Fabrication and Finite Element Analysis of Jute and Carbon fiber reinforced composite with polypropylene matrix

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CERTIFICATE

I hereby certify that the work being presented in the dissertation entitled "Fabrication and Finite Element Analysis of Jute and Carbon fiber reinforced composite with polypropylene matrix" in partial fulfillment of the requirement of the award of the Degree of master of technology and submitted to the Department of Mechanical Engineering of Lovely Professional University, Phagwara, is an authentic record of my own work carried out under the supervision of Prof. Aman Dutt, Assistant professor Department of Mechanical Engineering, Lovely Professional University. The matter embodied in this dissertation has not been submitted in part or full to any other University or Institute for the award of any degree.

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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

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(B. Venkata Naresh)

CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABSTRACT

The composite materials are succeeding the conventional materials, in view of its predominant properties, for example, high elasticity, low thermic expansion, high quality to weight proportion etc. The improvements of new materials are on the anvil and are developing step by step. Natural fiber composites, for example, jute polymer composites turned out to be more appealing because of their high quality, biodegradability and lightweight. Blending of NF with Carbon-Fiber (CF) are finding expanded applications. In this examination, jute– Carbon fiber reinforced polypropylene composites is produced and their mechanical properties, for example, flexural strength, impact strength and tensile strength are evaluated utilizing numerical and experimental investigation. The commercial FE Analysis software ANSYS is utilized for numerical examination. The internal cracks, interfacial properties and internal structure of the cracked surfaces are evaluated by utilizing Scanning Electron Microscope (SEM).

CHAPTER 1

INTRODUCTION

The word "composite" means two or more distinct parts physically bounded together". Thus, a material having two more unmistakable constituent materials or stages might be viewed as a composite material. Fiber-strengthened composite materials comprise of fiber of high quality and modulus installed in or attached to a lattice with unmistakable interfaces (limit) between them. In this frame, both fiber and network hold their physical and compound personalities, yet they create a mix of properties that can't be accomplished with both of the constituents acting alone. When all is said in done, strands are the chief load-conveying individuals, while the encompassing framework keeps them in the coveted area and introduction, goes about as a heap exchange medium amongst them, and shields them from ecological harms because of lifted temperatures and moistness and so on.

The properties that can be enhanced by shaping a composite material incorporate quality, firmness, wear protection, allure, weakness life, weight, temperature-subordinate conduct, erosion protection, warm conductivity, warm protection, electrical protection and acoustical protection. Composite materials have a broad history of utilization, yet all written history contains references to some type of composite material. For instance, straw was utilized by the Israelites to fortify mud blocks. Plywood was utilized by the old Egyptians when they understood that wood could be improved to accomplish better quality and protection than warm extension and in addition to swelling attributable to the nearness of dampness. All the more as of late, fiber fortified pitch composites that have high quality to weight and solidness to weight proportions have turned out to be vital in weight-delicate applications, for example, flying machine and space vehicles. As in all outline forms, it may not be conceivable to meet every one of the particulars precisely and bargain and exchange offs will be required, however by understanding the physical source of the required properties and building up a fitting numerical depiction, an appropriate composite can be planned. In this way, the composite must offer a particular favorable position as far as cost or execution than customary choices.

1.1. Classification of composites

The commonly accepted classification of composites is:

- laminated composites,
- fibrous composites,
- Particulate composites.

1.1.1. Laminated Composites

Bonding layers of same materials or dissimilar materials makes laminated composites. In this class of composites, discontinuous matrix or mechanical fasteners are used at times to keep the layers together. Depending upon the ways of fabrication, behaviour, or constituent materials of laminates, laminated composites are commonly called as bimetal, clad-metals, safety glass or laminated, plastic based laminates, sandwiches and hybrid composites or laminated fibrous.

1.1.2. The fibrous composite

The fibrous composites are formed by embedding and binding together of fibers by a continuous matrix. As indicated by the definition fiber is a material in a prolonged shape with the end goal that it has a base length to a most extreme normal transverse measurement of 10:1, a greatest cross-sectional region of 5.2 x 10 – 4 cm 2 and a greatest transverse measurement of 0.0254 cm. A fiber is innately substantially stiffer and more grounded than a similar material in mass frame, in view of its ideal structure. Financially accessible filaments are glass, carbon, boron, and graphite. The lattice is implied for holding the sinewy with the goal that they go about as concrete. The reason for the lattice is specifically to help, to ensure and to exchange worry among the filaments. The grid is for the most part of much lower quality, thickness and solidness. It would not withstand itself high anxieties. Pitches and thermoplastics are broadly utilized as lattice materials. The composites are framed from the mix of filaments and lattice which has higher particular quality and is lighter than regular designing materials.

1.1.3. Particulate composites

Suspending particles of one or more materials in a matrix of another material produces particulate composites. The particles and matrix can be either metallic or nonmetallic. The commonly used particulate composites are concrete, solid rocket propellants, carbides etc.

1.2. Classifications of fibres

1. Natural Fibers: Coir, Jute, Bamboo, Palm, Corn etc.

2. Man Made Fibers: Carbon, Boron, Glass, Kevlar, Graphite etc

Depending upon diameter of fibers can be classified as

- Filaments
- Wires & Rods

Filament form of fibers is attractive. Based on the strength, fibers can be grouped as high performance, medium performance and low performance.

1.2.1. Natural fibers

Fiber is an anatomical structure obtained from stems, leaves, roots, fruits, and seeds. Vegetable fibers consist of cellulose, pectin and hemicelluloses depending on the vegetable species. Worldwide, despite the availability of modern synthetic fibers, vegetable fibers remain in great demand and compete with wool, silk, and synthetics for quality resistance, durability, colour, and lustre.

The characteristic strands might be arranged by their source as cellulosic (from plants), protein (from creatures), and mineral. The plant filaments might be additionally requested as seed hairs, for example, cotton, bast (stem) strands, for example, material from the flax plant; hard (leaf) strands, for example, sisal, and husk strands, for example, coconut. The creature strands are assembled under the classes of hair, for example, fleece, hide, for example, angora; or discharges, for example, silk. The main vital mineral fiber is asbestos, which on account of its cancer-causing nature has been restricted from shopper materials.

The financially critical regular filaments are those cellulosic strands got from the seed hairs, stems, and leaves of plants, protein filaments acquired from the hair, hide, or cases of creatures; and the crystalline mineral asbestos. Regular plant and creature filaments have given the crude materials to meet our fiber needs. Regardless of which climatic zone people settled they could use the filaments of local species to make items, for example, garments, fabrics, structures and cordage. A significant number of the old plant strands are never again being used. Filaments, for example, jute, sisal, coir and kapok just began to be transported in into Europe from the nineteenth century. The regular vex has a long history as a wellspring of fiber. Archaeological stays in Denmark and Britain demonstrate that it was utilized for string and fabric enterprises

1.2.1.1. Natural Fiber classification:

According to very complete compilation of M. Vernardin in his Nomenclature the number of plant fibers used by the human species is more than 550 and perhaps 700.

The natural fibers are generally subdivided into

(a) Vegetable fibres

(b) Animal fibre

(c) Mineral fibres.

1.2.1.1. Man- made fibers

The first mentioning of the idea of producing a manmade fiber have been done by Dr. Robert Hook, a well-known physicist originator of Hook's law, in micrographic, published in 1664 in England. This idea Dr. Hook remains as an idea until, almost a century later, Rene Reaumur, a French naturalist and physicist recoded the possibility of making "an artificial silk"

1.2.1.1b. Vegetable fibers

The fiber yielding plants satisfy the second necessity of individuals i.e., dress. Humanity since time timeworn knows such plants. Cotton was developed in India since long and its material earned extraordinary notoriety for the nation. The filaments are comprised of cellulose or hemicelluloses with affidavit of lignin. The strands can be put under the accompanying classifications:

- Textile fibers
- Brush fibers Planting and rough weaving fibers
- Filling fibers
- Paper making fibers

1.3. Matrix materials

Polymers used as matrix materials are commonly referred to as resins. The matrix resin generally accounts for 30 to 40 percent, by volume, of a composite material. Matrix maintains the shape of the composite structure, aligns the reinforcements, and acts as a stress transfer medium. In addition, the matrix protects the fibers from abrasion and corrosion. More importantly the limitation of a composite may well be a function of matrix properties. For example, the thermal stability and maximum working temperature of a composite are largely determined by the matrix properties.

1.3.2. Functions of the matrix

- The capacity of composites strengthened with short strands to help heaps of any sort is reliant on the nearness of the network as the heap exchange medium, and the productivity of this heap exchange is specifically identified with the nature of the fiber/lattice bond.
- The network should likewise confine the strands from each other so they can go about as particular substances and many strengthening filaments are fragile solids with very factor qualities
- The grid ought to shield the strengthening fibers from mechanical harm (e.g. scraped spot) and from ecological assault. Since huge numbers of the pitches which are utilized as grids for glass strands allow dissemination of water. For composites like MMCs or CMCs working at lifted temperature, the framework would need to shield the strands from oxidative assault.
- By correlation with the regular strengthening fibers most lattice materials are frail and adaptable, and their qualities and module are frequently ignored in ascertaining composite properties. Be that as it may, metals are auxiliary materials and in MMCs their innate shear firmness and pressure unbending nature are imperative in deciding the conduct of the composite in shear and pressure.

1.4. Manufacturing process for Jute fiber composites

The fabrication of jute fiber composites involved several methods which are depending upon the type of shape and size. These processes follow the principle of polymerization. Polymerization basically two diverse types, step reaction (or condensation) and chain reaction polymerization. The main function of polymerization is used to joining the large synthetic molecules and it forms the rigid structures [33]. Some of the important techniques for manufacturing the jute fiber reinforced composite materials given in below Table 2.

1.4.1.1 Hand layup

A discharging operator, for example, silicone is connected to the shape to permit simple expulsion of the completed part. The woven wandering (texture) or slashed strand tangle (CSM) is laid in the shape. Fluid thermosetting gum is blended with a curing specialist. The blend is poured on and is then rolled or crush uniformly over the surface, with regard for expulsion air. This is performed in layers until the part is get finished. Curing is performed at room temperature, yet hot air blowers and infrared lights are tending to fasten the procedure. Some are the researchers are followed this layup process for fabricating the jute fiber composite materials that are bellow given.

1.4.1.2 Compression moulding

This manufacturing process utilized for thermoplastic matrices with fiber mats or detached cleaved fiber of long fiber or short fiber either arbitrarily adjusted or oriented, however, likewise be utilized with thermoset grids. The strands are regularly stacked on the other hand with thermoplastic matrices sheets sooner than warmth and stress are executed. This method is a technique used to mould where in the moulding composite materials, by and large preheated, is initially situated in an open, warmed mild empty space

1.4.1.3 Spray layup

Fiber is slashed in a hand-held weapon, Cleaved filaments, sap, and impetus are feed into the weapon which are splashed over the surface of the mold. The formed material is left for curing under some standard barometrical conditions. The showered composite must be moved to expel ensnared air and to give a smooth surface wrap up. Some are the researchers are followed this layup process for fabricating the jute fiber composite materials that are bellow given.

1.4.1.4 Injection moulding

Material granules for the component is bolstered through a container into a warmed barrel, dissolved utilizing warmer groups and the frictional development of a responding screw barrel. The plastic is then infusion through a spout directly into a form empty space in which it cools and solidifies to the arrangement of the hole. The mold instrument is set up on a moveable platen – when the part has set, the platen opens and the segment is launched out the utilization of ejector pins. This procedure give a decent surface wrap up.

This is appropriate for higher volumes. This procedure gives bring down rigidity than most thermoset frameworks.

1.4.1.5 Filament winding

This method is essentially utilized for fabricating hollow as well as the components which are round and egg-shaped, for example, pipe-works, weight vessels, stockpiling tanks and aviation parts. Winding bearings: Hoop or Helical winding. Wet winding fiber tows are passed through a gum shower before being wound onto a mandrel in an assortment of introductions, controlled by the fiber nourishing component, and rate of pivot of the mandrel. Now the composite material formed are subjected to room temperature or at a high temperature. From the composite part the mandrel is extracted and use afterwards, and this is performed along with curing.

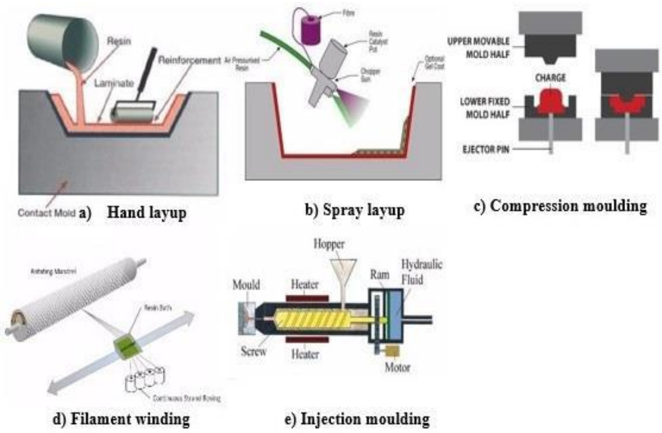

Figure 1: Types of Manufacturing Process (32).

All the above techniques are used to fabricating the composite materials, before fabrication we should remove the moisture content in the fibers by using drying methods.

Table 1: Manufacturing methods for JFRC materials

S. No.	Composite fabrication method	Type of polymer composite Processed/Manufactured	Chemical treatment	References
1	Hand layup	Glass-jute-sisal fiber reinforced polyester composite	–	2
		Nano titanium oxide particles-hybrid jute-glass FRP composite	–	3
		Abaca-jute-glass fiber reinforced epoxy composite	–	4
		Hybrid bamboo/GFRP and jute/ GFRP composite	–	6
		Hybrid glass fiber-sisal/jute	–	7

		reinforced epoxy composite		
		Jute and banana fibre reinforced epoxy hybrid composites	Silicon spray	10
		Jute -epoxy composite	Alkali	19
		Bi-directional jute-epoxy composite	_	20
		Untreated jute fabric-reinforced polyester composite	PVA	21
		Jute fabric- reinforced polyester composite	Alkali	23
		Jute cloth/wool felts hybrid laminates		25
		Succinylation and phthalicylation of jute fibre reinforced epoxy composite	DMS	27
		Jute-polyester composite	_	28
		Jute fibre epoxy composite	_	31
2	Compression moulding	Jute polypropylene fibre composite	Alkali	5
		Randomly oriented short jute fibre reinforced epoxy composite	_	9
		Jute fibre reinforced nano clay composite	_	12
		Jute fibre reinforced biopol nanophase green composite	Alkali	15
		Jute fibre/ polypropylene nonwoven composite	Alkali	16
		Woven jute fabric reinforced poly (L-lactic acid) composite	_	17
		Jute and banana fibre reinforced hybrid polymer matrix composite	CNSL	29
		Laminated composites based on Woven jute fibres reinforced epoxy resin	_	30
		Palmyra palm leaf stalk fiber/jute fiber reinforced hybrid polyester composite	Alkali	26
3	Injecting moulding	Jute-fibre-reinforced poly-lactide green-composite	_	8
		Jute-carbon hybrid composite	_	23
4	Spray layup	Jute composite	_	18
		Sisal and jute fibre composite	_	33
5	Filament winding	Tossa jute yarns/epoxy composite	Alkali treatment	13
		Jute yarn-biopol composite	_	33

CHAPTER 2

LITERATURE REVIEW

2.1 Literature review

Wambua W, et.al (2003) [1] investigated that impact properties of the various samples an impact test is done. The impact test did for the present examination is Charpy impact test. The vitality misfortune is discovered on the perusing got from the Charpy impact machine. The impact reaction in GFRP-jute composites mirrors a disappointment procedure including crack start and development in the matrix, pull-out and fiber breakage, disbanding and delaminating. The outcomes demonstrated that the greatest effect quality is acquired for GFRP-sisal composites took after by jute-sisal–GFRP composites.

Mohammad K, et.al (2011) [2] investigated elasticity variation for 10% NaOH treated and 5% NaOH treated jute strengthened composites. The tensile test outcomes demonstrated a variety in the elasticity of the 10% NaOH treated and 5% NaOH treated jute fiber strengthened composites. The 5% NaOH treated JFRC (jute fiber reinforced composite) showed better rigidity (12.46 N/mm2) than the 10 % NaOH (10.5 N/mm2) treated jute fiber strengthened epoxy composites. For jute polyester composites, it changed from 7.92 N/mm2 for 10% NaOH to 9.24 N/mm2 for 5% NaOH treated JFRC. Tensile test was done in UTM (Universal Testing Machine) to gauge the tensile strength of jute-polyester and jute-epoxy composite as per ASTM D3039 models. As from the outcomes it was unmistakable that the 5% NaOH treated jute fiber fortified composites demonstrated preferred outcomes over its counterpart and for the 5% NaOH treated JFRC. The tensile test outcomes demonstrate that the most extreme drive connected was 554N and 748 N for the jute-polyester and jute-epoxy composites individually. After applied force (554N and 748N) the specimen tends to fail. The most extreme dislodging yielded by the composite was between 1.14 mm and 1.17 mm for jute-polyester and jute-epoxy composites separately. The 5% NaOH treated JFRC appeared to have a higher rigidity than 10% NaOH treated JFRC by 18.67 % and for jute-polyester composites it was discovered to be an expansion of 16.67 %.

M. Ramesh et.al. (2013) [2] investigated that it was observed that Jute-GFRP composite specimen provided better tensile strength as compared to jute-GFRP-sisal composite.

Tensile strength of Jute-GFRP-sisal composite and jute-GFRP composites were 200 MPa and 229.54 MPa respectively. Higher impact strength was evaluated for the sisal fiber composite material. By utilizing SEM they observed the breaks, internal cracks and internal structure for the cracked surface of the tested materials.

B. Vijaya Ramnath et.al. (2013) [4] are investigated the break load in the hybrid composite materials is high. It is around 1.26 times better than the abaca composite material and 1.14 times better than the jute composite material. The most extreme dislodging is likewise high for the half and half composite. It is around 1.2 times better than the abaca composite materials and 1.15 times than the jute composite materials. This demonstrates when the percentage elongation in single fiber composite is not as much as that of the cross-breed composite which implies that the half-breed composite materials resist more strain as compared to single fiber composite materials before disappointment. It is moreover found that jute fiber fortification in a half and half expands the quality more than whatever other characteristic fiber. In this way, it can be closed that the half-breed composite materials are more pliable than the single sort fiber composite. From the consequences of the malleable test, it can be presumed that the abaca-GFRP-jute composite materials are well performing contrasted and different sorts of composites.

Nguyen Minh Hai et.al.(2013) [5] evaluated the material was fabricated by utilizing hot press with an 7 min at 195°C and 3 Kgf/mm^2 pressure. coir and Jute strands were treated for 24 h with 2%, 4%, 6% and 8% focuses of NaOH, individually. The strands were then washed with refined water a few times to evacuate any hints of NaOH on the fiber, neutralized with weaken acidic corrosive, and again washed with refined water. Last pH estimation was 7. For 50 wt% jute fiber-containing composites, the elasticity was 71.0 MPa with untreated and 100.0 MPa with 2% NaOH treatment composite. The tractable modulus was 4.2 GPa for untreated and that of treated composite was 4.7 GPa for 2% NaOH. Prolongation at break after 2% NaOH treatment and for untreated composite was 8.0% and 6%, separately.

M. Boopalan et.al (2013) [7] investigated the tensile modulus and tensile strength of jute-epoxy composite was watched that no upgrade in tensile properties of epoxy sap by the support of jute fiber. The reason might be a feeble bond between the epoxy matrix and jute fiber makes no appropriate exchange of load from lattice fiber. The ductile properties of the 15-mm length of jute-epoxy composite (J15) were discovered most extreme as a contrast with other every one of the composites. The elasticity of the composite J15 was watched higher by 8.27%, 0.98%, and 28.08% when contrasted with composites J20, J10 and J5 respectively and tensile modulus of the composites J20, J10 and J5 are less than as compared to J15 with the percentage of 3.51%, 3.51 % and 9.25% respectively

G.M. Arifuzzaman Khan et.al (2013) [8] concluded that JFRC materials have been portrayed for their viscoelastic properties utilizing DMA method. In general, expanding the jute content from 23 to 33 wt% in composites improved the capacity and loss moduli because of the support granted by the jute strands. In any case, the damping parameter diminished with an expansion in the jute content. The examination of stacking grouping of specially and non-specially adjusted nonwovens on viscoelastic properties of materials uncovered that MXMX and MMXX have yielded the most elevated extents of peak stowage modulus with jute substance of 23 and 33 wt%, separately. Curiously, MXXM and XMMX with jute substance of 23 and 33 wt%, separately yielded least benefits of damping parameter showing a decent fiber–matrix interface qualities. Also, the interface bond attributes between the jute fiber and PP grid were quantitatively breaking down utilizing AEF (A) and REC (C) (AEF-Adhesion efficiency factor and REC-Reinforcement effectiveness coefficient). It was found that A quality expanded with an expansion in jute fiber content in all the four stacking arrangements proposing poor interface bond in nonwoven composites having higher jute fiber content. Essentially, there REC (C) values for the composite materials decreased with increment in jute fiber content uncovering poor load exchange between PP matrix and jute fiber in composite materials with higher jute fiber substance.

T. Munikenche Gowda et.al (2013) [9], The TGA consequence of 0%, 25, 50%, 75% and 100% banana and 100%, 75%, 50%, 25% and 0% jute fiber respectively with epoxy composite are the underlying low-temperature weight reduction happens at 200 C was allotted to the expulsion of dissolvable. The significant weight reduction 79.01%,82.14%, 75.64%, 79.01% and 74.43% respectively happens at 376.51°C, 377.72°C, 380°C, 376.51°C and 377.72°C respectively because of degradation of fiber and epoxy. The degradation moved to higher temperature. Subsequently, the effect of this composite posse expanded thermal stability [20].

Md. Rashnal Hossain et.al (2013) [10], investigated that tensile properties of utilized epoxy matrix and BWB jute are strength 81.72 ± 13.16 and 844.72 ± 142.47 MPa, solidness 3.89 ± 0.53 and 55.66 ± 2.11 GPa, and strain to disappointment 2.23% ± 0.50% and 1.67% ± 0.31% respectively. In any case, as an anisotropic material, jute fiber has a huge diffuse in tensile properties relying upon test specimen traverse length, test machine presence of characteristic, slippage and surface of imperfections. The rigidity of the jute fiber diminishes with increment in the traverse length and disseminate for each traverse is moderately higher for lower traverse length contrasted with that of the higher traverse length. The chance of finding a deformity along the stacking heading of fiber is especially erratic for the low traverse. Yet, for higher traverse, the chance of finding various deformities or single deformities are more noteworthy thus the tensile strength is lower alongside lower scramble band. Then again, E-modulus/stiffness/Young's modulus is free of traverse length, the imperfection of fiber and machine slippage.

D. Shanmugam and M. Thiruchitrambalam (2013) [11] investigated that impact quality of the persistent unidirectional NaOH treated bi-layer jute/PPLSF hybrid composites appears in Table 4. It can be noticed that the effect quality of J100 composites is 31% smaller than P100 composites. The impact quality of the composites diminished when jute substance was expanded. The impact strength of P50J50, P25J75 and P75J25 composites was observed to be 27 kJ/m2, 26 kJ/m2 and 35 kJ/m2 respectively. P100 composites demonstrated the most astounding effect quality (36 kJ/m2) contrasted with J100 and other cross breed composites. T-test did for tensile strength with reference P100 composites was observed to be noteworthy for every one of the composites aside from P75J25 composites (Table 4). ANNOVA techniques for the impact strength qualities demonstrated the huge distinction between the methods. The low strength of J100 composites is because of expanded load shared by them in pressure because of better stress exchange from the fiber to network.

M. Niranjana et.al. (2013) [12] The impact energy and impact strength of jute and epoxy composite are evaluated. The effect properties of epoxy were increased by the support of jute fiber. The impact strength of J20 composite were discovered greatest contrast with epoxy and all the composite materials. The impact energy and impact strength of J20 composite were discovered enhanced by 35.61%, 57.02%, 73.40% and 16.50% when contrasted with J15, J10, J5 and E composite materials respectively.

Ajith Gopinath et.al (2014) [13] Experimental Investigated that mechanical properties of Tossa jute strands were streamlined by utilizing a NaOH-treatment handle with various alkali fixations and shrinkages. Shrinkage of the strands amid treatment had the most critical impact on the fiber structure and, accordingly, on the fiber mechanical properties, for example, tensile modulus, toughness and tensile strength. Besides, break conduct of the strands was in a general sense influenced by shrinkage, with changes in haul out the length of the cellulose fibrils from lignin grid/hemicellulose. A NaOH treatment under isometric conditions (20 min at 20C in 25% NaOH arrangement) lead, regarding yarn hub, to an expansion in jute yarn modulus and tensile strength of around 150% and 120%, respectively.

Tetsuo Kikuchi et.al (2014) [14] investigated the flexural modulus is used to measure the composite materials resistance to deformation in bending. Benzylated woven jute fortified PLLA composites had higher FS and FM contrasted and those of untreated partners. It demonstrates that the composites have better interfacial holding because of fiber surface treatments. Untreated woven jute strengthened PLLA, which had poor interfacial holding between the matrix and the fabric, demonstrated a lower tensile strength because of the way that a lower load is expected to break and haul out the fiber from the framework. Nonetheless, the poor interfacial holding property between the matrix and the fabric made it less demanding for the fiber to deboned from the framework. The crack was to some degree limit and the composites demonstrated weak properties. For treated woven jute strengthened PLLA composites, because of the enhanced interfacial holding properties, the pull-out fiber from the lattice is uncommon and a decent break resistance property was accomplished.
toughening mechanisms.

Abdellaoui H, et.al (2014) [15] By using INSTRON 8821S tensile machine with the speed of 3mm/min for measuring the tensile properties of JFRC material specimen with 1, 3, 5, and 7 layers and two different orientation (0° and 45°). The heap is upheld by the length of the unidirectional strands in the longitudinal heading of filaments, i.e., (0°), while out of this course (45°), The hub stack shapes a point with yarns in both sides. For the most part, it was watched an expansion of Young's modulus with expanding the quantity of layers. The maximal modulus was come to at 5 layers, which can be because of the ideal attachment between matrix-fiber. Be that as it may, a reduction of Young's modulus is noted at 7 layers, it can be clarified by the expansion of interfacial zones. This expanding can because of an expansion of the void percent in the produced laminated. The mechanical conduct of composite materials is for the most part enhanced by including natural fibers, particularly jute fibers.

Subhankar Biswas et.al (2015) [16] investigated that there was a peak at around 100°C showing the expulsion of moisture for both jute and bamboo fiber. Bamboo and jute fibers demonstrated thermal disintegration in the temperature scope of 260–240°C. In any case, the correct thermal decomposition temperature for bamboo and jute fiber epoxy composites was 246°C and 255°C respectively. Consequently, the jute fiber epoxy composite had higher warm strength when contrasted with bamboo fiber-epoxy composite. Amid preparing of epoxy composites, both bamboo and jute fibers were presented to high temperature frequently consolidated with caught air, which may bring about thermal degradation. If genuine degradation of normal fiber happens at the dissolve handling temperature, the mechanical fortification effect of the composite fiber is decreased. In this way, TGA examination was utilized to decide the high-temperature debasement conduct of the composites under nitrogen and air environments.

Sutanu Samanta et.al (2015) [17] concluded that elastic properties are expanded with increment in glass fiber in jute and bamboo fiber based covers. The compression properties of GG to BB have additionally demonstrated an indistinguishable pattern from their elastic properties. However, the compressive quality for the crossover composites builds at first and afterward reduced. The compressive modulus increments from JJ to GG with the expansion in glass support. If there should arise an occurrence of quality, it increments with hybridization and surpasses the glass composite quality. Flexure modulus of a jute hybrid and bamboo hybrid composites are progressively when the bamboo fortification is at base (under tension) and glass support is to finish everything (under compression). The flexure quality of bamboo hybrid and jute hybrid composites will be progressively when the bamboo and jute support will be to finish everything (under pressure) and glass fortification will be at base (under strain).

R.A. Braga and P.A.A. Magalhaes Jr (2015) [18] evaluated that the properties of JFRC materials were gotten by performing thermogravimetric examination (TGA) and heat redirection temperature investigation. Thermogravimetric investigation measures the quantity and rate of variation in the weight of a composite material as a time or function of temperature in a controlled atmosphere. Estimations are utilized primarily to decide the structure of materials and to anticipate their thermal stability at a temperature up to 1000°C. The method can portray materials that display weight reduction or increase because of decomposition, dehydration or oxidation.

K Deepak et.al (2015) [19] “Experimental Investigated that TGA after effect the 0%, 7%, and 19% glass fiber 31%, 25% and 18% jute fiber respectively with epoxy (E69-J31-V0, E68-J25-V7 and E64-J18-V19) was examined. While waiting for the temperature of 100 °C the composite materials loses 1.95%, 1.52 and 1.27% respectively of the underlying weight, with 200 °C the weight reduction is as of now 9.00%, 7.76% and 6.57% respectively of mass that compares to the evacuation of dissolvable in the polymer matrix. Between 200 °C and 450 °C the weight reduction was roughly 70.70%, 68.97% and 63.54% respectively, because of volatilization and degradation with jute fiber-epoxy existing in the composite. After that, the composite keeps up a direct mass misfortune up to 1000 °C, where the last deposit is 6.48%, 17.50% and 24.19% respectively of the first mass.

Sam Ashworth et.al (2016) [20] evaluated that the injection pressure has effected the properties of JFRP and HFRP in the manufacturing process. The increasing of pressure (4 to 8 bar) in fabrication process the little bit increase in the average specimen thickness (0.14-0.15mm). The HFRP and NFRP boards delivered at 8 bar had a lower elasticity than those created at 4 bar. It was most observable for the NFRP tests where elasticity dropped by roughly 38 % as opposed to 6 % for HFRP.

G. Seshanandan et.al. (2016) [21] evaluated the mechanical properties of the HFRP enhance with the expansion of Nano TiO_2 filler particles in view of higher imperviousness to forces, because of increment of high-quality Nano TiO_2 filler particles and lessening of polyester in the lattice. The expansion in flexural strength, shear strength and tensile strength of the HFRP uncovers that the stress are productively exchanged through the interface. The synergistic impact of Nano TiO_2 filler particles, WJM, polyester and GFCSM brings about the improvement of the mechanical properties of the HJG composites (hybrid jute-glass). The mechanical properties of the HFRP enhanced particularly with the expansion of Nano TiO_2 filler particles. The flexural strength expanded from 121 MPa for the 0 wt % TiO_2 HFRP1 to 182 MPa for the 6 wt % TiO_2 HFRP4. The shear strength expanded from 48 MPa for the 0 wt % TiO_2 HFRP1 to 69 MPa for the 6 wt % TiO_2 HFRP4. The tensile strength expanded from 62 MPa for the 0 wt % TiO_2 HFRP1 to 77 MPa for the 6 wt % TiO_2 HFRP4. The flexural strength, shear strength and tensile strength of the HFRP enhance with the expansion of nano TiO_2 filler particles. The expansion of TiO_2 nanoparticles in FRP indicated enhanced strength because of crack pinning, crack-tip blunting and crack avoidance

Fiore V et.al. (2016) [22] The damping conduct and the Tg estimation of a polymeric material depend only on the capacity of development of the macromolecules that create the polymer. Then again, the consolidation of fiber in a polymeric grid influences the tanδ versus temperature arc of the composites and due both to the vitality dispersal inside the shear stress and matrix concentration at the fiber-lattice interfaces. accordingly, Tg esteem and stature of the tanδ highest of composites relies on upon the fiber-lattice adhesion, that is a feeble filler-matrix adhesion prompts higher estimations of tanδ peak and bring down estimations of glass move temperature while a fiber-lattice adhesion limits the portability of the polymer chains accordingly decreasing the damping and expanding the Tg.

2.2. Aspects of the proposed project work

For the past few decades' researchers have put lot of effort to design the composite materials using synthetic fibers according to the design requirements. Lot of experimental and theoretical investigations was carried out for this purpose. There is a need to bring the composites within the reach of a common man using renewable and eco-friendly natural resources. However, very small contribution of research work exists in the design and fabrication of composite materials using natural fibers. The proposed research work is intended to exploit the advantages of using natural fibers as reinforcement material in composites and effect of NaOH solution on natural fiber composite. The work provides basic understanding of the behaviour and response of new natural fibers, and lightweight materials. Under the proposed project work the following aspects of natural fibers and composites have been studied.

- i Identification of natural fiber.
- ii Identification of matrix material.
- iii Preparation of natural fiber reinforced composite specimens as per ASTM standards for tensile, impact and bending testing.
- iv Result and Analysis.

CHAPTER 3

SCOPE OF THE STUDY

There is a wide extent of composite material in wind energy, automotive, electrical, domestic purpose, sports, medical, civil construction and chemical industries etc. Composite materials have an extraordinary possibility of utilization in structures subjected basically to compressive load and tensile strength. Composite materials have interesting facets like the generally high compressive quality, great flexibility in creating thick composite shells, low weight, low thickness and erosion protection. Composite materials have great mechanical, electrical, synthetic properties, because of which we can utilize composite material in numerous different ventures. Different parts of vehicle and aviation are produced by composite material because of good properties. Composite materials are utilized for residential reason like furniture, window, entryway, mating, common development and so on. In the marine, concoction ventures, sports, we can utilize composite material for better execution of the parts. With the assistance of survey, we presume that composite materials have wide focal points and application in different businesses; we can improve way of life with the assistance of composite material.

CHAPTER 4

EQUIPMENT, EXPERIMENTAL SETUP, MATERIALS AND RESERCH METHODOLGY

4.1 Equipment

The complete setup is basically consisting following items.

1. Compression moulding machine
2. Compression moulding die
3. Heating element
4. Releasing agent
5. Electrical control panel

4.2 Experimental Setup

4.2.1 Compression moulding machine

HEICO’s compression testing machine was using for fabrication of composite materials. The limit of the machine is 1000KN figure 10. This machine comprises of stacking unit and additionally pumping unit. At the base of the stacking unit, a hydraulic powered jack is fitted and a weight show unit is connected to the upper end of stacking unit which is utilized to work the pumping unit and controls the load. Particular: most extreme load (1000KN), mechanized pump (200V, single stage AC), and Hydraulic oil servo framework ENKL 68.

Figure 2: compression testing machine

4.2.2 Compression moulding die

It is a specialized tool used for the fabrication of composite by pressing it. Basically, it consists of an upper part (punch plate) and the lower part (die block) as shown in figure 11. There are different types of strips used for making the different samples. The die is made of EN31 steel. Material which achieves very high compressive strength with high hardness value.

Figure 3: Die with upper and lower parts

4.2.3 Heating element

The setup was heated by commercial heating rod elements as shown in figure 12. Total nine heater rods used to heat the setup. The voltage of each rod heater is 750W with single phase.

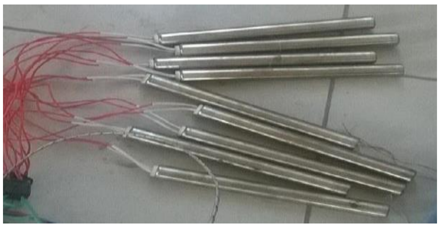

Figure 4: Heating rods

The controllers were used to cut off the supply of heater when temperature reaches required values.

4.3 Materials

The selection of fiber and matrix materials is an important role of a composite fiber reinforced materials.

4.3.1 Polypropylene

Polypropylene provides excellent resistance to organic solvents, degreasing agents and electrolytic attack. It has a lower impact strength, but its working temperatures and tensile strength are superior to low or high-density polyethylene. It is light in weight, resistant to staining, and has a low moisture absorption rate. This is a tough, heat-resistant, semi-rigid material, ideal for the transfer of hot liquids or gases. It is recommended for vacuum systems and where higher heats and pressures are encountered. It has excellent resistance to acids and alkaline, but poor resistance to aromatic, aliphatic and chlorinated solvents. Polypropylene is a conservative material that offers a mix of remarkable physical, mechanical, chemical, electrical and thermal properties not found in some other thermoplastic. Contrasted with high or low-density polyethylene, it has a lower affect quality, yet predominant tensile strength and working temperature. The physical properties of polypropylene as given in below table 2.

4.3.1.1 General properties

Polypropylene gives astounding resistance from natural solvents, degreasing specialists and electrolytic assault. It has a lower affect quality, however its tensile strength and working temperatures are better than high or low density polyethylene. It is light in weight, impervious to recoloring, and has a low dampness absorption rate. This is an heat resistance, tough, semi-unbending material, perfect for the exchange of hot fluids or gasses. It is suggested for vacuum frameworks and where higher warms and weights are experienced. It has incredible protection from alkaline and acids, however poor protection from fragrant, aliphatic and chlorinated solvents

Table 2: Physical properties of fiber and matrix

Physical property	Jute fiber	Polypropylene
Density (g/cm^3)	1.4	0.946
Elongation at break (%)	1.8	150.00
Cellulose content (%)	50-57	-
Lignin content (%)	8-10	-

Tensile strength (MPa)	400-800	33.00
Young's modulus (MPa)	30-oct	140.00

4.3.2 Carbon fiber

Carbon fiber is a whisker or high tensile fiber made by warming rayon or petroleum reduces to suitable temperatures or polyacrylonitrile filaments. Strands might be 7 to 8 microns in distance across and are progressively that 90% carbonized.

This fiber is the stiffest and most grounded strengthening strands for polymer composites, the most utilized after glass filaments. Made of unadulterated carbon in type of graphite, they have low thickness and a negative coefficient of longitudinal warm extension. Carbon filaments are extremely costly and can give galvanic erosion in contact with metals. They are for the most part utilized together with epoxy, where high quality and solidness are required, i.e. race autos, car and space applications, wear hardware.

Contingent upon the introduction of the fiber, the carbon fiber composite can be more grounded in a specific bearing or similarly solid every which way. A little piece can withstand an effect of numerous tons and still distort negligibly. The complex entwined nature of the fiber makes it extremely hard to break

4.3.2.1 Characteristics/Properties of Carbon fiber

1. Physical quality, particular durability.
2. light weight. Great vibration damping.
3. Quality, and durability. High dimensional strength.
4. low coefficient of warm extension.
5. low scraped spot. Electrical conductivity.
6. Natural inactivity and x-beam porousness.
7. Weakness protection, self-grease.
8. High damping. Electromagnetic properties.
9. Compound inactivity, high consumption protection.

4.3 Jute fiber

Jute is the most essential plant close by with cotton that are developed exclusively for their strands. Jute filaments are separated from the bark of the from tossa jute and white jute plant by either organic or concoction retting process. It is portrayed by brilliant and plush sparkle and in this manner, known as 'the Golden Fiber'. A solitary jute fiber has a length going from 1 to 4 m. Jute filaments comprise for the most part of cellulose and lignin. The structure of a jute fiber has a polygonal segment of different sizes, which brings about uneven thickness of fiber cell dividers, and this thusly causes varieties in quality.

Jute bast fiber is isolated from the essence in a retting procedure. If there should be an occurrence of water retting, cut jute stalks are set in lakes for half a month. Microbial activity in the lake mellows the jute fiber and debilitates the bonds between the individual strands and the substance. The fiber strands are then physically stripped from the jute stick and held tight racks to dry.

Jute fiber is a better encasing and it has antistatic properties. Also, it is portrayed by direct dampness maintenance. It is impervious to microorganisms, however not to substance and photochemical assault. Because of a high lignin content (up to 20%), jute filaments are fragile, yet solid and have a low expansion to break (around 1.5%). Jute filaments are utilized as a part of numerous areas of industry, similar to mold, travel, baggage, outfitting and in the generation of rugs and other floor covers, and to wrap things up as a support in bio-composites. The physical properties of jute fiber as given in table 2.

4.4 Research methodology

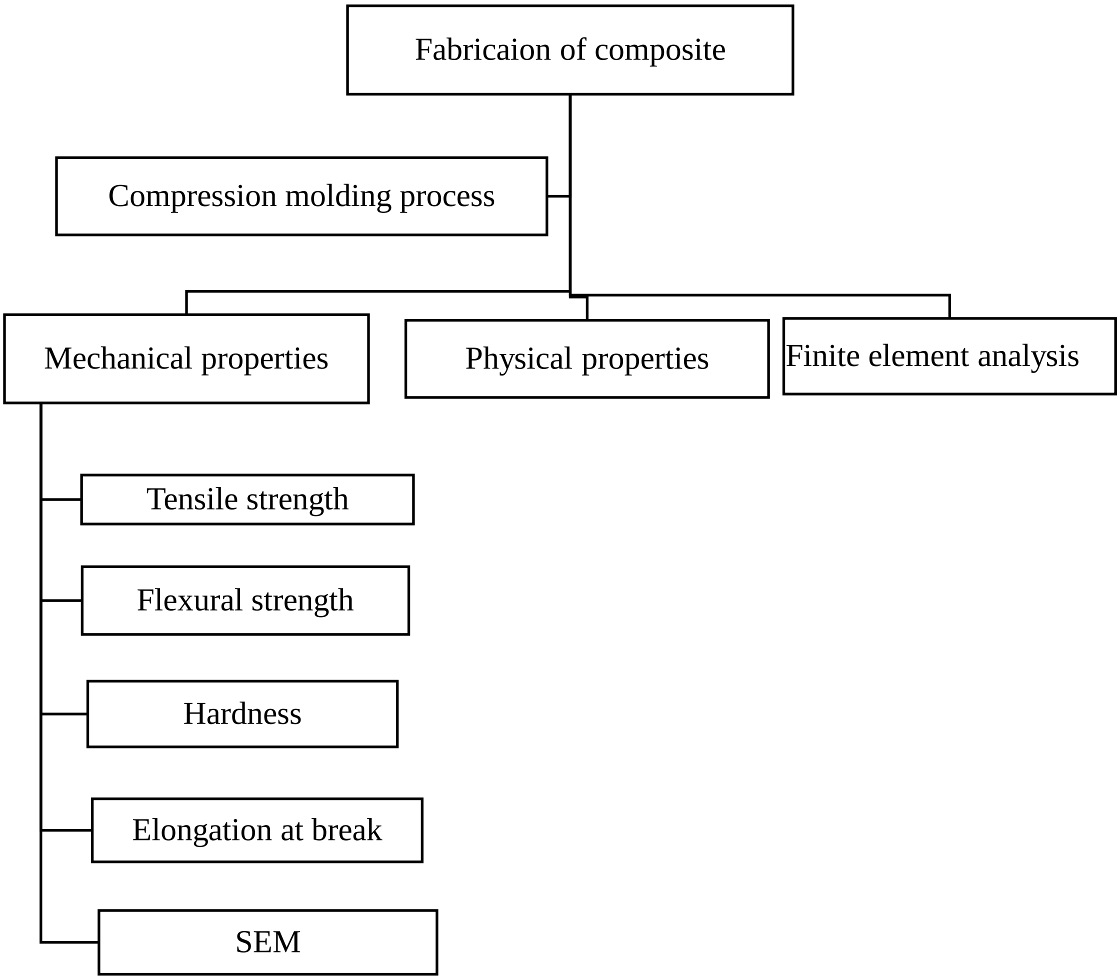

Figure 5: Step by step process for research methodology

CHAPTER 5

CONCLUSION

The logical world is confronting a significant issue of growing new and propelled innovations and strategies to treat compact wastes, especially non-normally reversible polymers. The procedures to break down those squanders (wastes) are not price effective and will in this way deliver unsafe chemicals. Attributable to the over the ground, reinforced polymers with regular fibers is the approach. In this paper, a large portion of the natural fibers said were plant based however it ought to be noticed that animal-fibers like case silkworm silk, insect silk and chicken plume have likewise been utilized and the pattern ought to go on. Those filaments, both plant-based and animal-based have given helpful solutions to the new materials improvement, in the field of material science and building. Characteristic fibers are undoubtedly sustainable assets that can be developed and made inside a brief timeframe, in which the supply can be boundless as contrasted and conventional carbon and glass fibers for making propelled composites. Be that as it may, for some recyclable polymers, their general vitality utilization amid gathering, remolding, refining and recycling forms must be considered to guarantee the harm of the common cycle would-be kept as negligible.

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