Company, Private Limited Singapore in the form of homo-polymer pellets. The coir, used as reinforcing fiber, was collected from a rural area of Bangladesh. It comprises 43.44% cellulose, 45.84% lignin, 0.25% hemi-cellulose, 3% pectin, 5.6% ash, and 7.47% other constituents. Chemicals used in this study to treat coir were HCl, basic chromium sulfate and sodium bicarbonate.

II. Material Details

II.1 Resin and Hardener

Epoxy resin was used as matrix in the composite. The Epoxy resin (AY-105) and Hardener (HY-951) and were purchased from local resources. The density and dynamic viscosity of epoxy at 25 ºC are 1.109 g/cm3 and 11789 mPa.s respectively.

Fig 1: ResinandHardener

II.2 Fiber

Jute fibres were used as reinforcement in the work. Jute plant belongs to the genus Corchorus, family Tiliaceae and jute is obtained from the stem of the jute plant. Jute plants grow to about 2.5 to 3.5 m i0000000000n height. Biological retting is a process used for removing fibre from stem [8]. Jute fibre has an importance among the natural fibres because jute grows opulence in Bangladesh and Eastern part of India and jute reinforced composites have moderate tensile and flexural properties compared with other natural fibres [9]. Table 1 shows the chemical and mechanical properties of jute fibre.

Fig 2: Jute Fiber

II.3Chemical, mechanical and physical properties of jute fiber

Properties	Jute fiber
Cellulose (%)	64.4
Hemicellulose (%)	12
Lignin (%)	11.1
Moisture content (%)	1.1
Density (g/cm3)	1.46
Fibre length (mm)	0.8-6
Diameter of fibre (mm)	5-25
Tensile strength (MPa)	400-800
Young's modulus (GPa)	10-30
Elongation at break (%)	1.8

Property	Thermoset	Thermoplastics
Formulations	Complex	Simple
Melt viscosity	Very low	High
Fibre impregnation	Easy	Difficult
Prepeg stability	Poor	Excellent
Processing cycle	Long	Short to long
Processing temperature / pressure	Low to moderate high	High
Environmental durability	Good	Unknown
Solvent resistance	Excellent	Poor to good
Database	Very large	Small

Sl. No.	Samples	Tensile strength (MPa)	Flexural strength (Dry) (MPa)	Flexural strength (After 2 hrs. boiling in water) (MPa)
1.	Untreated non-woven* + PF resin	42.10	68.24	22.17
2.	MF pretreated non-woven + PF resin	49.99	73.97	27.50
3.	PF pretreated non-woven + PF resin	47.70	72.32	26.13
4.	CNSL – PF pretreated non-woven + PF resin	62.21	90.03	58.27

II.4 Effect of Cyanoethylation on Mechanical Properties of jute composites

Sample	Tensile Strength (MPa)	Flexural Strength (MPa)	Flexural Mod (GPa)	Water absorption %		Thickness swelling %	
				2hr in boiling water	24hr in cold water	2hr in boiling water	24hr in cold water
Control	74.24	84.81	12.97	48.09	49.76	62.31	31.94
MJC-4	108.60	136.90	18.05	12.46	5.45	12.97	10.36

Reference: "Improvement of functional properties of jute based composite by acrylonitrile pre-treatment", J. of Applied Polymer Science, vol. 78, 495-506 (2000)

III. Material and Specimen Geometry

Dimension for Tensile Testing: The specimen of dimension 165 mm × 20 mm × 3.2 mm with gauge length 53 mm was used for tensile testing.

Dimension for flexural Testing: The specimen of dimension 80 mm× 13 mm × 3.2 mm with span length 48 mm as per ASTM D 790 was used for Flexural test.

Dimension for Impact Testing: The dimension of specimen for impact test was 65 mm × 13 mm × 3.2 mm and 2.5 mm notch thickness as per ASTM D 256

IV. Result And Comparison

Fig3: Impact Test on jute fiber

Test conducted on: SHORT JUTE FIBER
Test conducted : IMPACT TEST
Test conducted by: PRAJ METALLURGICAL LAB
Machine used for testing :IMPACT TESTING MACHINE
Strength find by testing :46.40 J/m
Test conducted on: LONG JUTE FIBER
Test conducted: IMPACT TEST
Test conducted by : PRAJ METALLURGICAL LAB
Machine used for testing : Impact Testing Machine
Strength find by testing : 155.50 J/m

Fig4: Tensile Test OnJute Fiber

Test conducted on: SHORT JUTE FIBER
Test conducted :TENSILE TEST
Test conducted by: PRAJ METALLURGICAL LAB
Machine used for testing :TENSILE TESTING MACHINE
Strength find by testing :18.45 MPa
Test conducted on: LONG JUTE FIBER
Test conducted: TENSILE TEST
Test conducted by : PRAJ METALLURGICAL LAB
Machine used for testing : TENSILE TESTING MACHINE
Strength find by testing : 34.66 MPa

Fig5: Compression Test OnJute Fiber

Test conducted on: SHORT JUTE FIBER
Test conducted :COMPRESSION TEST
Test conducted by: PRAJ METALLURGICAL LAB
Machine used for testing :COMPRESSION TESTING MACHINE
Strength find by testing :72.15 MPa
Test conducted on: LONG JUTE FIBER
Test conducted: COMPRESSION TEST

Test conducted by : PRAJ METALLURGICAL LAB
Machine used for testing : COMPRESSION TESTING MACHINE
Strength find by testing : 82.84 MPa

Fig 6: Flexural Test On Short Jute Fiber

Test conducted on: SHORT JUTE FIBER
Test conducted :FLEXURAL TEST
Test conducted by: PRAJ METALLURGICAL LAB
Machine used for testing :FLEXURAL TESTING MACHINE
Strength find by testing :14.79 MPa
Test conducted on: LONG JUTE FIBER
Test conducted: FLEXURAL TEST
Test conducted by : PRAJ METALLURGICAL LAB
Machine used for testing : FLEXURAL TESTING MACHINE
Strength find by testing : 54.27 MPa

Comparision Of Short And Long Jute Fiber

Sr. No.	Test Description	Unit	Results	
			Short Jute Fibre	Long Jute Fiber
1	Tensile Strength	MPa	18.45	34.66
2	Flexural strength	MPa	14.79	54.27
3	Compression Strength	MPa	72.15	82.84
4	Izod Impact Strength	J/m	46.40	155.50

V. Conclusion

The following conclusions have been drawn from the study of the jute epoxy composite:

1. Successful fabrication of the bidirectional jute fiber reinforced epoxy composite has been done by the hand lay-up technique.
2. Jute fiber composite gives better tensile strength , flexural strength, Compression strength, Impact strength.
3. Long jute fiber strength is more than the short jute fiber.

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