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TRIBO MECHANICAL BEHAVIOUR OF HYBRID NATURAL FIBER (SISAL-BANANA) COMPOSITES

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Abstract Natural fibers can take a significant role within the rising "green" economy supported energy potency, the utilization of renewable materials in compound product, industrial processes that cut back carbon emissions and utile materials that minimize waste. the utilization of composite materials field is increasing bit by bit in engineering. The composite consists of primarily 2 phases i.e. matrix and fiber. The accessibility of characteristic fiber and ease of aggregation have enticed scientists worldwide to aim by regional standards accessible cheap fiber and to learning their attainableness of fortification determinations and to what degree they fulfill the obligated particulars of nice reinforced compound composite aimed toward structural requisition. Fiber strengthened compound composites has varied preferences, as an example, usually negligible effort of creation, straightforward to form associate degrees higher quality distinction than good compound tars due with this reason fiber reinforced compound composite used inside an assortment of provision as category of structure material. natural fibre strengthened compound composite includes immense affinity to interchange the composite created of fibre. this is often primarily as a result of the benefits like lightweight weight, non-toxic, non-abrasive, straightforward accessibility, low cost, and perishable properties. In this paper, take a look at square measure conducted for material constitutes banana and fewer discovered sisal.These composites square measure adhered victimisation rosin |epoxy |epoxy glue|synthetic resin} consists of resin and hardener befittingly mixed in acceptable volume. Here for making ready samples Hand lay-up technique and serration is employed, specimens square measure ready and conjointly the take a look at like the tensile take a look at, hardness takes a look at and also the impact takes a look at square measure disbursed and also the mechanical properties of the material square measure studied

Keywords: Composite, Matrix, Natural Fiber, Sisal, Banana, Epoxy Resin, Hand layup, Serration, Mechanical Testings.

I. INTRODUCTION

Progress within the field of materials science and technology has born to fascinating and marvellous materials referred to as composites, that area unit one in all the foremost advanced and flexible engineering materials. Composites area unit heterogeneous in nature, created by the assembly of 2 or a lot of elements with fillers or reinforcing fibers and a compactable matrix.Composite material area unit exchange ancient materials, attributable to their superior properties, like high strength-to-weight quantitative relation, high mechanical strength and minimum thermal enlargement. the event of latest materials is on the anvil, and therefore the variety is growing day by day. natural fibre bolstered compound composites became a lot of engaging because of their high specific strength, light-weight, biodegradability, and atmosphere friendliness. natural fibre mixed with artificial fiber-reinforced compound composites area unit finding magnified applications. during this experimental study, sisal–banana fiber bolstered hybrid composites area unit developed and their mechanical properties, like strength, hardness strength, and impact strength area unit evaluated.

A. COMPOSITE MATERIALS:

A stuff may be outlined as a mix of 2 or additional materials that ends up in higher properties than those of the individual parts used alone. In distinction to aluminous alloys, every material retains its separate chemical, physical and mechanical properties.The reinforcing section of the composites provides the strength and stiffness, to create them more durable, stronger and stiffer than the matrix. The reinforcement is sometimes within the sort of a fiber or a particulate. The length-to-diameter magnitude relation is thought because the ratio, and might vary greatly for fibers as a result of the length of the fiber is way

larger than its diameter. Continuous fibers have high facet ratios, whereas discontinuous fibers have low facet ratios, and therefore the orientation of continuous fiber composites ordinarily is ideal, whereas discontinuous fibers usually have a random orientation. Continuous fiber composites area unit typically created into laminates by stacking single sheets of fibers in several orientations to get the required strength and stiffness properties with fiber volume as high as sixty to seventieth. In general, the smaller the diameter of the fiber, the upper its strength, however the value will increase once the diameter becomes smaller. additionally, smaller diameter fibers have larger flexibility, and area unit additional amenable to fabrication processes like weaving or forming, across the radius.The continuous section is that the matrix, that could be a compound, metal or ceramic. Polymers have low strength and stiffness, metals have intermediate strength and stiffness however high plasticity, and ceramics have high strength and stiffness however area unit brittle. Discontinuous fiber composites area unit ordinarily random in alignment that drastically reduces their strength and modulus. However, these composites area unit usually a lot of less costly than continuous fiber composites. Therefore, continuous fiber composites area unit used wherever higher strength and stiffness area unit needed even at a better value, and discontinuous fiber composites area unit used wherever value is that the main driver and strength and stiffness area unit lower.

II. CLASSIFICATION OF COMPOSITES

According to the type of reinforcing material composites can be classified as:

A.FIBROUS COMPOSITE:

A fiber is characterised by its length being abundant larger compared to its cross-sectional dimensions. the scale of the reinforcement verifies its capability of contributory its properties to the composite. Fibers are terribly effective in up the fracture resistance of the matrix since a reinforcement having an extended dimension discourages the expansion of early cracks traditional to the reinforcement that may otherwise cause failure, significantly with brittle matrices. semisynthetic filaments or fibers of non-chemical compound materials exhibit abundant higher strength on their length since massive flaws, which can be gift within the bulk material, ar decreased as a result of the little cross-sectionaldimensions of the fiber. In the case of polymeric materials, orientation of the molecular structure is responsible for high strength and stiffness.

B. PARTICULATE COMPOSITES:

In particulate composites the reinforcement is of particle nature. it's going to be spherical, cubic, tetragonal, a platelet, or of alternative regular or irregular form. In general, particles aren't terribly effective in up fracture resistance however they enhance the stiffness of the composite to a restricted extent. Particle fillers are wide wont to improve the properties of matrix materials like to change the thermal and electrical conductivities, improve performance at elevated temperatures, cut back friction, increase wear and abrasion resistance, improve machinability, increase surface hardness and cut back shrinkage.

C. COMPOSITE MATRIX MATERIAL:

A fiber-reinforced composite (FRC) is a high-performance composite material made up of three components - the fibers as the discontinuous or dispersed phase, the matrix acts as the continuous phase, and the fine interphase region or the interface.

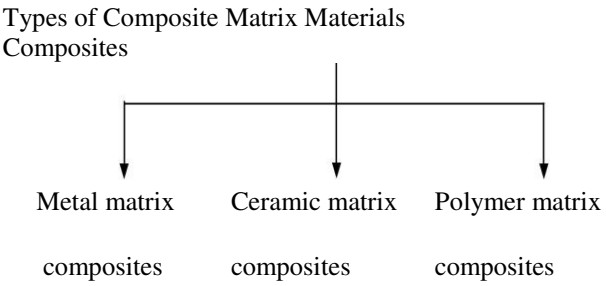


FIGURE 1. TYPES OF COMPOSITES

Metal matrix - Metal matrix composites (MMCs) square measure composite materials that contain a minimum of 2 constituent elements – a metal and another material or a special metal. The metal matrix is bolstered with the opposite material to enhance strength and wear. wherever 3 or a lot of constituent elements square measure gift, it's known as a hybrid composite. In structural applications, the matrix is typically composed of a lighter metal like metal, titanium, or Al. In warmth applications, Co and cobalt-nickel alloy matrices square measure common. Typical MMC's producing is largely divided into 3 types: solid, liquid, and vapor. Continuous carbon, carbide, or ceramic fibers square measure a number of the materials that may be embedded during a argentiferous matrix material. MMCs square measure fireplace resistant, operate during a big selection of temperatures, don't absorb wet, and possess higher electrical and thermal physical phenomenon. they need conjointly found applications to be immune to radiationinjury, and to not suffer from out gassing. Most metals and alloys keep matrices for composite applications.
Ceramic matrix - Ceramic matrix composites (CMCs) square measure a subgroup of composite materials. They accommodateceramic fibers embedded in an exceedingly ceramic matrix, therefore forming a ceramic fiber strengthened ceramic (CFRC) material. The matrix and fibers will accommodateany ceramic material. CMC materials were designed to beat the most important disadvantages like low fracture toughness, crispness, and restricted thermal shock resistance, baby-faced by the standard technical ceramics.

Polymer matrix- Polymer matrix composites (PMCs) is divided into 3 sub-types, namely, thermoset, thermoplastic, and rubber. compound could be a giant molecule composed of continuation structural units connected by valence chemical bonds. PMC's encompass a compound matrix combined with a fibrous reinforcing dispersed particles. they're cheaper with easier fabrication ways. PMC's area unit less dense than metals or

ceramics, will resist region and different varieties of corrosion, and exhibit superior resistance to the conductivity of electrical current. Two varieties of compound composites are:

(a) Fiber strengthened compound (FRP)
(b) Particle strengthened compound (PRP)

(a)Fiber Reinforced Polymer:
Common fiber strengthened composites square measure composed of fibers and a matrix. Fibers square measure the reinforcement and therefore the main supply of strength whereas matrix glues all the fibers along in form and transfers stresses between the reinforcing fibers. Sometimes, filler may be another to swish the producing method, impact special properties to the composites, and / or cut back the merchandise value.

(b)Particle Reinforced Polymer:
Particles used for reinforcing embody ceramics and glasses like tiny mineral particles, metal particles like Al and amorphous materials, as well as polymers and soot. Particles ar accustomed increase the modules of the matrix and to decrease the malleability of the matrix.

D. COMPOSITE MATRIX MATERIAL APPLICATION:

The following square measure common applications of composite matrix materials:

- Electrical moldings
- Decorative laminates
- High performance kitchen utensil
- Sealants and gaskets
- Heat protect systems (capable of handling high temperatures, thermal shock conditions and significant vibration)
- Components for high-temperature gas turbines like combustion chambers, stator coil vanes and rotary engine blades
- Brake disks and brake elements employed in extreme thermal shock environments
- Components for slide bearings below significant hundreds requiring high corrosion and wear resistance
- Carbide drills square measure made up of a tricky metallic element matrix with onerous W inorganic compound particles within
- Components for burners, flame holders, and hot gas ducts.

E.ADVANTAGES OF COMPOSITE MATERIALS:

- Low density and high specific strength and stiffness.
- Fibers area unit a natural resource, that production needs very little energy, involves greenhouse emission absorption, while returning atomic number 8 to the setting
- Fibers are often made at lower price than fiber
- Low hazard producing Processes.
- Low emission of hepatotoxic fumes once subjected to heat and through combustion at finish of life
- Less abrasive harm to process instrumentation compared therewith for fiber composites

III.NATURAL FIBERS PREPARATION

The natural fibers like Sisal and banana were extracted by the decorticating method. Here continuous fiber is employed for fabricate the fiber composites. initial the natural fibers are cleansed within the H2O. The cleansed natural fibers are dried within the sun lightweight. The dried natural fibers are once more cleansed by chemical cleanup method. In chemical cleanup method the eightieth hydroxide (NaOH) is mixed with two hundredth H2O. The dried natural fibers lordotic within the diluted hydroxide resolution that it cleans from muddy particles and that we get the graceful fibers. it's once more dried in sun lightweight.The dried natural fibers are cut within the length of various size by manually. The cut natural fibers are utilized in fabricate the natural fibers strengthened epoxy stuff.

A. NATURAL FIBER REINFORCED COMPOSITES:

It will be used as part of CM. they will even be matted into sheets to create product like paper or felt. Fibers area unit of 2 types: fibre and manmade or fiber.

B. CLASSIFICATION OF NATURAL FIBER:
Natural fibers are greatly elongated substances produced by plants and animals that can be spun into filaments, threador rope. Woven, knitted, matted or guaranteed, they kind materials that are essential to society.Like agriculture, textiles are elementary a part of human life since the dawn of civilization. Fragments of cotton articles dated from 5000 BC are excavated in Mexico and Asian nation. in keeping with Chinese tradition, the history of silk begins within the twenty seventh century BC. The oldest wool textile, found in Denmark, dates from 1500 BC, and also the oldest wool carpet, from geographical region, from five hundred BC. Fibers like jute and fibre are cultivated since antiquity. whereas the strategies wont to build materials have modified greatly since then, their functions have modified terribly little: nowadays, most natural fibers are still wont to build article of clothing and containers and to insulate, soften and enhance our living areas. progressively, however, ancient textiles are being employed for industrial functions further as in parts of composite materials, in medical implants, and geo- and agro-textiles.In this section we have a tendency to gift profiles of fifteen of the world's major plant and animal fibers. they vary from cotton, that dominates world fiber production, to other, specialty fibers like cashmere that, although made in so much smaller quantities, have explicit properties that place them within the luxury textiles market.
Plant fibers:

Plant fibers include seed hairs, such as cotton; stem (or bast) fibers, such as flax and hemp; leaf fibers, such as sisal; and fruit fibers, such as banana coconut.

C. APPLICATIONS OF NATURAL FIBERS:

- Storage devices: post-boxes, grain storage silos, bio-gas containers, etc.
- Furniture: chair, table, shower, bath units, etc.
- Electric devices: electrical appliances, pipes, etc.
- Everyday applications: lampshades, suitcases, helmets, etc,

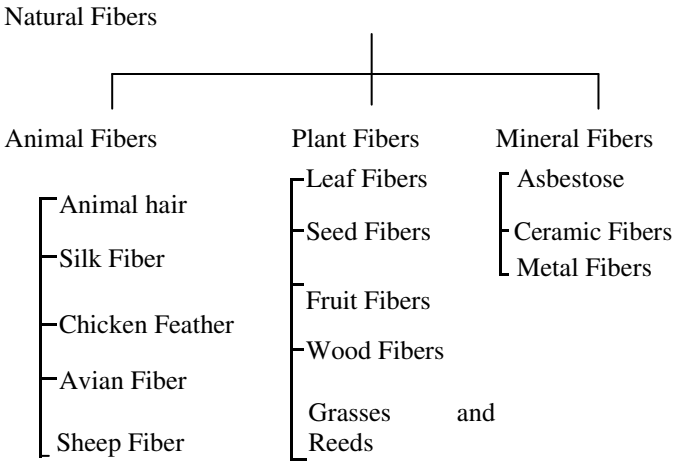
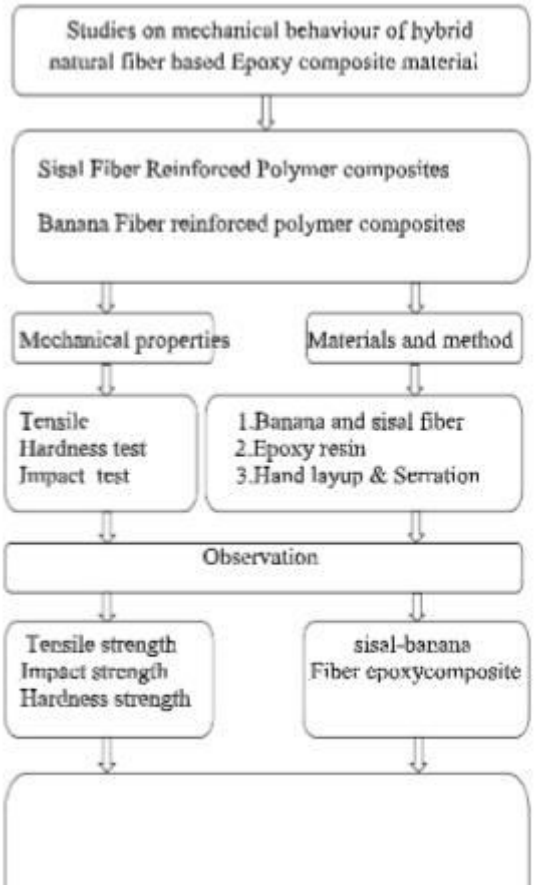


FIG 2. CLASSIFICATION OF NATURAL FIBERS

IV. PROJECT METHODOLOGY

In the present study, the sisal and banana fiber reinforced polymer composites have been prepared by the hand lay-up method, with two different fiber orientations. The tensile, hardness and impact strengths of these composites have been evaluated. These composites are adhered using epoxy resin consists of resin and hardener suitably mixed in appropriate volume. Here for preparing samples Hand layup method is used, specimens are prepared. The scheme of the present work is presented in Fig.1.3.In recent years, there has been a tremendous growth in the field of natural fiber reinforced composites, and lot of research work has been carried out. From the literature review, it is understood that studies on the mechanical properties and machining characteristics of hybrid composites are necessary, and there is a good scope for carrying out a detailed analysis on the modellingfibers using response surface methodology



Studies on mechanical behaviour of hybrid natural fiber based Epoxy composite material

Results and discussion

1. Analysis of fiber ratio properties (sisal-banana)
2. Analysis of testing on materials (sisal-banana)

CONCLUSION

FIG3. THE SCHEME OF WORK

V. MATERIAL DESCRIPTION

- BANANA FIBER
- EPOXY
- SISAL FIBER

A. BANANA FIBER:

Banana fiber is obtained from the pseudo stem of the banana plant by decortications i.e. stem is generally scrapped with the help of a blunt knife.

FIG 4. BANANAFIBER

FIG 5. BANANA FIBER EXTRACTOR

The plants are preventing as shortly because the fruits are harvested. The trunk is in the buff. Brown-green skin is thrown away holding the cleaner or white portion which is able to be processed into knotted fibers. To extract the fiber, the pseudo stem is cut at the lowest at AN angle, and its sheaths are removed, as every series of leaf sheaths produces totally different grades of fibers. The fibers are extracted through hand extraction machine composed of either toothed or non-serrated knives. The peel is clamped between the wood plank and knife and hand-pulled through, removing the non-fibrous material. The extracted fibers are preserved that whitens the fiber. Once dried, the fibers are prepared for knotting. A bunch of fibers are mounted or clamped on a continue facilitate segregation. every fiber is separated in line with fiber sizes and sorted consequently. To knot the fiber, every fiber is separated and knotted to the tip of another fiber manually. The separation and knotting is continual till bunches of unknotted fibers are finished to create a protracted continuous strand. This fiber will currently be used for creating varied product.

B. EPOXY:

Epoxy could be a term accustomed denote each the essential elements and also the cured finish product of epoxy resins, also as a conversational name for the epoxide practical cluster. Epoxy resins, additionally called polyepoxides, square measure a category of reactive prepolymers and polymers that contain epoxide teams. Epoxy resins is also reacted (cross-linked) either with themselves through chemical change homopolymerization, or with a good vary of co-reactants together with polyfunctional amines, acids (and acid anhydrides), phenols, alcohols and thiols.These co-reactants square measure typically spoken as hardeners or curatives, and also the cross-linking reaction is often spoken as natural action.

PROPERTY	BANANA	EPOXY
Density(Kg/m^3)	1350	1200
Young'smodulus(Gpa)	3.48	1.359
Poisson s	0.28	0.3

TABLE 1. TYPICAL PROPERTIES OF MATERIALS

Epoxy has a wide range of applications, including metal coatings, use in electronics / electrical components,fiber-reinforced plastic materials and structural adhesives.

FIG 6. EPOXY RESINFIG 7. HARDENER

C. SISAL FIBER

Sisal fiber comes from the leaves of the plant. it's sometimes obtained by machine decortications during which the leaf is crushed between rollers so automatically scraped. The fiber is then washed and dried by mechanical or natural suggests that. The dried fiber represents solely four-dimensional of the full weight of the leaf. Once it's dried the fiber is automatically double brushed. The lustrous strands, sometimes creamy white, average from eighty to one hundred twenty cm long and zero.2 to 0.4 metric linear unit in diameter. The sisal leaf contains 3 varieties of fibers, like mechanical fibers, ribbon fibers and vascular tissue fibers. The mechanical fibers area unit extracted largely from the bound of the leaf. they're the foremost commercially helpful sisal fiber. Ribbon fibers occur in association with the conducting tissues within the median line of the leaf.

FIG 8. Dry season plant FIG 9. Rainy season plant

FIG 10. Sisal Fibers

VI. FABRICATION OF COMPOSITES

The fabrications of composite block are dispensed by standard hand basketball shot technique. the scale of length and breadth is of 300*300mm was accustomed prepare the specimen. The composite specimen consists of all three Layers of Banana Fiber for the preparation of 1 sample. A measured quantity of epoxy is taken and mixed with the hardener within the quantitative relation of 10:1 the layers of fibers were unreal by adding the specified quantity of epoxy. The Banana fiber is mounted on the table then epoxy applies and next layer is jute fiber. Before the rosin gets dried, the second layer of fiber is mounted over the Banana fiber. the method is continual until three layers of fiber. The epoxy applied is distributed to the whole surface by suggests that of a roller. The air gaps shaped between the layers throughout the process were gently squeezed out. The processed wet composite was then ironed laborious and therefore the excess rosin is removed and dried. Finally, these specimens were hydraulic ironed to force the air gift in between the fibers and rosin, then unbroken for many hours to induce the right samples. once the material dried fully, the material was taken out from the mechanical press and rough edges were showing neatness cut and removed as per the specified ASTM standards.

FIG 11. SISAL LAYER FIG 12. BANANA LAYER

VII. RESULTS

A. SHORE-D HARDNESS TEST:

FIG 13. DUROMETER SHORE HARDNESS

TEST RESULTS:

S. No.	Description	Observed values, HRB			Average, HRB
		1	2	3	
1	Banana & Sisal Fiber	79	79	78	79

TABLE 2. OBSERVED HARDNESS TEST

B. TENSILE TEST:

FIG 14. TENSILE TEST

TEST RESULTS:

Yield stress : 7.03 N/mm2

Tensile strength : 8.789 N/mm2

Elongation : 2.36%

Stress vs. Strain

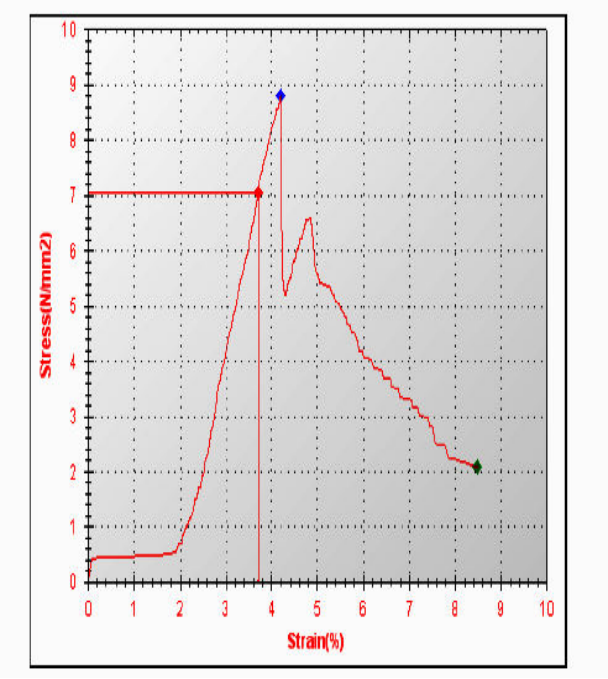


FIG 15. TENSILE TEST (STRESS VS STRAIN)

C. CHARPY IMPACT TEST:

FIG 16. CHARPY IMPACT TEST

TEST RESULTS:

Specimen temp	:room temp
Thickness	:10.00
Width	:10.00
Length	:55.00
Charpy energy joules	:3

VIII.CONCLUSION AND FUTURE WORK

Natural Fibres square measure renewable raw materials and that they square measure reusable. The tensile and flexural properties of epoxy composites strengthened with Sisal fibre and banana fibre are studied and mentioned. the subsequent conclusions will be drawn from the current analysis.

- It has been noticed that the mechanical properties of the composites like durability and compression strength of the composites also are greatly influenced by the fibre fraction and sort.
- This work shows that triple-crown fabrication of sisal fibre and banana fibre strengthened epoxy composites is feasible by easy hand lay-up technique.
- The developed long Sisal fibre strengthened composite (LSFRC) will be employed in completely different engineering applications supported the offered knowledge provided by this analysis report.
- In future, the ultimate material coated by phosphate and hydroxyapatite (hybrid) composite will be used for each internal and external fixation on the build for broken bone.

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