ISSN No: - 2456 - 2165

To Study the comparison of mechanical properties of Banana/Kapok fabrics reinforced unsaturated polyester resin

Deepak Sharma ,
Student in SSCET Badhani

Sangamdeep singh ,
Assistant Professor in SSCET Badhani

Dinesh Kumar
Assistant Professor in SSCET Badhani

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 banana, kapok, jute, bamboo, and silk plays an important role to enhance the properties of composite material. In the present work polyester is used with natural fiber i.e. banana and kapok. The composite material (Polyester & Banana fiber and Polyester & kapok 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 kapok is better in tensile strength as compared to banana but in case of banana fiber, flexural and shear strength is better obtained.

***KEY WORDS**: Polyester, kapok fibre and banana fibre.*

I. INTRODUCTION

In the recent years natural fibers are attaining more attention as reinforced to thermo set and thermoplastic matrices. The application of natural fibers as reinforcement to polymer matrices has been extensively revised and it is now possible to produce plastic composite using natural fibers for application such as roofing, paneling, food grains, and low cost units.[1] Natural fiber are also replacing the synthetic replacing the synthetic reinforcement for the preparation of the composite. Due to their light weight and easy processing natural fiber are replacing conventional material in many field like in automobile parts as an filler material.[2] Natural fibers have good mechanical properties and also low density material. These natural fibers when undergo chemical modification leads in the changes of acidity and basify which changes the mechanical behavior of the composite. In order to meet the specific need hybrid polymer composite are prepared. Two types of specimen are to be prepared one with polyester with banana fiber and other is kapok with polyester resin. Addition of the fiber in the polyester resin decrease in the moisture absorption of the composite [3]. B Sruthi work on the banana fiber reinforced polyester composite. It observed that the tensile strength of the banana fiber reinforced polyester composite is increased by 90% as compared to virgin polyester. The banana fiber composite exhibits a ductile appearance with minimum plastic deformation. A Chaitanya et al, [5] studied the effect of NaOH on mechanical properties of banana fiber in polyester composite. We found that bending ,mean tensile strength, mean bending strength and mean impact strength of NaOH treated polyester composite is higher than that of the untreated banana fiber. Leonard Y et.al., [6] investigated about a cotton-kapok fabric at a ratio of 2:3, unsaturated polyester resin , 5% sodium hydroxide are used . For fabrication a sample manual layup method is used. A hand operated hydraulic electrically heated press is used. At the end we find that cotton kapok fabric polyester composite can be used for commercial purpose such as school buildings and housing units because of high tensile and flexural properties.

To enhance the rural incomes more research should be done on kapok. N.George et al,[7] analyzed the dynamic mechanical and dielectric behavior of banana-glass hybrid fiber reinforced polyester composite. In this the hybrid composite of glass and banana fiber in a polyester matrix , are subjected to dynamic mechanical analysis over a range of temperature and three different frequencies like storage modulus, loss modulus and loss factor is determined. We found that the hybridization of banana fiber impacts the mechanical properties of the composite. Layering pattern also increases the temperature of the damping. G.Venkata et al.,[2008**]** studied the impact properties of kapok based unsaturated polyester hybrid composites. The highest mechanical properties is at 9% volume of total fabrics loading in kapok/glass and at 5 vol% fabrics loading in kapok/sisal composite which is due to dispersion and load distribution.

II. PROBLEM FORMULATION

After going through the above reviewed literature it is seen that during few recent years natural fibers in polymer matrix are widely used in construction and non construction field as a very useful resources. As, we all know that the Indian economy depends upon on its agriculture as it is an agricultural country. A large amount of different types of crops are produced but their waste products are not used anywhere so they get wasted in large amount. Agricultural waste like wheat, rice, husk, and their straw, hemp fiber and shells of various dry fruits are waste which can used to form fiber reinforced polymer composite which can be used in industrial field. Various methods and techniques are being applied to use renewable sources for preparing composite materials based on polymer and natural resources and their better performance because of its biodegradable nature. The final properties of the composites are studied by the properties of the fiber, properties of the resin and the ratio of fiber to resin in the final composite (fiber volume fraction). The arrangement and direction of the fibers also greatly affects the properties of the composite. .The behavior of the composite depends greatly on the framework, involved in construction of natural fiber reinforced composite such as chemical treatment. Amount of fiber used in matrix techniques involved in mixing of fibers these frameworks are studied by different methods. Through chemical treatments the properties of the fiber surface gets enhanced and also it increases the fiber strength. It minimizes the water absorption of the composite and mechanical properties get improved.

For better construction of materials to be used in different service conditions, two or more fibers are mixed together. Less work has been done on hybridized natural fiber reinforced composite as found from open literature. From all above study it is found that we need to manufacture and study the mechanical properties of hybridized kapok/banana fiber reinforced polyester composites by mixing the fibers with various fiber loading.

III. EXPERIMENTATION PROCEDURE

A. Material used

- Banana fiber

Raw and plain continuous fiber from Go Green Products Kamala Apartment, Alwarthirunagar, Chennai India. It is untreated extracted from banana trunk. Fiber layer are prepared and separated mechanically from banana stalk.

- Kapok fiber

continuous fiber from Go Green Products Kamala Apartment, Alwarthirunagar, Chennai India.

- Polyester

Cheaply available everywhere brought from local shop Arora fabrics ,Amritsar. It is used as base matrix in the composite. Cobalt napthanate is added as an accelerator. It is used as 0.8% 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 Arora Fabrics Amritsar.

B. Surface treatment of fabrics

The kapok 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 characteristics between the fabric/fibre and the matrix. The fibre was then washed thoroughly with water to remove the excess NaOH. Finally, the fibre was washed with distilled water and dried in a hot air oven at 70o C for 1 h. This method was also repeated for banana fibres , soaking the fibre 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 removed 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 80oC 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 2% volume (hybrid composite).

D Mechanical testing

- 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 fibre 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

- 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

- 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.

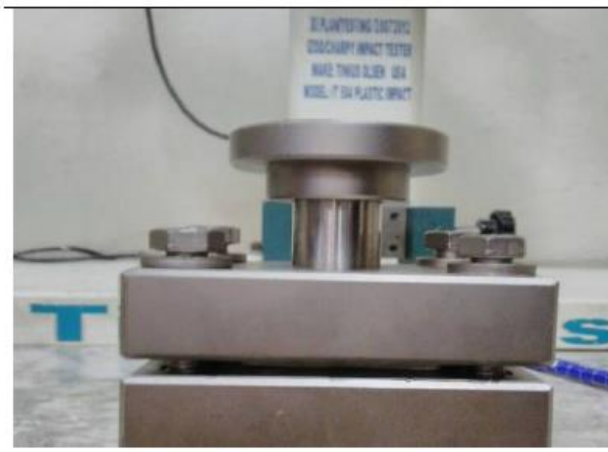

Fig 5: Universal Testing Machine

Fig 6: Shear Test specimen

IV. RESULTS AND DISCUSSION

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

Table 1: Mechanical properties of different samples of banana fiber

SAMPLE NO		Tensile strength (MPa)	Flexural strength (MPa)	Shear strength (MPa)
Banana B 10% R 90%	1	26.88	42.11	33.72
	2	25.42	46.99	33.43
	3	28.90	40.13	33.45
	4	22.59	43.42	32.04
	5	23.67	43.44	35.25
	Avg.	25.49	43.22	33.58

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

Table 2: Mechanical properties of different samples of kapok fiber

SAMPLE NO		Tensile strength (MPa)	Flexural strength (MPa)	Shear strength (MPa)
Kapok K 10% R 90%	1	30.01	35.02	22.95
	2	26.05	28.35	25.01
	3	28.12	44.43	28.30
	4	27.16	28.99	23.38
	5	22.13	28.75	26.77
	Avg.	26.69	33.11	25.28

The comparison of the kapok and the banana in different mechanical properties are shown in table 3.

Table 3: Comparison of mechanical properties of banana and kapok fiber

SAMPLE NO		Tensile strength (MPa)	Flexural strength (MPa)	Shear strength (MPa)
Banana 10%	1	25.49	43.22	33.58
Kapok10%	2	26.69	33.11	25.28

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

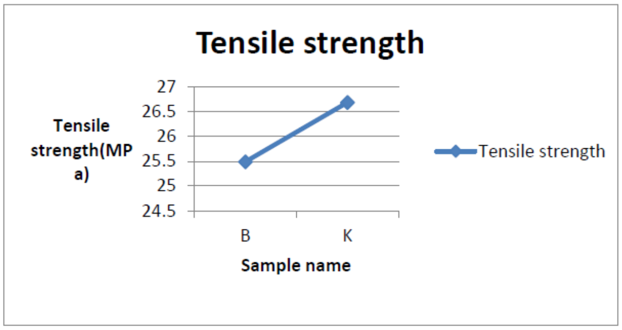

Fig 7: Tensile properties of banana and kapok fibre

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

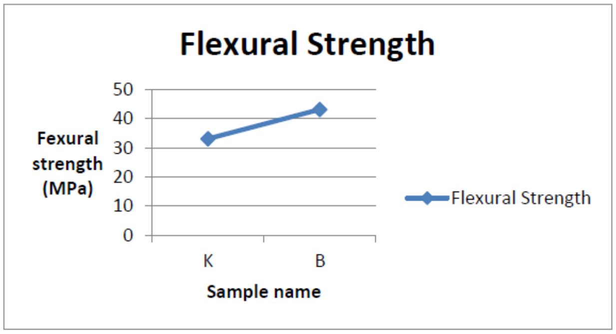

Fig 8: Flexural strength of Banana and kapok fibre

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

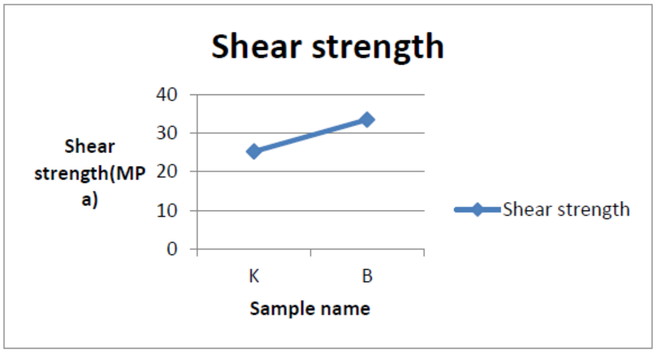

Fig 9: Shear strength of Banana and kapok fibre

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

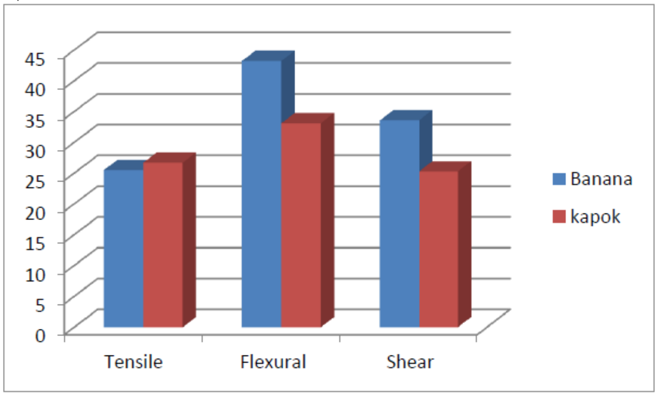

Fig 9: Comparison of mechanical properties of Banana and kapok fiber

V. CONCLUSION

In this work it is concluded that:

- The tensile strength increases in case of the kapok fibre (k 10%, R 90%) as compared to banana fiber (B 10%, R 90%).
- The flexural strength in banana fibre (B 10%, R 90%) is more than kapok fibre (k 10%, R 90%).
- Shear strength also increases in case of banana fibre (B 10%, R 90%) as comparison of kapok fibre (k 10%, R 90%).

References

[1]. M.R..Sanjay, G.R..Arpita, l.luxmana Niak K.Gopalakrishna (2016),"Studies on mechanical properties of banana/E-Glass fabrics reinforced polyester hybrid composites," International Journal of Engineering Research and Application. Vol. 7,pp 3179-3192 .

[2]. Chandramohan, D.and J. Bharanichandar (2013), "Natural fiber Reinforced polymer composites for automobile accessories,"American Journal of Environmental Science, vol. 6,pp.494-504.

[3]. Xue Li, Lope G.Tabil & Satyanarayan Panigrahi (2007)," chemical treatments of natural fiber for use in natural fibre-reinforced composites," journal of polymer environment, pp 15- 25.

[4].Bandi sruthi & Chandbadshah (2015), "Tensile properties of banana fibre polyester composite," International Journal of Emerging Trends in Engineering Research, vol . 3 , pp 489-491

[5]. A.K.Chaitanya, D.Kishore Babu & K.Sumant(2016)," investigation on the mechanical properties of banana fiber reinforced polyester composites,"International Journal of Engineering Research and Application, vol. 6, pp 76-82

[6]. Leonard Y. Mwaikambo, Elias T.N. Bisanda (1999), "The performance of cotton – kapok polyester composites," National Research Council in Engineering and Technology, Vol. 18, pp 181-198

[7]. Laly A.pothan & Chandy N.george (2009),'"Dynamic mechanical and dielectric behavior of banana-glass hybrid fiber reinforced polyester composites '"journal of reinforced plastics and composites, vol.3.

[8]. G.Venkata Reddy,S.Venkata Naidu (2009),"Impact properties of kapok based unsaturated polyester hybrid composites,"Journal of reinforced plastics and composites, Vol.27, pp 1789- 1803.

[9]. Andressa Cecfliua Milanese, Herman Jacobus Cornelis Voorwald (2011) ,"Mechanical behavior of natural fiber composites, Vol. 10, pp 2022-2027

[10] J.Sahari&S.M.Sapuan (2011),"Natural fibre reinforced biodegradable polymer composites, "Institute of Advanced technology, vol.(30), pp 166-174.