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STUDY AND FABRICATION OF BAMBOO-ARAMID HYBRID COMPOSITE MATERIAL

Mr. Amar M*, Mr. Chikkadevegowda S.S
* PG Student, VVIET, Mysuru, Karnataka, India
Associate Professor, Dept. of Mechanical Engineering, VVIET, Mysuru, Karnataka, India

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ABSTRACT

A composite material is a combination of two or more different materials. Composite materials can be used not only for structural applications, but also in various other applications such as automobiles, aerospace, marine, etc. Fibre reinforced plastic materials are widely used in various engineering industries because of their superior performance. The present experimental work aims at studying the mechanical behavior of natural composites and hybrid composites, natural composites which consist of pure natural bamboo fabric reinforced with epoxy resin and hybrid composite which consists of synthetic - Kevlar fiber with natural bamboo fabric reinforced with epoxy resin. They are prepared using hand layup method in which, the stacking of plies is done at 0□ degree orientations. Specimens are developed from the fabricated laminate according to the ASTM standards. To evaluate mechanical properties, tensile, flexural, impact, hardness and specific gravity are carried out. The material is expected to be beneficial with lesser environmental issues.

INTRODUCTION

A composite is combination of two materials in which one of the materials, called the reinforcing phase, is in the form of fibers, particles, & is embedded in the other materials called the matrix phase. The reinforcing material & the matrix material can be metal, polymer. Composites typically have a fiber or particle phase that is stiffer and stronger than the continuous matrix phase and serve as the principal load carrying members. The matrix acts as a load transfer medium between fibers & in less ideal cases where the loads are complex, the matrix may even have to bear loads transverse to the fiber axis. The matrix is more ductile than the fibers and thus acts as a source of composite toughness. The matrix also serves to protect the fibers from environmental damage before, during and after composite processing. When designed properly, the new combined material exhibits better strength than would each individual material. Composites are used not only for their structural properties, but also for electrical, thermal, tribological, and environmental applications. The following are some of the reasons why composites are selected for certain applications:

High quality to weight proportion, High creep resistance, High rigidity at lifted temperature & High strength

Merits of Composites

- Composites enjoy reduced life cycle cost compared to metals.
- 30% - 40% lighter for example any particular aluminium structures designed to the same functional requirements.
- Tensile strength of composites is four to six times greater than that of steel or aluminium
- Improved torsional stiffness and impact properties.
- Higher fatigue endurance limit (up to 60% of ultimate tensile strength).
- Lower embedded energy compared to other structural metallic materials like steel, aluminium etc.
- Composites are less noisy while in operation and provide lower vibration transmission than metals.

Classification of Composites

1.2.1 According to the sort of fortifying material composites can be delegated:
1) Fibrous Composite:
2) Particulate Composites:
1.2.2 According to sort of lattice material they are named:

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1) Metal Matrix Composites (MMC)
2) Ceramic Matrix Composites (CMC)
3) Polymer Matrix Composites (PMC)
   (a)Fiber fortified polymer (FRP)
   (b) Particle strengthened polymer (PRP)

Natural Fiber Reinforced Composites

The interest in natural fiber-reinforced polymer composite materials is rapidly growing both in terms of their industrial applications and fundamental research. They are renewable, cheap, completely or partially recyclable, and biodegradable. Plants, such as flax, cotton, hemp, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, etc., as well as wood, used from time immemorial as a source of lingo-cellulosic fibers and more often applied as the support of composites. Their availability, renewability, low density, and price as well as satisfactory mechanical properties make them an attractive ecological alternative to glass, carbon and man-made fibers used for the manufacturing of composites. The natural fiber composites are more environmentally friendly, and are used in transportation (automobiles, railway coaches, aerospace), military applications, building and construction industries packaging, consumer products, etc

Advantages of Natural Fiber Composites

- Good thermal and acoustic insulating properties
- Reduced wear of tooling, healthier working condition, and no skin irritation.
- Producible with low investment at low cost, which makes the material an interesting product for low wage countries..
- Reduced wear of tooling, healthier working condition, and no skin irritation.

Applications of Natural Fiber Composites

- Furniture: seat, table, shower, shower units, and so forth.
- Electric gadgets: electrical machines, funnels, and so on.
- Everyday applications: lampshades, bags, head protectors, and so forth.
- Transportation: car and railroad mentor inside, vessel, and so forth.

Hybrid Composite

The hybrid composite are composites in which two or more sorts of strands are utilized. On the whole, these are called as cross breeds. The utilization of two or more filaments permits the blend of wanted properties from the strands. For instance, mix of aramid and carbon filaments gives amazing elastic properties of aramid and compressive properties of carbon strands. 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 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 mechanical properties of a hybrid composite can be varied by changing volume ratio and stacking sequence of different plies

LITERATURE REVIEW

Composites are multifunctional material systems that provide characteristics not obtainable from any discrete material. They are cohesive structures made by physically combining two or more compatible materials, different in composition and characteristics and sometimes in form. The weakness of this definition resided in the fact that it allows one to classify among the composites any mixture of materials without indicating either its 4 specificity or the laws which should given it which distinguishes it from other very banal, meaningless mixtures. Unmistakably focuses on that the composites ought not be viewed basic as a mix of two materials. In the more extensive centrality, the mix has its own particular unmistakable properties. Regarding quality to imperviousness to warmth or some other alluring quality. It is superior to anything both of the segments alone or fundamentally not the same as both of them. The paper traces the significant work completed in the field of normal fortifications. The life cycle of the common composites has been contemplated and the normally happening chemicals in different plants accessible in nature and its arrangement. The alluring physical and

mechanical properties that can be acquired with bamboo fiber strengthened composites, for example, high particular modulus, quality and warm soundness, have been very much recorded in the writing.

Bamboo has several advantages such as light weight, high strength, stiffness, biodegradability, and even its roots and leaves keep the soil together and protect it against the sun respectively. The impact of bamboo strands fortification in the epoxy grid on the flexural and compressive properties. These cross breed composites were found to display great flexural and compressive properties. Kevlar fiber-fortified composites have increased much consideration because of their utilization in military, aviation, marine, vehicles, therapeutic and other building commercial enterprises. Epoxy gums are the most well-known networks for superior aramid-fiber composites because of their simple preparing conditions.

Keeping in perspective the aforementioned learning holes, the accompanying targets were decided for the present examination venture work. Fabrication of Natural composite and half and half composite of another class of epoxy based mixture composites fortified with bamboo strands and Kevlar filaments as support and epoxy as grid material by hand lay-up technique. Evaluation of mechanical properties of Natural composite and half and half composites, for example, elasticity, flexural quality, sway quality, hardness particular gravity for these composites. Comparison between Natural composite and hybrid composite.

FABRICATION OF COMPOSITE MATERIALS

Reinforcement Materials

The part of strengthening in composite material to build the mechanical properties. The quality, solidness, and thickness of the composite material is extremely subject to the strengthening material. Reinforcement as a rule includes inflexibility and extraordinarily blocks break proliferation. Meager filaments can have high quality, and gave they are mechanically very much joined to the lattice they can enormously enhance the composite's general properties. The utilization of fortification Fibers can results in the accompanying changes.

- Increase in modulus of flexibility and firmness.
- Lower shrinkage.
- Low temperature reliance of mechanical and physical properties.
- Increase in elastic, compressive and flexural quality & High quality and better effect safe.

KEVLAR FIBER

The high modulus aramid organic fibers were first introduced commercially in the seventies by Du Pont. Initially referred to as Fiber B and PRD-49, these fibers are now produced and sold by Du Pont under the trade name Kevlar. These are synthetic organic fibers consisting of aromatic polyamides. The aramid fibers have excellent fatigue and creep resistance. Although there are several commercial grades of aramid fibers available, the three most common ones used in structural applications are Kevlar 29, Kevlar 49 and Kevlar 149. The normal for Kevlar fiber is its exceptional quality it is an extremely solid fiber has had its greatest effect in the ballistics barrier where it's utilized as a part of impenetrable vests. It is more grounded than fiberglass and five times more grounded than steel on a pound-for-pound correlation. It is particularly intended for use in regions where high-affect resistance is of essential significance, for example, airplane decelerators, security tackles, and where cut and cut resistance is wanted, for example, for ropes, links, and covered fabrics for inflatable's and building fabrics. Kevlar filaments are light weight, high quality and solidness, vibration damping, and imperviousness to harm, exhaustion, and anxiety burst are key properties

Fig 3.1 Kevlar fiber

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Properties Of Kevlar Fiber

High Tensile Strength at Low Weight , Low Elongation to Break , High Modulus, Low Electrical Conductivity, High Chemical Resistance, Low Thermal Shrinkage, High Toughness, Excellent Dimensional Stability, High Cut Resistance, Flame Resistant, Self-Extinguishing, Resistance to effect harm.

Bamboo Fiber

Bamboo fiber is a recovered cellulosic fiber delivered from bamboo through the procedure of hydrolysis - alkalization and multi - stage fading then handled and mash is transformed into bamboo filaments. Dull mash is delivered from bamboo stems and leaves through a procedure of basic hydrolysis and multi-stage fading. Bamboo is considered as extreme green material, since it is a quickly developing plant it can be collected in six weeks, albeit all the more ordinarily in 3-5 years. Bamboo replicates through its broad arrangement of rhizomes all things considered there is a consistent supply of bamboo which meets the meaning of renewable asset, it is a feasible material equipped for managing itself with insignificant effect of the earth.

Rehashed innovative investigation has demonstrated that this sort of fiber has a slimness degree and whiteness degree near ordinary finely blanched gooey and has a Strong strength, security and relentlessness. Bamboo fiber fabric is made of 100% bamboo mash fiber. It is described by its great hygroscopicity, fabulous penetrability, delicate feel, effectiveness to fix and color and mind blowing shading impact of pigmentation.

Fig 3.2 Bamboo fiber

Characteristics of Bamboo Fiber

- Biodegradable, breathable and cool, solid, adaptable, delicate and has a rich gleaming appearance.
- Smooth, Soft and Luxurious Feel.
- Good ingestion capacity, Temperature versatility and Anti-bacterical.
- Strong toughness, dependability and industriousness.
- Product of bamboo fiber is eco-accommodating and bio-degradable.

Matrix Material

The network in a composite is the consistent stage giving uniform burden appropriation to the fortifying constituent(s). The network, notwithstanding ensuring the strengthening constituent(s), shields the composite surface against scraped area, mechanical harm and natural erosion. Uniform burden circulation is because of the presence of legitimate attachment between disparate constituents, the degree of which might be required as insignificant, i.e., for ballistic parts, or maximal as much of the time, contingent upon the application. Lattice choice is performed in view of synthetic, warm, electrical, combustibility, ecological, cost, execution, and assembling necessities.

Epoxy Resin

Epoxy gums are described by their great electrical properties and concoction resistance, great quality and low ingestion of dampness. They are flexible pitches, offering especially great imperviousness to erosion (solvents, salts and a few acids), high quality, and dimensional security and attachment properties. The least complex epoxy gum is set up by the response of bisphenol A (BPA) (80-05 7) with epichlorohydrine (ECH) (106-89-8). The gums are moderately high in thickness, so they are normally shaped at temperatures in the locale of 50-100°C, Curing operators, additionally alluded to as impetuses, hardeners or quickening agents, are utilized, acting either by synergist activity or straightforwardly responding with the tar.

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Properties of epoxy sap:-

- Good bond to most fiber, fillers
- Good electrical properties
- Low shrink amid cure
- Excellent dampness resistance
- Excellent substance resistance

Lapox L-12(Epoxy)

Lapo x L-12 is a fluid, unmodified epoxy gum of medium thickness which can be utilized with different hardeners for making strengthened composite and covers. The decision of hardener relies on the handling technique to be utilized and on the properties required of the cured composite.

Hardene r K-6

Hardener K-6 is a low thickness room temperature curing aliphatic amine curing specialist. It is ordinarily utilized for structural building framework where low thickness and quick setting at encompassing temperature is wanted.

Methodology Of Fabricating Thecomposite Material

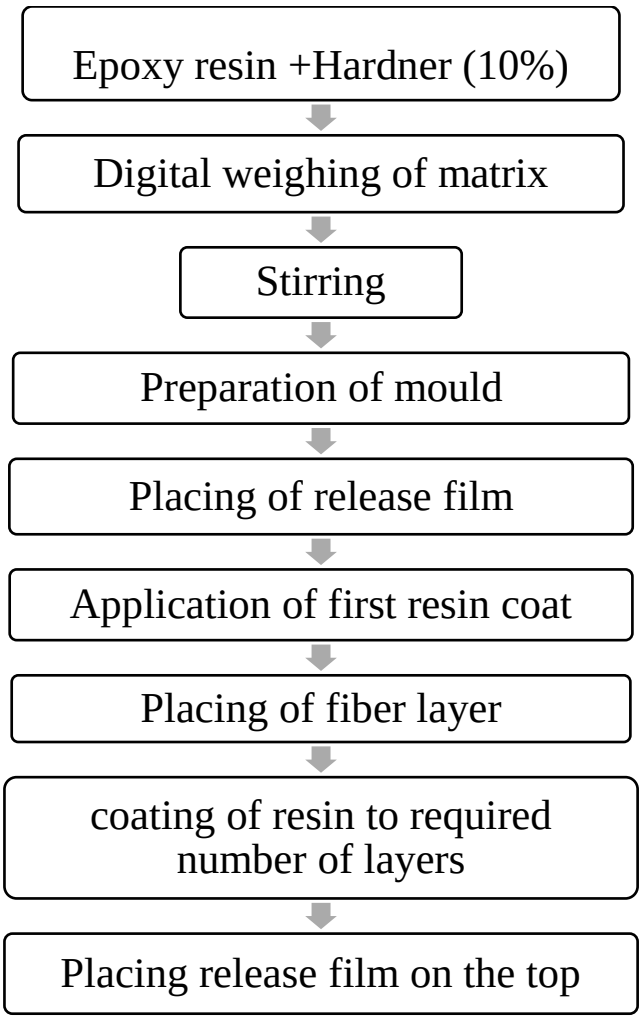

Fig.3.4 Methodology of fabrication of composite

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Hand Lay-Up Method

- The first step of the hand lay-up process is cleaning the surface of the mould, followed by the application of a release agent/film for easy part removal.
- In the second step, a thin gel coating will be applied to the outside surface of the molding, if the surface quality of the product is important. The gel coating resin is applied to the mould by using a hand roller.
- The third step begins when the gel coat is partially set. In this step of the hand lay-up, as the name suggests, resin and fibre forms are manually applied to the open mould as successive layers. Each layer is consolidated by a roller, ensuring that the resin impregnates the fibre and that any air bubbles that are present are removed.
- The fourth step is the curing stage, which is applied in order to harden the part.
- In the fifth and final step, the component is removed from the mould, and is now ready for trimming and other surface finishing processes.

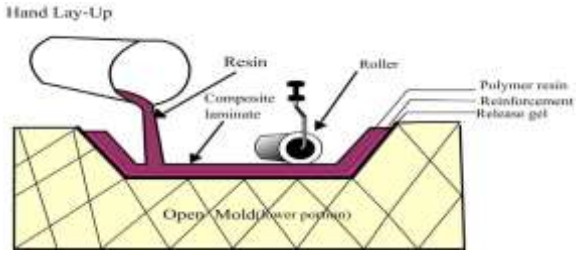


Fig 3.5 Hand lay-up method

Fabrication Procedure Followed

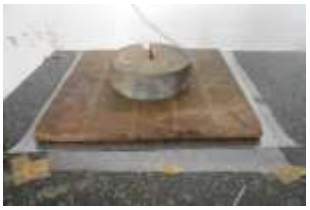
(a) Slab forming the mold

(b) Placing of Release Film on.

(c) Application of first resin coat

(d) Placement of fabric

(e) Placing release film over the lay-up



(f) Curing Stage

(g) Bamboo composite

(h) Bamboo -Kevlar Composite

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FUNDAMENTALS OF MECHANICAL TESTING

TENSILE TEST

The tension test is the most commonly used method to evaluate the mechanical properties of metals. Its main objective is the determination of properties related to the elastic design of machines and structures. Since the test is fully standardized and well established, one may state that it is a rapid way of obtaining the desired mechanical characteristics of materials.Basically, in a tension test a metallic specimen of specified dimensions according to relevant standards is pulled under the action of uniaxial forces applied at both ends until the specimen undergoes fracture.The "gage length" corresponds to the effective length of the specimen over which the elongation occurs. Therefore, the initial length of the specimen is taken to be equal to the gage length Lg

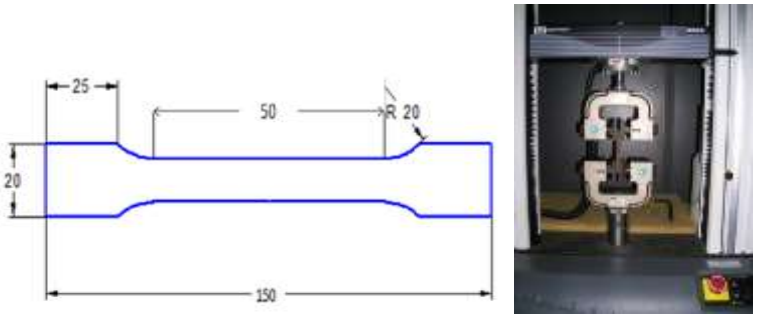

Fig 4.1: Tensile test specimen & Computerized Universal testing machine

Procedure

- Tensile test is led by D-638
- Specimen is sliced by D-638
- Specimen is grasped between the grippers of modernized general testing machine
- Load is gradually connected by disfiguring the example
- Load relating to misshapening is noted down naturally inside the PC
- Graph and elastic properties are likewise created
- Procedure is repeated for various trials

Flexural Test

Flexural quality is characterized as a materials' capacity to oppose disfigurement under burden. The short pillar shear (SBS) tests are performed on the composites tests to assess the estimation of between laminar shear quality (ILSS). It is a 3-point twist test, which for the most part advances disappointment by between laminar shear. This test is led according to ASTM standard utilizing UTM. The flexural quality is communicated as modulus of burst (MR) in psi (MPa). Flexural MR is around 10 to 20 percent of compressive quality relying upon the sort, size and volume of coarse total utilized. However the best relationship for particular materials is gotten by research center tests for given materials and blend plan. The MR dictated by third-point stacking is lower than the MR controlled by focus point stacking, some of the time by as much as 15%. Smooth rectangular examples without indents are for the most part utilized for twist testing under three-point or four-point twist courses of action as separately.

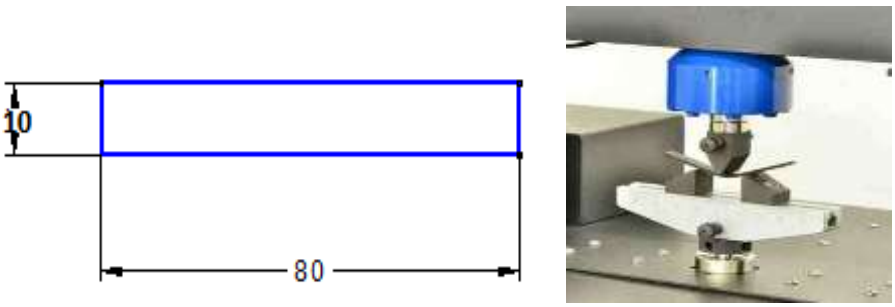

Fig.4.2: Flexural test specimen and Flexural Testing Machine

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Procedure

- Flexural test was directed by D-790
- Specimen is sliced by D-790
- Specimen is put as basically upheld pillar and a focal burden is connected.
- Load is gradually connected by twisting the example
- Load comparing to distortion is noted down consequently inside the PC
- Graph and flexural properties are additionally created Procedure is rehashed for various trials

Impact Test

A metal might be hard (and in this manner exceptionally solid but be unacceptable for applications in which it is subjected to sudden burdens in administration. Materials carry on distinctively when they are stacked all of a sudden than when they are stacked all the more gradually as in ductile testing. In view of this, effect test is thought to be one of the essential mechanical tests (particularly for ferrous metals). The term weak break is utilized to depict quick proliferation of splits with no unnecessary plastic misshapening at an anxiety level underneath the yield anxiety of the material. Metals that show flexible conduct normally can, in specific situations, act in a weak manner. The anxiety expected to bring about yield ascends as the temperature falls. At low temperatures, crack happens before yielding. Sway tests are utilized not likewise to gauge the vitality engrossing limit of the material subjected to sudden stacking; additionally to decide the move temperature from malleable to fragile conduct.

The test comprises of breaking by one blow from a swinging pendulum, under conditions characterized by models, a test piece can be indented or un-scored in the center and bolstered at every end. The vitality consumed is resolved in joules. This consumed vitality is a measure of the effect quality of a material. The test bar, indented/un-scored in the inside, is situated on two backings. The sledge will break the test bar and the assimilated vitality (in Joule) is a sign for the resistance of the material to stun loads.

Procedure

- Impact test is directed by D-256
- Specimen is sliced by D-256
- Potential vitality is kept at greatest quality
- Specimen is altered on the space
- The effect burden is connected, by discharging the pendulum
- When pendulum is discharged, it hits the example put in the spaces
- Load consumed for breakage is noted down
- Procedure is rehashed for various trials

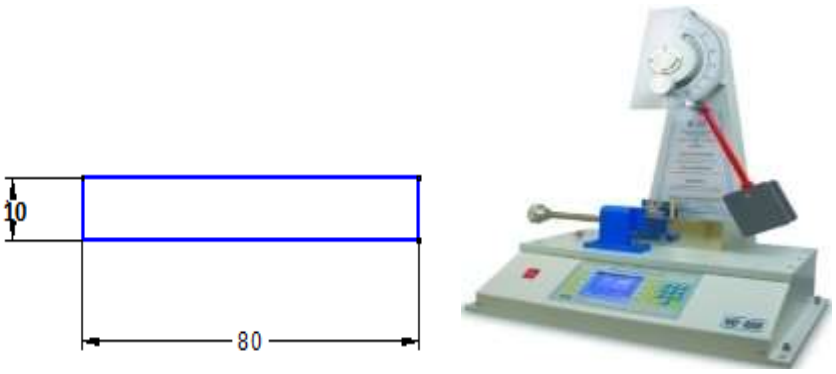

Fig.4.3.1: Impact test specimen and Impact Testing Machine

Hardness Test

Rockwell Hardness Test

Rockwell hardness test is regularly utilized among modern practices on the grounds that the Rockwell testing machine offers a fast and pragmatic operation and can likewise minimize blunders emerging from the

administrator. The profundity of a space decides the hardness values. There are two sorts of indenters, Brale and steel ball indenters. The previous is a round-tip cone with an included point of 120o while the last is a solidified steel ball with their sizes extending from 1.6-12.7 mm. Along these lines distinctive blends of indenters and burdens chose are reasonable for hardness testing of different materials. The Rockwell hardness units are in RA, RB and RC (or HRA, HRB, HRC), contingent upon material's hardness. The connected real loads shift from 60, 100 and 150 kgf, likewise relying upon the Rockwell hardness scale used.

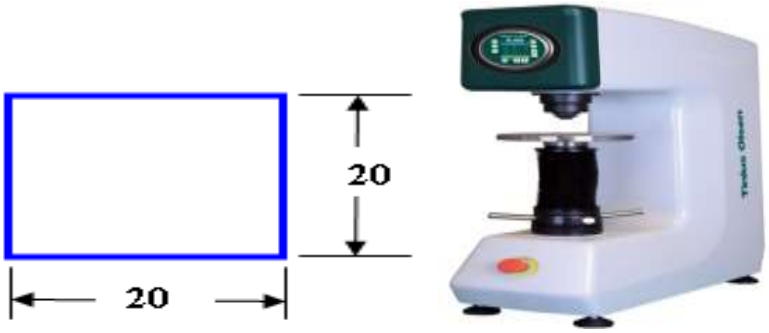

Fig.4.4.1 Hardness test specimen and Rockwell hardness test equipment

Procedure

- Hardness test led by D-785
- Example is set up as indicated by ASTM D-785
- Example is put on blacksmith's iron
- Minor burden is connected
- Real load is connected
- Rockwell hardness numbers is noted down and rehash the method for number of trials

Specific Gravity Test

In spite of the fact that they are frequently treated conversely, weight and mass are distinctive physical properties. Mass (m) is a major measure of the measure of matter. Weight (w) is a measure of the power applied by a mass. On the surface of the earth the transformation variable is the increasing speed of gravity (g = 9.8 m/s²). In this way, an item on earth has a weight identified with its mass by w = mg. Thickness (ρ the greek letter "rho") is characterized as the mass (m) of an item partitioned by the volume (V) of the article. The thickness of a material relies on upon the stage it is in and the temperature. (The thickness of fluids and gasses is exceptionally temperature subordinate.) Water in the fluid state has a thickness (ρw) of around 1 g/cm3 = 1000 kg/m3.w = mg.

The thickness of an item can be utilized to recognize the material of the article, and to foresee its conduct when set in a liquid, either fluid or gas. On the off chance that the thickness of an item is more prominent than the liquid it will sink, and on the off chance that it is not exactly the thickness of the liquid it will rise. Water is the most generally utilized liquid to look at material for thickness estimation. The particular gravity (SG) is the proportion of a material's thickness contrasted with water, SG = ρ/ρw. The official particular gravity is characterized utilizing water at 4°C. Since it is the proportion of two densities with the same units (g/cm3), it has no units itself. Note that since water has a thickness of 1 g/cm3, the particular gravity is the same as the thickness of the material measured in g/cm3.

At the point when an item is in a liquid there is light constrain following up on the article because of the weight of the liquid. The light compel is equivalent to ρwgV where g is the increasing speed of gravity and V is the volume of the item in the fluid. Since ρwV is equivalent to the mass of the water uprooted by the item, this amount is additionally precisely equivalent to the heaviness of the water. This is known as the lightness (or Archimedes) guideline: the light compel on a body drenched in a liquid is equivalent to the heaviness of the liquid uprooted by the item.

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Global Journal of Engineering Science and Research Management

The thickness for composite material is controlled by measuring the example in air and after that measuring it while suspended on a wire and inundated in water, and afterward taking note of down the distinction in water. In the event that the example is prone to have the thickness lower than that of water, a sinker is joined to the wire to encourage inundation.

The thickness ρ is acquired from
$\rho=(0.9975)a/(a+w-b)$
Where, a - Weight of the example in air
b – Total weight of the example and sinker (if utilized) in water
w – Weight of submerged sinker if utilized and in part drenched wire

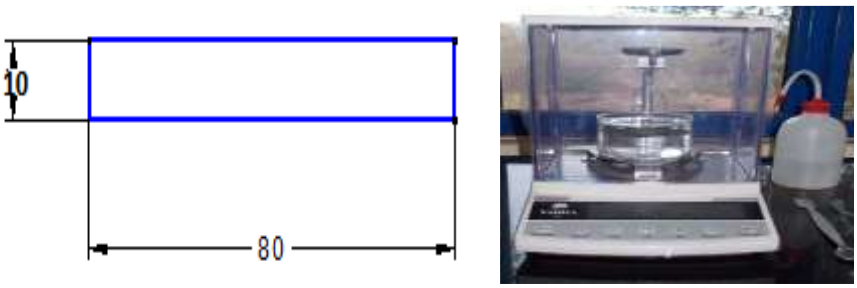

Fig.4.5: Specific gravity test specimen and Specific gravity Testing Machine

Procedure

- Specific gravity test directed by D-792
- Specimen is set up as indicated by ASTM D-792
- Specimen is said something air
- Then the example is drenched in refined water and it is weighed
- Finally the particular gravity is ascertained naturally by the analyzer
- The quality is noted down and the technique is rehashed

RESULTS AND DISCUSSION

Tensile Test

Tensile testing is a central mechanical testing strategy in which a specimen is subjected to uniaxial pressure until disappointment. The outcomes from the test are normally used to choose a material for an application, for quality control, and to anticipate how a material will respond under different sorts of strengths. Properties, for example, extreme elasticity, Young's modulus, and greatest burden can be resolved. In this test example is stacked in an exceptionally controlled way. Examples are set up according to ASTM D638 standard. The automated general testing machine is utilized for testing with higher exactness, the greatest limit of machine 20 KN is utilized for testing, which worked on electronic control servo system. Speed rate is 5mm/min; the example is settled between lower crosshead and middle cross head.

Material	*Maximum Load in KN*	*Ultimate Tensile Stress in Mpa*	*Young's Modulus in Mpa*
Hybrid	*5.67910437*	*62.2708812*	*3679.255559*
Natural	*3.277009077*	*37.84949269*	*2458.316507*

Table 5.1: Tensile test result of Hybrid and Natural composite

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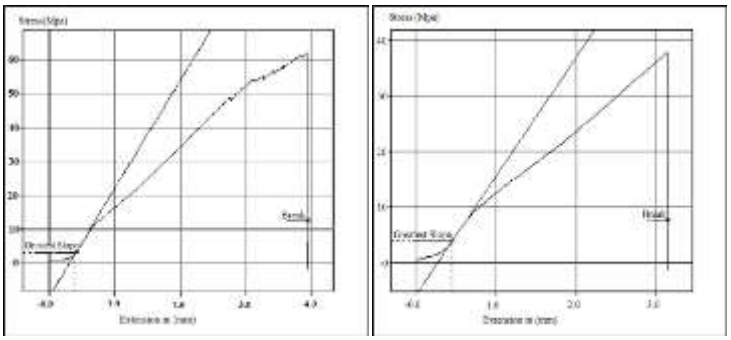

Fig 5.1: (a) Hybrid Composite Fig 5.1: (b) Natural Composite

As saw from the table's and the above bends maxmium load for mixture composite is high contrasted with regular composite so it can oppose a high limit contrasted with common composite, elasticity is most extreme for half breed composite. The rigidity of cross breed composite strengthened with epoxy sap is 62.27(MPa) as appeared in the figure. The rigidity of the half and half composite is impacted by the quality and modulus of the Kevlar filaments. The expansion in the elasticity and modulus of half breed composite is expected to the Kevlar filaments are more grounded, stiffer and have high rigidity than the bamboo strands. So extreme elasticity for common composite is low contrasted with half and half composite. Youthful's modulus is high in hybrid composite contrasted with normal composite due the Kevlar fiber have high solidness.

Comparison of ultimate tensile stress and young's modulus for Hybrid Epoxy & Natural Epoxy Composite

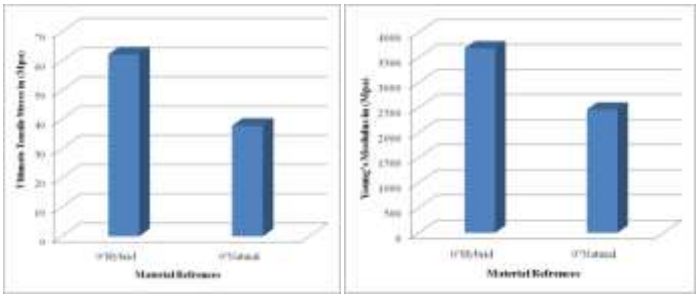

Fig 5.1.1 Comparison of ultimate tensile stress and young's modulus

The fig 5.1.1 demonstrates the examination of extreme elastic anxiety of cross breed composite fortified with epoxy sap and common composite strengthened with epoxy tar. A definitive malleable anxiety is greatest for half and half composite since it can with stand the most extreme anxiety under the heap contrasted with common composite. The fig 5.3 demonstrates the correlation of youthful's modulus half breed composite and common composite fortified with epoxy tar. The youthful's modulus is greatest for mixture composite due its have high firmness contrasted with regular composite.

Flexural Test

The flexural testing is done by three-point twisting course of action in which the test is essentially bolstered near its closures and halfway stacked. Properties, for example, Maximum. Flexural quality, Young's modulus, and most extreme burden can be resolved. In this test example is stacked in an extremely controlled way. Examples are set up according to ASTM D790 standard. The test is led by utilizing Computerized Universal testing machine. In this test there is no inclusion with end-tabs, or (typically) changes fit as a fiddle, tests being led on essentially bolstered light emissions crosssectional zone. The example is stacked in three point bowing with a suggested range of 1.6 mm. The test is directed on the machine, by applying the velocity of stacking 1.3mm/sec is connected amid the testing.

Material	*Maximum Load in N*	*Ultimate Flexural Stress in (Gpa)*	*Young's Modulus in(Gpa)*
0 °Hybrid	*491.8153628*	*3.619127964*	*0.179874001*
0 °Natural	*360.6373675*	*2.414019188*	*0.093341488*

Table 5.2 Flexural test result of Hybrid and Natural composite

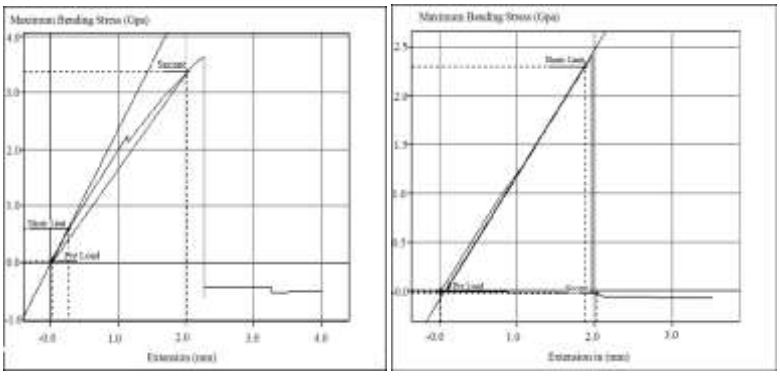

Fig 5.2(a) Hybrid CompositeFig 5.2(b) Natural Composite

From the above tables and curvess, for cross breed composite and regular composite fortified with epoxy tar, crossover composite indicating more imperviousness to flexural load by withstanding 491.81 N as limit before disappointment. The flexural stress got for cross breed and common composite fortified with epoxy gum 3.61919(GPa) and 2.4140 (GPa) thusly flexural anxiety is high in crossover composite, so bowing quality is high contrasted with characteristic composite. The Young's Modulus got for half and half and characteristic composite fortified with epoxy pitch 0.1798 (GPa) and 0.0933 (GPa) thusly youthful modulus is high in cross breed composite.

Comparison of Flexural Strength for Hybrid Epoxy & Natural Epoxy Composite

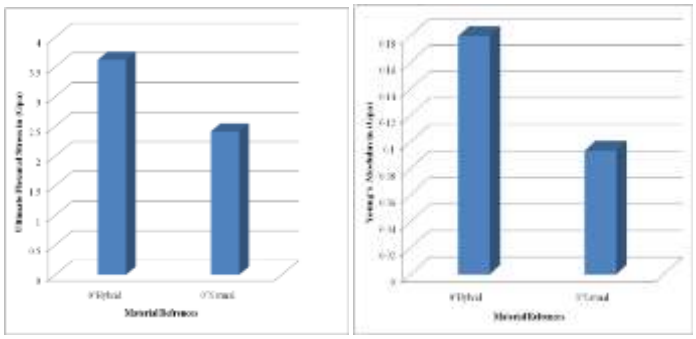

Fig 5.2.1: Comparison of ultimate flexural stress and young's modulus

The fig 5.2.1 demonstrates the correlation of extreme flexural anxiety of half and half composite fortified with epoxy tar and regular composite strengthened with epoxy pitch. A definitive elastic anxiety is greatest for cross breed composite since it can with stand the most extreme twisting anxiety under the heap contrasted with characteristic composite. The fig 5.5 demonstrates the correlation of youthful's modulus cross breed composite and characteristic composite fortified with epoxy pitch. The youthful's modulus is most extreme for mixture composite due its have high bowing modulus contrasted with common composite.

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Impact Test

The effect testing is a mechanical testing technique in which a specimen is subjected to sudden effect stacking. Properties, for example, vitality retained, sway quality and most extreme burden can be resolved. In this test, example is acquainted with effect stacking by utilizing a Pendulum sway analyzer. Examples are set up according to ASTM D256 standard.

SAMPLE REF	*Charpy Impact Strength (kj/m²)*
0° HYBRID	*14.67*
0° NATURAL	*4.73*

Table 5.3 Impact test result of Hybrid and Natural composite

From the above table, the Impact quality of half and half composite strengthened with epoxy tar 14.67kJ/m2. The Impact quality of cross breed overlay made of Kevlar and bamboo, so charpy sway quality is low for common composite fortified with epoxy gum.

Comparison of Charpy Impact Strength for Hybrid Epoxy & Natural Epoxy Composite

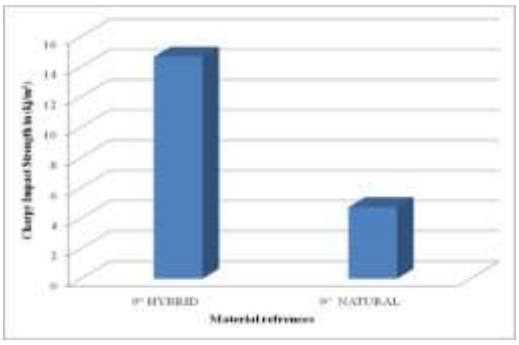

Fig 5.3.1: Comparison of Impact strength

The fig 5.3.1 demonstrates the examination of Charpy Impact quality for characteristic and half and half composite fortified with epoxy sap. Charpy Impact quality is most extreme for crossover composite

Hardness Test

The hardness testing is done to give a speedy appraisal and the outcome can be utilized as a decent pointer for material choices. Examples are set up according to ASTM D785 standard. The test is led by utilizing Rockwell hardness analyzer.

SAMPLE REF	*Rockwell Hardness*
0° HYBRID	*80*
0° NATURAL	*74*

Table 5.4 Hardness test result of Hybrid and Natural composite

From the above table, the RHN of hybrid composite reinforced with epoxy resin is 80, is found to be greater than the natural composite reinforced with epoxy resin.

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Comparison of Rockwell Hardness Number for Hybrid Epoxy & Natural Epoxy Composite

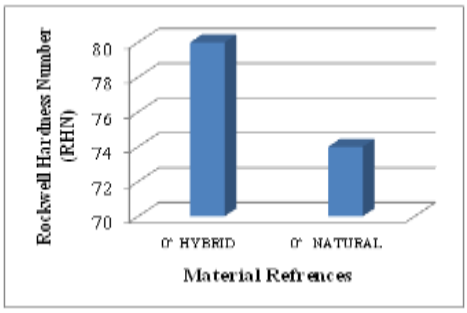

Fig 5.4.1: Comparison of Hardness strength

The fig demonstrates the examination of Rockwell Hardness Number for regular and cross breed composite fortified with epoxy tar. The particular gravity is most extreme for mixture composite.

Specific Gravity Test

The specific gravity testing is extremely valuable in deciding yield and contrasting diverse materials. specific Gravity implies the proportion of the mass of an example to that of an equivalent volume of a standard substance. Examples are set up according to ASTM D792 standard. The test is led by utilizing advanced thickness analyzer.

SAMPLE REF	*DENSITY*
0° HYBRID	*1.178*
0° NATURAL	*1.172*

Table 5.5 Specific Gravity test result of Hybrid and Natural composite

From the above table, the particular gravity of hybrid composite fortified with epoxy sap is 1.178 is observed to be more noteworthy than the normal composite strengthened with epoxy pitch

Comparison of Specific gravity for Hybrid Epoxy & Natural Epoxy Composite

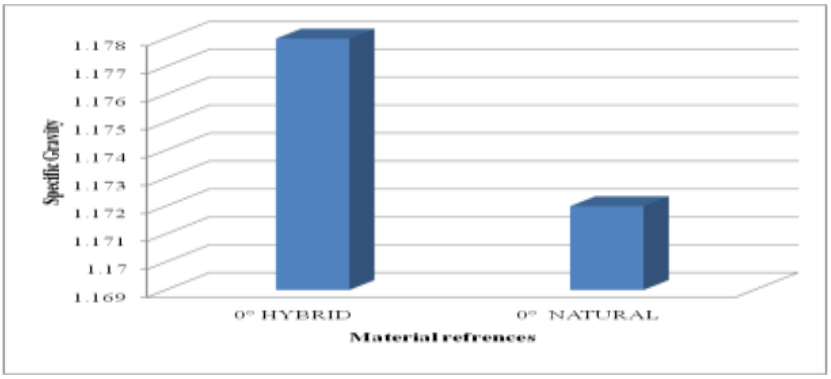

Fig 5.6 Comparison of specific gravity

The fig 5.5.1 demonstrates the examination of specific gravity of material for regular and hybrid composite fortified with epoxy sap. The particular gravity is most extreme for hybrid composite.

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CONCLUSION

The work demonstrates that effective manufacture of a mixture and common composite. Hybrid composite is produced by mix of engineered filaments of Kevlar fiber and natural fiber of bamboo reinforced with epoxy tar, Natural composite is created by blend of bamboo strands strengthened with epoxy gum by basic hand layup system. Mechanical properties like tensile, flexural, effect, hardness and particular gravity have been tentatively directed according to the ASTM standard and results are examined. From the outcomes it can be seen that all mechanical properties of half breed composite is high contrasted with normal composite due to the affected by Kevlar fiber since it conveyed a greatest burden than the characteristic composite. Kevlar fiber as a synthetic fiber in hybrid composite demonstrates the upgrade in mechanical properties - ductile, flexural, effect, hardness and specific gravity in light of the fact that Kevlar fiber have a high quality and firmness than the bamboo filaments. General pressure between the properties of cross breed and normal composite it can be seen that two manufactured filaments handles on both sides of the composite material so it can oppose the greatest load and give the great mechanical properties.

FUTURE WORK

- Fabrication of composite in various introductions like 30° and 45°to comprehend the heap conveying in strands.
- Composite material is uncovered in ocean water to comprehend the warm properties or thermal properties.
- Study the Cryogenic treatment process where the material is cooled to low temperatures. By utilizing fluid nitrogen, the temperature can go as low as 190°C.

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