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Characterisation of Jute, Areca and Glass Reinforced Polymer Composite

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***Abstract*- Composite material market is exponentially growing and finding its application in almost every walks of life. Here we prepared three composites of different stacking sequences and fibre reinforcement for our experiment. We have used areca, jute and glass fibres for making a composite with epoxy as resin. Our composites had ten layers of fibre of different stacking sequence for every specimen. Hand layup technique was used for preparing the material. Compression moulding was done on the stacked laminates and the final product was measured to be 30x30x3 mm. the composite then was converted different specimens as per ASTM standards. The tensile and flexural test was done for every combination of specimen and in three different combinations jute+glassfibre reinforced matrix was found to have more tensile and flexural properties. Graphical results were obtained for the tests and analysed and final result was drafted.**

***Key Words*: areca fibres, glass fibres,hybrid composite, jute fibres, epoxy,**

I. INTRODUCTION

Decades ago we were highly depended on monolithic materials and their own properties to do the specific work. With the invention of composite the materials are developed with respect to the properties required for the application. Natural fibre composites and synthetic fibre reinforced composites find a wide range of applications from roofing to aerospace industries. When a new material is being made with the combination of other materials it combines the properties of all those materials and it paved the way for a new area of scientific research known as composites. The desirable properties of a material such as high strength to weight ratio, low density, stiffness, impact resistance and durability can be achieved using composite materials outpacing the conventional materials. Composite materials making doesn't involve high machinery working rather is cost effective and efficient in most of the cases. The usage of inherent properties of fibres, polymers, ceramics and metals to produce a new category of material with superior properties which will have the combined properties of all materials is paving the way for revolutionary changes in the field of engineering. Glass fibres are the most widely used to reinforce epoxy due to their low cost (compared to carbon) and good mechanical properties. However, these fibres have serious shortcomings as indicated in Table 1. These drawbacks have been highly exploited by naturalfibre composites. Table 1 compares natural and glass fibres and clearly shows areas the former have distinct advantages over the latter.

TABLE 1
Comparison Between Natural Fibre And Glass Fibre.

Parameters	Natural fibres	Glass fibres
Cost	Very low	low
Renewbality	Yes	no
CO2 neutral	Yes	no
Pollution	No	yes
Disposal	biodegradable	Non biodegradable
Density	Low	More than natural fibre
Abrasion	No	yes
Work hazards	No	yes
Recyclability	Yes	no

According to the European Guideline 2000/53/EG issued by the European Commission, 85% of the weight of a vehicle had to be recyclable by 2005. This recyclable percentage will be increased to 95% by 2015[1].Mercedes-Benz used epoxy matrix with the jute reinforcement in the door panels in its E-class vehicles back in 1996[2]. The next step of green composite application appeared commercially in 2000, when Audi launched the A2 midrange car: the door trim panels were made of polyurethane reinforced with a mixed flax/sisal material [3]. Toyota on its turn claims to be the leading brand in adoption of environmentally friendly materials as 100% bio plastics. material selection

EPOXY RESIN (Lapox L12)

Lapox L-12 (diglycidyl ether bisphenol) is a commonly used polymer resin for high strength property materials. They are expensive than other polymers but

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are commonly used for PMC applications, the resin has a low viscosity and low flow rates, which allow good wetting of fibres and also prevent misalignment of fibres during process. Various types of resins can be mixed with epoxy to produce a different resin which will have an entirely new property. The epoxy resin is mixed with hardener to produce a thermosetting polymer. Volume fraction of epoxy – hardener can be varied according to the application.

Fig:2.1epoxy -hardener

JUTE FIBRES

Jute is one of the main agricultural products of India. We are the largest producer of jute in the world ,so promoting jute is utmost importance as an Indian. Jute fibres are eco friendly and have good tensile properties. Jute fibres have high tenacity, sound and heat insulation property, low thermal conductivity and high water retention properties.

ARECA FIBRES

Sheaths of areca are processed into making fibres which in turn is made into mat for further use. Areca sheath are waste product predominantly produced in konkan areas of India and south eastern parts of Asia. These fibres come of absolutely no cost and have quite average properties compared other fibres.

Fig:2.2 areca mat

GLASS FIBRES

Glass fibres are widely used in composite making and have good flexural and tensile properties .they are used in many application such as fibre glass. It has strength to weight ratio and excellent fatigue performances.bi-directional glass mats are used for making our composite.

Fig:2.3 glass fibre mat

II. PREPARATION OF LAMINATES

The composite preparation hand lay-up and closed pressure moulding were chosen. The metallic frames were made with 30x30x3mm which was the machine standard where we have gone for testing. Before the composite were made, a layer wax is applied on both sides so that it won't stick to the plate and also the surface finish will be good. Epoxy (LY556) and

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Hardener (HY951) were mixed in 10:1 ratio and stirred very slowly to remove air bubbles. After 10 minutes the temperature of mixture changes and it's a sign of indicating to pour. The mats are stacked in sequence and adding resin between each layer as per hand layup technique. We have tried three different combinations of composites with different fibres and stacking sequence. First combination has a stacking sequence of GGJJJJJJGG (J-JUTE, G-GLASS) ,second combination is GGAAAAAAGG (A-ARECA,G-GLASS) and the third had GGAJAJAJGG (J-JUTE ,G-GLASS,A-ARECA).The setup was made in a compression moulding machine and The setup is allowed to cure for 1-2 hours and the final composite is prepared. The composites produced in above are heat treated 80 degree and 1500psi pressure is applied. Both are done in the compression moulding machine itself. Then the specimens were cut as per ASTM standards for tensile and flexural with the help of a skilled labour who cuts the acrylic sheets for electric switch boards. Then the specimen prepared was taken out for testing (tensile and flexural).

Fig:specimen testing results and discussion

Table 2 Tensile Strength

Serial number	sample	Test parameter	Unit	Test result	Avg
1	Jute+glass	Ultimate tensile strength	MPa	102	96.8
				106	
				94	
				100	
				82	
2	Jute+areca +glass	Ultimate tensile strength	MPa	92	86.2
				94	
				85	
				76	
				84	
3	Areca+ glass	Ultimate tensile strength	MPa	48	51.2
				59	
				50	
				51	
				48	

Table 3 Flexural Strength

Serial number	sample	Flexural load, N	Flexural strength, N/mm^2	Average N/mm^2
1	Jute+ glass	320	299	279.4
		320	297	
		280	266	
		240	227	
		320	308	
2	Jute+ areca+ glass	240	182	197.8
		240	204	
		240	191	
		200	177	
		280	235	
3	Areca+ glass	240	142	149.6
		240	154	
		240	163	
		200	131	
		240	158	

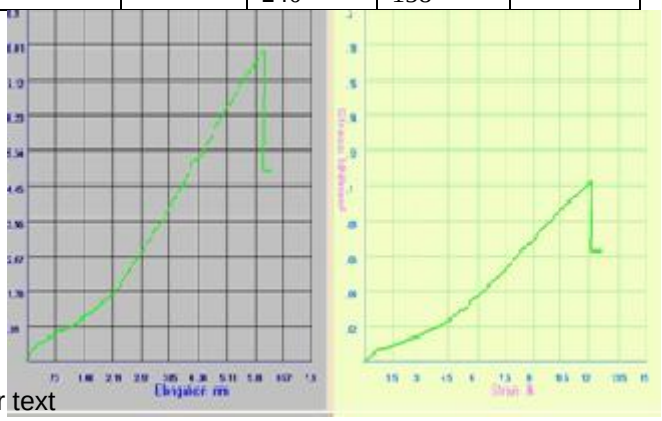

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Fig:4.1 sample tensile graph

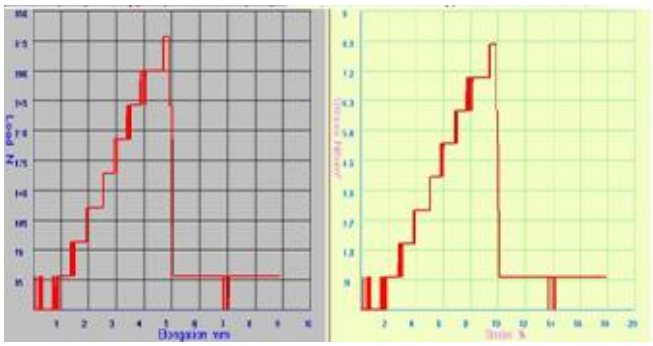

Fig:4.2 sample flexural graph

CONCLUSION

The strength of jute and glass fiber was superior to other combinations of the composite. Jute fibres are cheaply available as sacks which are put to use for just packing purpose. This fibre can be effectively used for making composite of different kinds and put into various industrial applications. Even though areca fibers have less strength sheath of areca is virtually thrown without any use. So the raw material cost is minimal and can put to use in making materials which require low strength. Areca farmers can make an extra income by using the sheath to composites.

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