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Mechanical Properties of Kevlar Fibre Reinforced With Banana Fibre and Aluminium Mesh using Epoxy Resin

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***Abstract:**Kevlar fibres are para aramid fibres rather than Meta-Aramid structure of Nomex. These fibres have high tensile strength, tensile modulus and heat resistance .Kevlar is about five times lighter than steel in terms of the same tensile strength. In fact, it is the strongest textile fibre available today. It is therefore used in Radial tyres, Conveyor belts, Aircraft parts and mainly used in Ballistics and Frictional products. The aim of this investigation is to increase the mechanical properties of composite material of Kevlar fibre. The Kevlar fibre is reinforced with the banana fibre,which is a Natural Fibre and Aluminium Mesh using Epoxy resin. The Mechanical Properties of Newly formed Composite material using Kevlar Fibre is improved and find its application in a higher position while comparing to the Kevlar Fibre.*

***Keywords :**Kevlar fibre, Banana fibre, Aluminium mesh, epoxy resin, Tensile strength, Impact strength*

I. INTRODUCTION

There is an unabated quest for new materials which will satisfy the specific requirements for various applications like, transportation, electronics, house-hold, construction, structural, industrial, electrical, medical, etc.
In these applications the most commonly used materials are metals. There is unabated thirst for new materials with improved desired properties. Finding a single material with all the desired properties is difficult. For example, a material which needs high fatigue life may not be money effective. The list of the desired properties, depending upon the requirement of the application are, stiffness, high fatigue life, toughness, high wear resistance , high corrosion resistance , strength etc.

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The Kevlar fibre is prepared as composite material using Epoxy resin in the form of required composite plate and it is compared with the same features of the steel material. In this process the prepared Kevlar composite material undergone mechanical tests like Impact test, Bending test, Compressive test and Tensile test. Then obtained test results are compared with the results of the steel. This result showed that the Kevlar fibre is strong enough than the Kevlar fibre and also lighter in weight [1].
A investigation of study has made on Orthogonal Kevlar-PWF-reinforced TPU film. This study explains the notch sensitivity and fracture behaviour of Orthogonal Kevlar. From the experiments, it is concluded if the size of thehole increases, the notch sensitivity of the film increases, but the stress concentration sensitivity of notch is insignificant and there are is a decrease of only about 4%-10% in tensile strength of the notched specimens with different sizes of hold in diameter compared with the UN notched specimen. This study becomes the basis for the design of high altitude ballon[2].
One of the developing composite materials with Kevlar fibre is Boron, which can be used up in creating theirphysical properties and manufacturing costs. Composites are used in aerospace structures, marine structures, automobile and so on. The properties of composites like tensile, flexural and impact as is more complicated when compared to traditional materials. Theses combo shows the high strength and the elastic modulus which replaces the many more weight metals[3].Kevlar 29 is used in manufacturing ballisiticarmour plate using thermosetting resin. From the study it is confirmed that the suitability of the materials and technological process that used to manufacture the armoursensuirng good ballistic performances and showing ballistic limits of about 8% more than those predicted by the analytical model [4]. It is proved that the woven kenaf hybrid composite with Kevlar is 20.78% and 43.55 greater than UD and mat samples respectively. Woven kenaf composites under the Charpy impact strength of being 19.78% and 52.07% higher than UD and matkenaf composites [5].There are two reasons for using the Kevlar fibre – Lightweight and easy to mix. Structural reinforcement or ballistic protection can be obtained by thin blanket, everywhere from seismic shear walls to bank counters. For cutting weight and increase strength, sprayer the fibres into carbon composites.The lightest are Kevlar 49 and 149.Kevlar 29 is similar in potency to glass fibre, but weight [6].

II. MATERIALS USED IN COMPOSITE

A Kevlar Fibre

By combining the para-phenylenediamine and terephthaloyl chloride, Kevlar material can be formed. The result is aromatic polyamide threads.They are further developed, by softening the threads and whirling them into regular fibres. When mixed, Kevlar forms a sturdy and flexible material. The result is 20 times the strength of steel when the layers of the woven Kevlar are mixed with layers of resin. Aromatic polyamide (aramid) threads are the result. Due to the burdens of the production process and the want for high-quality equipment, Kevlar (Figure 1) is expensive.

Fig.1. Kevlar Fibre

B Banana Fibre

Banana plant gives the fruit and fiber called the banana fibre (Figure 2).It grows easily as it sets out young leaves. It is commonly found in hot climates. Banana fibre, also known as musa fibre is one of the world's strongest natural fibres. Biodegradable, the natural fibre is made from the stem of the banana tree and is incredibly durable. The fibre consists of thick-walled cell tissue, bonded together by natural gums and is mainly composed of cellulose, hemicelluloses and lignin. More fibres are available in different varieties of banana plants.It is the strongest fibre which can be obtained easily.

Fig.2. Banana fibre

C Aluminium mesh

Aluminium (Figure 3) is a silvery white reactive metal covered by oxide coating.The metal has high thermal properties and is malleable and ductile. Aluminium and its alloys are usually used for different applications like aircraft assemblies and engine parts. Aluminium meshes is made from 99.6% of grade 1050 Aluminium 14.

Fig.3. Aluminium mesh

D Epoxy Resin

The Epoxy Resin (Figure 4) used in this study isAraldite LY556 and Hardener HY951.

The Importance of these Epoxy Resins is:

- High performance bonding strength.
- Excellent mechanical strength and electrical properties

Fig.4. Epoxy Resin

III. PROCEDURE FOR MAKING COMPOSITE MATERIAL

A mixture is made by Hand Lay-up process. The test pieces of mould should be 4.5mm thickness as per the ASTMD 638-02a stds. After the mould is prepared, 400 grams of LY556 epoxy resin with 200 grams of HY951 hardener is mixed well. The selection of hardener is based on the processing method.400gms of Epoxy resin and 20gms of HY951 hardener is taken in a mixing jar or pot as per the ASTM standards. Safety precautions must be considered While combine the resin as epoxy that is very harmful if it is inhaled.

The mixture must be combined thoroughly so that the resin is constant in every part. Before mixing the mixture, Banana fibres, kevlar 49 type kevlarfibres and aluminium mesh must cut and preserved ready. Two parts of Banana fiber, one number of Aluminium mesh and two parts of Kevlar fibre cloth are used for fabrication (figure 5). They should be act with a dimension of 300x300 mm and as per ASTM 638-02a standards and requirements of 1mm thickness.

Fig.5. Layersof composite material

Fig.6. Fabricated composite plate

Thus, finally obtained composite plate consist of Kevlar fibre Reinforced with banana fibre and Aluminium Mesh using Epoxy Resin. The Dimensions are 300x300mm, 5 mm thickness and 400 gram weight (Figure 6).

IV. RESULTS AND DISCUSSION

A Tensile Test

The test is implemented by applying an axial load or longitudinal load at specific extension rate to standard tensile specimen with cross sectional area, thickness,gauge length,known dimensions.The extension rate and applied load are recorded for stress and strain calculation during the test.A_range of universal standards for such as JIS standard,DIN standard, American Society of Testing and Materials and British Standard. The universal standards we used for this experiment is ASTM. The material specimen is prepared as per the ASTM D638 Standard. The Specimen prepared is shown in figure 7.

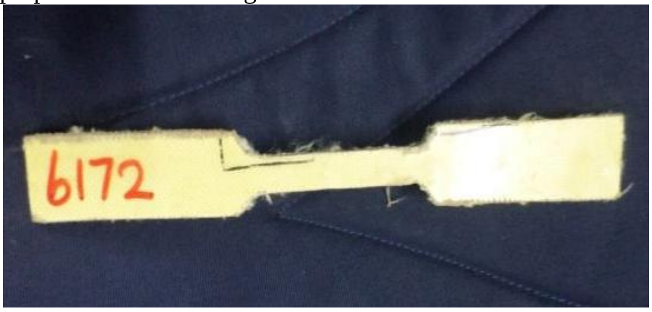

Fig. 7. Specimen prepared for the tensile test

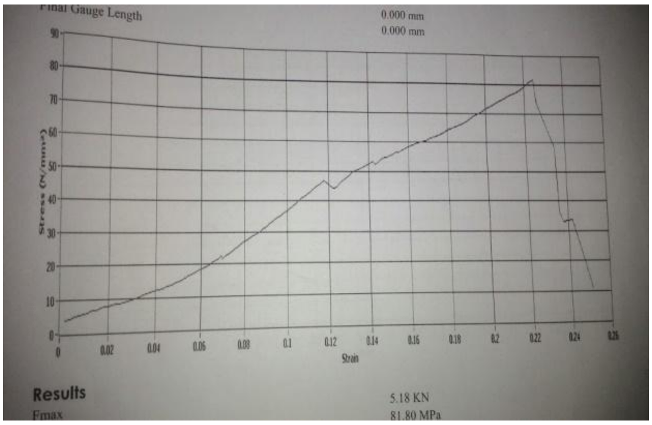

Fig.8.Result of Tensile Test

The Result (Figure 8) obtained from the above experiment are
Maximum Force (F max):5.18 KN
Ultimate Tensile Strength (UTS):81.80 MPa

B Impact Test

This test determine the amount of energy stimulated by a material during fracture.This stimulated energy is a measure of a given materials toughness and acts as a tool of study temperature dependent brittle ductile transition. It helps to check the material weather it is a ductile or brittle in nature. This test is used to find the material behaviour deformation at higher speed. Due to this ,it is considered to be one of the basic mechanical test specially for ferrous metals.Brittle fracture defined as the rate of rapid propagation of cracks. In brittle fracture, no apparent plastic deformation takes place before fracture. Brittle fracture typically involves little energy absorption and at high speed. Materials that do not fail in a ductile manner will fail in a brittle manner. Brittlefractures are characterized as having little or no plastic deformation prior to failure. Materials that show ductile fracture behaviour usually can,under some circumstances behave in a brittle fracture way. As the temperature falls, the yield rises, which is produced by stress. At very low temperatures, fracture occurs before yielding. Impact tests are also used to determine the transition temperature from ductile to brittle behavior.

Fig.9. Specimen before impact test

Fig.10. Specimen after impact test

The ductile and brittle transition curve is plotted for number of tests performed at different temperature. The Specimen is prepared as per the standards ASTM D 256. The prepared specimen is shown in figure 9. The figure 10 shows the specimen after the test.
The impact values in joules of two specimens are 10 and 12 J
Hence the average impact value is 11 J

V CONCLUSION

From different tests conducted, it is found that Composite of Kevlar fibre reinforced with Banana fibre and Aluminium mesh has better mechanical properties. Tensile test and Impact test were performed on the plate.

It can be concluded that the properties of ordinary Kevlar fibre can be improved when the Kevlar fibre is used as a composite material.
. Such that Kevlar fibre reinforced with a Natural Fibre i.e., Banana fibre and Aluminium mesh using epoxy resin shows higher result in Tensile Strength, Impact Strength properties.

Table-I: Comparison with pure Kevlar

TEST	KEVLAR FIBRE	KEVLAR COMPOSITE
Tensile strength	40.3 MPa	81.80 MPa
Impact Strength	7.10 J	11 J

Such that these composite material of Kevlar fibre can be used in Armour Military applications, Hand Gloves that are used to handle Glass and Knifes. This material can also be used in Aerospace and Automobile industry.

REFERENCES

1. Dr.M.AnandaRao, Dr.K.Vijay Kumar Reddy, "Effect of Kevlar Fibre Ly-556 Epoxy Resin on Tensile, Impact, Compressive and Flexural Strength Properties of Fibre Reinforced Plastics", International Journal of Engineering Research and Development, Volume 10, Issue 10 (October 2014), PP.09-13.
2. BaiJiangbo, XiongJunjiang, "Tear Resistance of Orthogonal Kevlar-PWF-reinforced TPU Film"Chinese Journal of Aeronautics 24(2011) 113-118
3. Kai Kin Herbert Yeung and KamineniPitcheswaraRao, "Mechanical Properties of Boron and Kevlar-49 Reinforced Thermosetting Composites and Economic Implications" Journal of Engineering Science, Vol. 10, 19–29, 2014
4. L. Sorrentino, "Ballistic performance evaluation of composite laminates in kevlar 29"Procedia Engineering 88 (2015) 255 – 262.
5. R. Yahaya, "Effect of fibre orientations on the mechanical properties of kenaf–aramid hybrid composites for spall-liner application"Defence Technology 12 (2016) 52–58.
6. Engr. NasrinFerdous, "Kevlar-The Super Tough Fiber", International Journal of Textile Science 2012, 1(6): 78-83.

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