To Evaluate the Comparison of Mechanical Properties of Flax/Jute Fibers Reinforced Unsaturated Polyester Resin

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Abstract— Today the use of composite material in the manufacturing field is increasing day by day. The composite material consists of two or more different forms of material. The natural fiber like flax, jute, sisal, kapok silk plays an important role to enhance the properties of composite material. In the present work polyester is used with natural fiber i.e. flax and jute. The composite material (Polyester & flax fiber and Polyester & jute fiber) having weight percentage 90% &10% respectively. The fibers are treated with NaOH and water solution. The specimen of composite material are manufactured by hand layup method. The mechanical properties such as tensile, flexural and shear are calculated and analyzed. In this conclusion flax is better than jute in tensile strength and shear strength. Jute is better than flax in flexural strength.

Keywords: Polyester Resin, flax fiber and jute fiber

I. INTRODUCTION

Composite materials are made from the combination of two or more different materials on a macroscopic scale to form a material capable of sustaining loads. It should be noted that the products of microscopic mixing of materials, such as alloying, do not belong to the class of composite materials. It consists of a reinforcing material which is enclosed in a different phase called matrix. With the help of matrix the fibers can be kept in appropriate position and emplacement, scratches can be removed and load between the fibers can be relocated. Ductility of fibers is less than that of matrix. So it is liable for stiffness of the composite. Better load transfer by the matrix is attained in case of High aspect ratio (length/diameter). It is tougher stiffer and harder than that of the matrix. Natural fibers offer may leads over synthetic fibers. Presently natural fibers are not having suitable applications, these are used as cattle feed and fuel purpose, i.e. no proper utilization. We can get applications in industries, there will be value addition to the natural fiber wastes and the farmers can get extra profit. As the cost of the natural fiber is very low and these are light in weight with sensible strength making it very high strength to weight ratio.

There are many types of natural fibers which include flax, jute, sisal, hemp, wood, cotton, banana, pineapple and sugarcane fibers. The natural fiber composites are cheaper and have higher strength and modulus in comparison with the composites produced with synthetic fibers specially, when difference between fibers densities are considered. The main groups of plastics that are used are polyethylene (PE) and polypropylene (PP).Only thermoplastics that melt at temperatures below 200°C are frequently used in making the composites because of the limited thermal stability of natural fibers. Currently, PE is the most attractive thermoplastic in making the natural fiber plastic composites which are mainly used as the exterior building components. Composited made from polypropylene (PP) are used in automotive application and have recently been investigated for using as building profiles.

II. PROBLEM FORMULATION

After going through the above reviewed literature is seen that during limited current years natural fibres in polymer matrix are normally used in construction and non-construction field as a very useful resources. As, we all know that the Indian economy varies upon on its agriculture as it is an agricultural country. A huge amount of different kinds of crops are produced but their waste products are not used anywhere so they get wasted in huge amount. Agricultural waste like wheat, rice, husk, and their straw, flax fiber and shells of several dry fruits are waste which can used to form fibre reinforced polymer composite which can be used in industrial field. Various methods and techniques are being realistic to use renewable sources for preparing composite materials based on polymer and natural resources and their better presentation because of its biodegradable nature. The final properties of the composites are calculated by the properties of the fibre, properties of the resin and the ratio of fiber to resin in the final composite. The planning and direction of the fibres also greatly affects the properties of the composite. The behaviour of the composite hangs greatly on the framework, concerned in construction of natural fibre reinforced composite such as chemical treatment. Amount of fibre used in matrix techniques concerned in mixing of fibers these frameworks are calculated by different methods. Through chemical treatments the properties of the fiber surface gets enhanced and also it increases the fiber strength. It reduces the water absorption of the composite and a mechanical property gets improved. For better construction of materials to be used in dissimilar service conditions, two or more fibres are mixed together. From all above study it is found that we need to manufacture and investigate the mechanical properties of hybridized flax and jute fiber reinforced polyester composites by mixing the fibres and with various fibres loading.

III. EXPERIMENTATION PROCEDURE

A. Material used

1) Flax fiber

Raw and plain continuous fiber from Go Green Products Chandra Parkash, jaipur, Chennai India. It is untreated extracted from flax trunk. Fiber layer are prepared and separated mechanically from flax stalk.

2) Jute fiber

continuous fiber from Go Green Products Chandra Parkash, jaipur, Chennai India.

3) Polyester Resin

Cheaply available everywhere brought from local shop Happy fabrics, Amritsar. It is used as base matrix in the composite. Cobalt napthanate is added as an accelerator. It is

used as 0.9% of volume in entire mixture. The solution is mixed and stirred before applying on the laminate. Methyl ethyl ketone peroxide, which acts as a catalyst, was received from Happy Fabrics Amritsar.

B. Surface treatment of fabrics

The jute fabric was taken in a glass tray. Two percent of NaOH was added into the tray and the fabric was allowed to soak in the solution for half an hour to remove the soluble greasy material. In order to enhance the adhesion uniqueness between the fabric/fiber and the matrix. The fiber was then washed thoroughly with water to remove the excess NaOH. Finally, the fiber was washed with distilled water and dried in a hot air oven at 710 C for 1 h. This method was also repeated for flax fibers, soaking the fiber in alkali solution for 1 h.

C. Composite fabrication

A glass mould of required dimensions was used for making the composite. The mould cavity was coated with a thin layer of aqueous solution of polyvinyl alcohol which acts as a good releasing agent. The uncured matrix mixture was poured into the mould up to a quarter of its volume. Over this the chopped fabrics were placed, to which another layer of matrix was poured. This was continued until the complete mould was filled and air bubbles were uninvolved carefully with a roller. The top of the mould was covered with Teflon release film to prevent the cured composite from sticking to the top plate. Then the mould was closed for curing. The closed mould was kept under pressure for 24 h at room temperature. To ensure complete curing the composite samples were post cured at 800C for 1 h and test specimen of the required size were cut according to American chemical Society Standard Test Methods (ASTM) standard. The composite having different fabric content were prepared by varying the volume ratio of two fabrics, keeping the volume percent constant at 3% volume (hybrid composite).

D. Mechanical testing

1) Tensile testing

The tensile test is done by cutting the composite specimen as per ASTMD-638 standard. A universal testing machine (UTM) as shown in figure is used for testing with a maximum load rating. The tensile test is generally performed on flat specimens. The commonly used specimens for tensile test are dog-bone type.

Fig. 1: Universal testing machine

Composite specimens with different fiber combinations are tested, which are shown in figure. The specimen is held in the grip and load is applied and the corresponding deflections are noted. The load is applied until the specimen breaks and break load, ultimate tensile strength are noted. Tensile stress and strain are recorded and load v/s displacement graphs are generated.

Tensile strength=peak load/maximum displacement

Fig. 2: Tensile test specimen

2) Flexural test

The flexural test is done in a three point flexural setup as per ASTMD-790 standard. When a load is applied at the middle of the specimen, it bends and fractures. It is a 3-point bend test, which generally promotes failure by inter-laminer shear. Formula;

Flexural strength=3pl/2wT2

P=peak load
L=Gauge length
W=width
T=thickness

Fig. 3: Universal Testing Machine

Fig. 4: Flexural Test specimen

3) Shear test

This test is based on the force which is required to measure the shearing force required to make holes or tears in the plastic. The shear test is useful in structural calculations for parts that may fall in shear. This is based on the force required to rip the plastic divided by the thickness. Test specimens shall be at least 3mm thick.

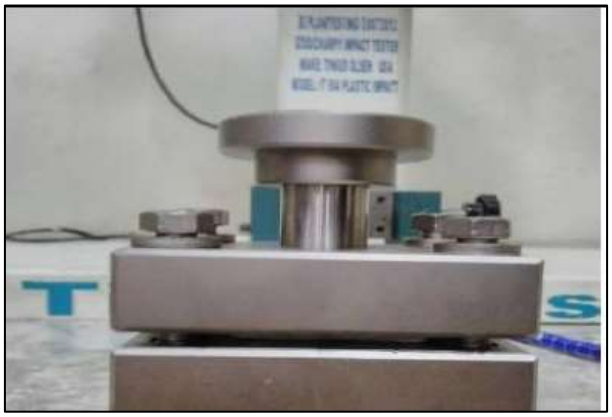

Fig. 5: Universal Testing Machine

Fig. 6: Shear Test specimen

IV. RESULTS & DISCUSSION

The composite samples 1, 2, 3, 4 and 5of flax are tested for tensile properties, flexural and shear in UTM machine and obtain tensile properties are shown in table 1.

Sample No.		Tensile Strength (Mpa)	Flexural strength (Mpa)	Shear strength (Mpa)
Flax 10% UPR 90%	1	35.40	40.24	32.45
	2	29.09	33.17	33.84
	3	35.52	45.24	31.96
	4	23.96	40.50	28.09
	5	30.98	36.74	32.43
	Avg.	30.99	39.18	31.75

Table 1: Mechanical properties of different samples of flax fiber

The composite samples 1, 2, 3, 4 and 5 of jute are tested for tensile, flexural and shear properties in UTM machine and obtain tensile properties are shown in table 2.

Sample No.		Tensile Strength (Mpa)	Flexural Strength (Mpa)	Shear strength (Mpa)
	1	28.14	38.05	32.78
	2	22.25	33.17	24.01
	3	25.68	45.24	29.92
	4	28.37	40.50	32.38
	5	27.42	36.74	29.77
	Avg.	26.37	39.86	29.77

Table 2: Mechanical properties of different samples of jute fiber

The comparison of the flax and the jute in different mechanical properties are shown in table 3.

Sample No.		Tensile Strength (Mpa)	Flexural strength (Mpa)	Shear strength (Mpa)
Flax1 0%	1	30.99	39.18	31.75
Jute 10%	2	26.37	39.86	29.77

Table 3: Comparison of mechanical properties of flax and jute fiber

The graph is to be plotted between the flax and jute fiber as shown in fig 7. In the graph it clearly shows that flax is better than jute in tensile strength.

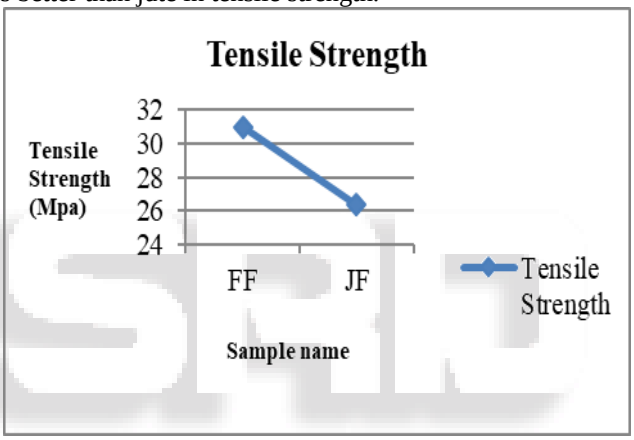

Fig. 7: Tensile properties of flax and jute fiber

The graph is to be plotted between the flax and jute fiber to measure the Flexural strength as shown in fig 8. In the graph it clearly shows that jute is better than flax in flexural strength.

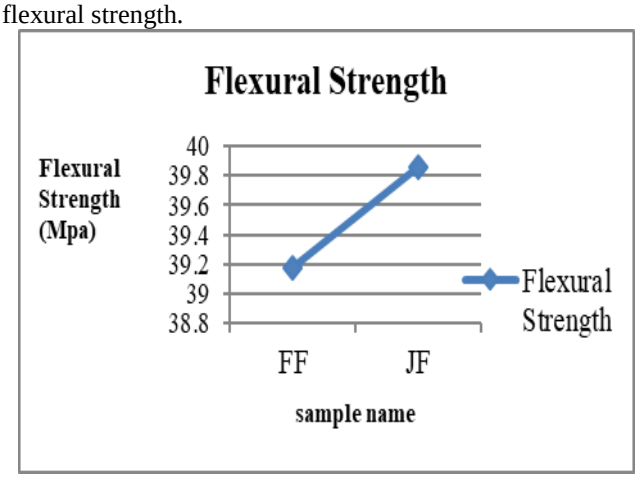

Fig 8: Flexural strength of flax and jute fiber

The graph is to be plotted between the flax and jute fiber to measure the Shear strength as shown in fig 9. In the graph it clearly shows that flax is better than jute in shear strength.

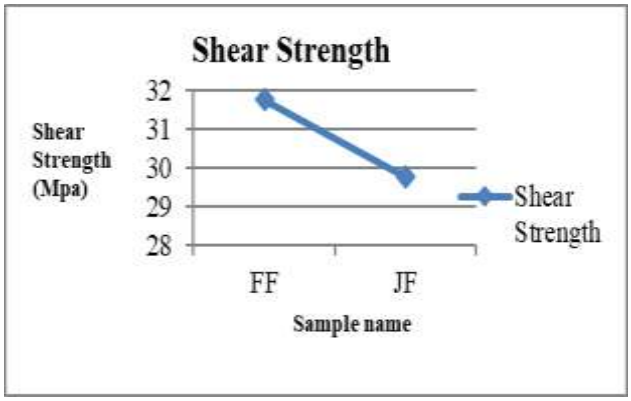

Fig. 9: Shear strength of flax and jute fiber

In fig. 9 shows that the comparison between the flax and jute fiber for measuring the mechanical properties like tensile, flexural and shear strength. The tensile strength and shear strength is increasing in case of flax fiber but the flexural strength is increasing in the case of jute fiber.

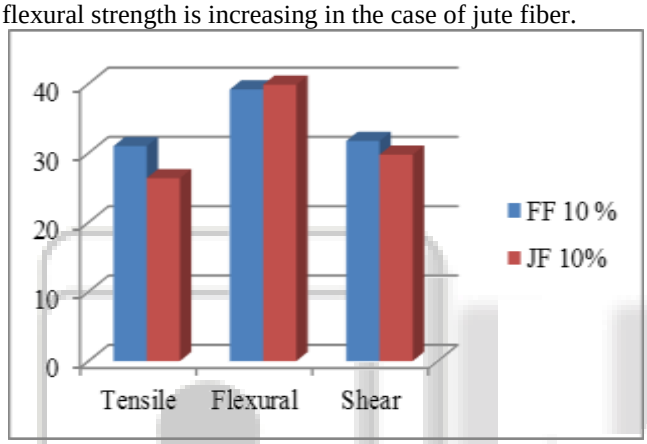

Fig. 10: Comparison of mechanical properties of flax and jute fiber

V. CONCLUSION

In this work it is concluded that:

- The tensile strength increases in case of the flax fiber (FF 10%, UPR 90%) as compared to jute fiber (JF 10%, UPR 90%) due to adhesion.
- The flexural strength in Jute fiber (JF 10%, UPR 90%) is more than flax fiber (FF 10%, UPR 90%). This is because of high stiffness.
- Shear strength also increases in case of flax fiber (FF 10%, UPR 90%) as comparison of jute fiber (JF 10%, UPR 90%) due to saline treatment.

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