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TENSILE & FLEXURAL CHARACTERIZATION OF EPOXY BASED REINFORCED WITH SUGARCANE TRASH AND KEVLAR PULP FILLER HYBRID POLYMER COMPOSITES

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ABSTRACT

This project work presents the fabrication and tensile & flexural characterization of filler reinforced hybrid composite using sugarcane trash and Kevlar Pulp filler in Epoxy Matrix. The fabrication of composites was done using compression molding technique on different weight fractions of the rainforcement.Specimens were prepared by using 20wt. % sugarcane trash and varying percentage (0%, 3%, 6%, 9%&12%) of Kevlar pulp in the material.Tensile And Flexural Tests had been performed on the developed hybrid composite and have found in the experiment that the percentage elongation and percentage of deflection of the developed hybrid composite decreases with increasing Kevlar weight percentage while there is increase in Tensile Strength, Young's Modulus, Flexural Strength Of the developed hybrid composite with increasing Kevlar weight percentage.

Keyword : UTM,SBS,FS,MMC,CMC,R

I.INTRODUCTION TO HYBRID COMPOSITE

Hybrid composites are more advanced composites as compared to conventional FRP composites. Hybrids can have more than one reinforcing phase and a single matrix phase or single reinforcing phase with multiple matrix phases or multiple reinforcing and multiple matrix phases. They have better flexibility as compared to other fiber reinforced composites. Normally it contains a high modulus fiber with low modulus fiber. The high-modulus fiber provides the stiffness and load bearing qualities, whereas the low-modulus fiber makes the composite more damage tolerant and keeps the material cost low. The mechanical properties of a hybrid composite can be varied bychanging volume ratio and stacking sequence of different plies. Hybrid composites contain more Epoxy is either any of the basic components or the cured end products of epoxy resins, as well as a colloquial name for the epoxide functional group.

II.RAW MATERIAL

A. Epoxy

polymers which contain epoxide groups. Epoxy resins may be reacted (cross-linked) either with themselves through catalytic homopolymerisation, or with a wide range of co-reactants including polyfunctional amines, acids (and acid anhydrides), phenols, alcohols Epoxy resins, also known as polyepoxides, are a class of reactive prepolymersand thiols. These co-reactants are often referred to as hardeners or curatives, and the cross-linking reaction is commonly referred to as curing. Reaction of polyepoxides with themselves or with polyfunctional hardeners forms a thermosetting polymer, often with high mechanical properties, temperature and chemical resistance. Epoxy has a wide range of applications, including metal coatings, use in electronics / electrical components/LED, high tension electrical insulators, paint brushes manufacturing, fiber-reinforced plastic materials and structural adhesives.

B. Epoxy Hardener (Araldite HY 951)

Hardener is used as solvent. Hardeners are substances that are added to polymers for aiding in curing of composites. Hardeners are used to enhance the physical properties of epoxy resins such as adhesion, impact strength and to alter the viscosity of the polymer matrix. It also improves the life, lower exotherm and reduce shrinkage

C.Sugarcane Trash:

Sugarcane Trash can be used as filler material. It is an excellent biomass resource in sugar- producing countries worldwide. The amount of sugarcane trash depends on the plant variety, age of the crop at harvest and soil and weather conditions. Sugarcane Trash can potentially be converted into heat and electrical energy. This trash contains 28.6%- organic carbon, 0.35 to 0.42 % nitrogen, 0.04 to 0.15 % phosphorous, 0.42 to 0.50% potassium. The sugarcane trash incorporation in the soil influences physical, chemical and biological properties of the soil.

Fig.1.Sugarcan Trash

Fig.2.Kevlar Pulp

D. Kevlar Pulp

Kevlar is the registered trademark for a para-aramidsynthetic fiber, related to other aramids such as Nomex and Technora. Developed by Stephanie Kwolek at DuPont in 1965, this high-strength material was first commercially used in the early 1970s as a replacement for steel in racing tires. Typically it is spun into ropes or fabric sheets that can be used as such or as an ingredient in composite material components.Currently, Kevlar has many applications, ranging from bicycle tires and racing sails to body armor, because of its high tensile strength-to-weight ratio; by this measure it is 5 times stronger than steel. It is also used to make modern drumheads that withstand high impact. When used as a woven material, it is suitable for mooring lines and other underwater applications. Kevlar pulp is shown in Figure 2

III.FABRICATION OF COMPOSITE FIBER

Table 4.1 Material Estimation Table for All the Specimens.

Component	Mass Of Epoxy (ingms.)	Mass Of Sugarcane Trash (ingms.)	Mass Of Kevlar Pulp (ingms.)	Mass Of Hardener (ingms.)
C1	47.25	5.67	-	4.73
C2	45.48	5.67	0.43	4.55
C3	43.71	5.67	0.85	4.37
C4	41.93	5.67	1.28	4.19
C5	40.16	5.67	1.70	4.02

A.Preparation Of Composite Specimen

Epoxy mixtures is taken in the bowl and thoroughly mixed and added sugarcane and Kevlar pulp particle in mixture according to volume fraction and then continue mixing till its solidification starts. Gradually poured the mixture in the mould and spread it in the mould thoroughly. The mould was filled to brim and was placed on flat surface. Sharp needle was used for punching to remove the excess bubble. Finally cover the mould with OHP sheet and pressure exerted on it by putting weight. Left the mould to cure for 24 hours under normal atmospheric condition. Finally composite was taken out from mould and stored safely for further test. The Mixing of Epoxy Resin, Sugarcane Trash & Kevlar Pulp is shown in Figure 3.

B. Specification of mould

Length -215mm, Breadth-290, Thickness-4mm And Volume-(215× 290 × 4) =249400mm^3

The drawing of the mould used for the fabrication of hybrid composite is shown in Figure 4

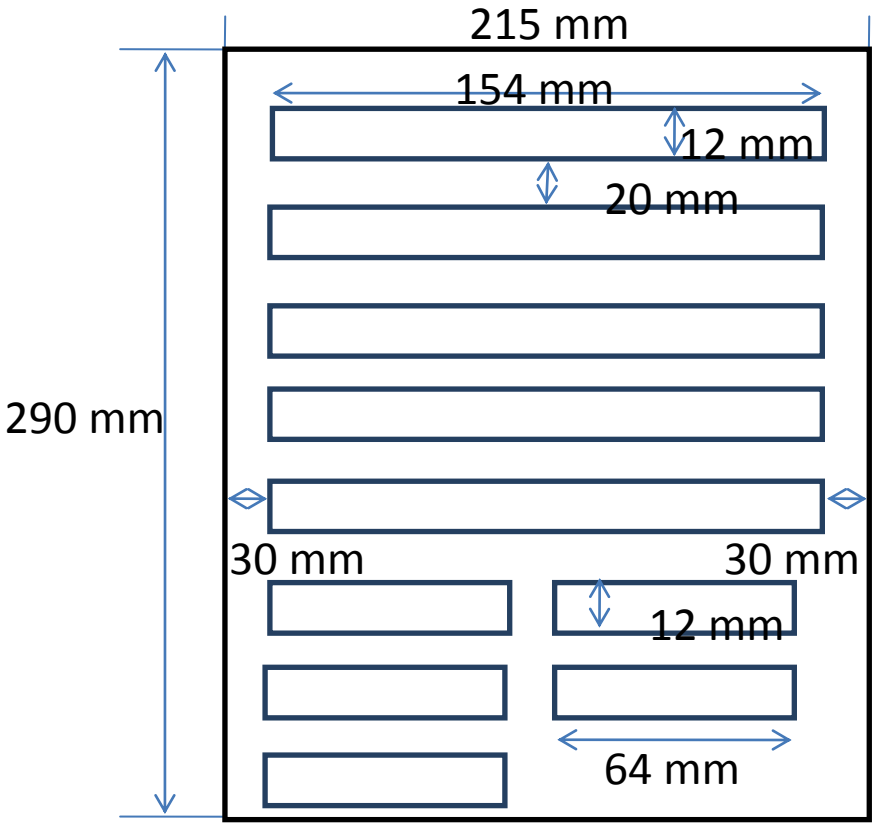

Fig.4 Mould Drawing

IV.EXPERIMENT PROCEDURES

A. Tensile Test

The tensile strength of a material is the maximum amount of tensile stress that it can take before failure. The commonly used specimen for tensile test is the dog-bone-type. During the test a uniaxial load is applied through both the ends of the specimen. The dimension of specimen is 150 × 10 × 4.5 mm^3. Typical points of interest when testing a material include: ultimate tensile strength; offset yield strength which represents a point just beyond the onset of permanent deformation; and the rupture or fracture point where the specimen separates into pieces. The tensile test is performed in the universal testing machine and results are analyzed to calculate the tensile strength of composite.

Standard dimension for testing

150× 10 × 4.5mm^3 (As per ASTM D3039-76)

B.Flexural Test

Flexural strength is defined as a materials ability to resist deformation under load. The short beam shear (SBS) tests are performed on the composites samples to evaluate the value of Flexural Strength. It is a 3- point bend test, which generally promotes failure by inter laminar shear. This test is conducted as per ASTM standard using UTM. The loading arrangement is shown in figure. The dimension of the specimen is $60\times 10 \times 4.5$ mm^3. However, early flexural tests often gave strength values that were considerably lower than the tensile strength. One reason for this was that the loading points in flexural test rigs designed for metals often caused localized damage which initiated premature failures. But even when this defective test procedure was rectified, low-stress failures still occurred. It was then considered that this was because in materials with poor in-plane shear resistance and with compression strengths that were lower than the tensile strengths, it was shear and/or compression damage modes that initiated the premature flexural failures

VI.CONCLUSION

A series of Hybrid composites had been developed by keeping sugarcane Trash weight percentage constant (20 wt. %) and varying Kevlar pulp weight percentage (0%, 3%, 6%, 9%&12%) filler.Tensile test and Flexural Tests were successfully carried as per the ASTM Standard using Universal testing Machine on developed hybrid composite.The test results had been tabulated in Tables as well as Graphical Representation of test results were also shown using appropriate graphs.As Kevlar Pulp weight content % increases the tensile strength, young's modulus & flexural strength of the hybrid composite increases.As Kevlar Pulp weight content % increases the % elongation &% deflection of the hybrid composite decreases.ExpectedMaximum Tensile Strength of 20-25 N/mm^2 , Expected Maximum Young's Modulus of 1025-1030 N/mm^2&Expected Maximum Flexural Strength of 60-65 N/mm^2 were observed in C5 (12 wt.% Kevlar pulp) specimen.

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