# A REVIEW PAPER ON STUDY OF MECHANICAL PROPERTIES OF JUTE AND HEMP EPOXY POLYMER COMPOSITES

**Anuj Garg[1], Shyam Lal[2]**
M.Tech. Student[1], Professor[2]
Noida Institute of Engineering and Technology, Greater Noida

Abstract: A Composite material is a mix of two and more material those have very different properties. These materials give the composite unique properties by working together. However, the individual component in the finished structure remains separate and distinct differentiating composites from mixtures and solutions. Composites have many important advantage as a result of these are made by engineering processes and mainly useful to reduce the weight and therefore to extend the efficiency. . Due to incompatibility between polymer and fiber it is more to likely form unwanted substances during processing and the poor resistance to moisture, reduce the use of the natural fibers as reinforcements in polymer. To end this, an attempt has been made to study the mechanical properties of jute and hemp epoxy composites. Composites are fabricated using simple hand lay-up compression moulding technique. Tensile test, impact test, flexural test and thermo gravimetric analysis have been done to test whether these polymer composites can be used in production of industrial applications in future.

**IndexTerms: Jute, Hemp, Epoxy, Tensile Strength, Flexural Strength, Impact Strength, TGA**

## 1. INTRODUCTION

A Composite material is a combination of two and more material those having very different properties. These materials give the composite unique properties by working together. However, the individual component in the finished structure remains separate and distinct differentiating composites from mixtures and solutions. Composites have many important advantage as a result of these are made by engineering processes and mainly useful to reduce the weight and therefore to extend the efficiency. They're usually used for buildings, bridges, and structures like swimming pool panels, automobile bodies, shower stalls, bathtubs, boat hulls, storage tanks, imitation granite and cultured marble sinks and countertops. Concrete could be a most common artificial stuff of all and usually consists of loose stones command with a mixture of cement. It's a cost-effective material and cannot compress simply. One of the most important advantages is having development of composite materials and their related design and manufacturing technologies in the past of materials. Figure 1.1 depicts the composite material. It is made of different layers. The layers include the natural fibers and epoxy.

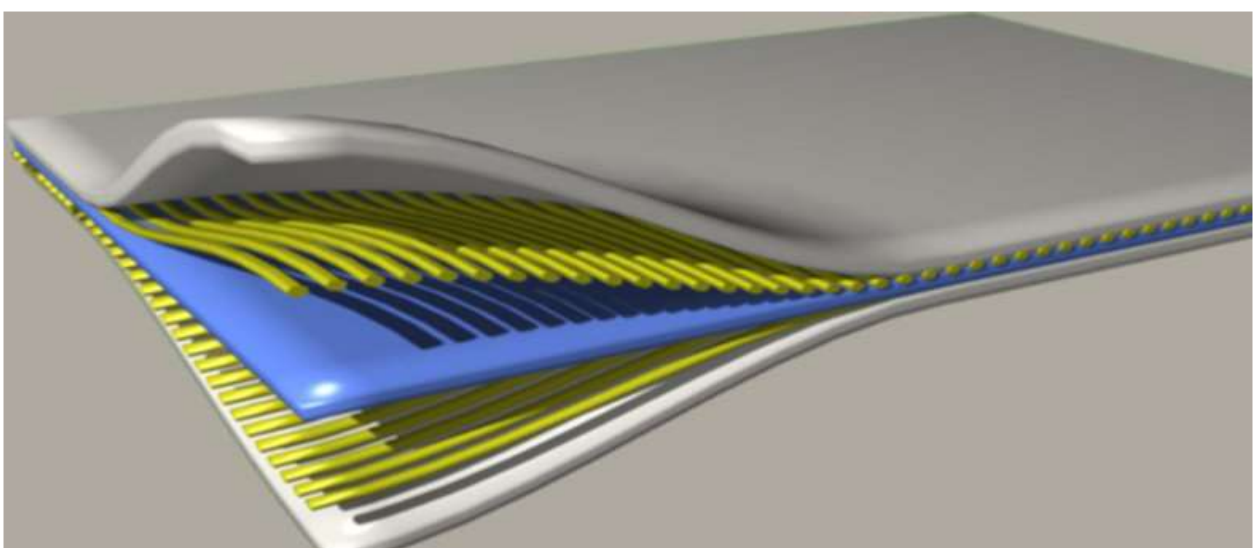


Fig 1.1 Composite Material

**1.1 USES OF COMPOSITE**

Traditional solid materials have restriction in accomplishing great mix of solidarity, firmness, strength and thickness. To d efeat these inadequacies and to fulfill the consistently expanding need of present day innovation, composites are most encouraging material of late intrigues. The composite business has started to perceive that the business utilization of composites guaran tee to offer a lot bigger business openings than the aviation part because of the sheer size of transportation industry. In this wa y the move of composite application from flying machine to other business employments has turned out to be conspicuous as of late. Composite materials are increasing wide spread acknowledgment due to their attributes of conduct with their high solidarity t o weight proportion. The enthusiasm for polymer matrix composites is because of the connection of structure to properties, for example, specific stiffness or explicit quality. Composites materials are high stiffness and high quality, low thickness, hig h temperature ability, high electrical and thermal conductivity, flexible coefficient of thermal expansion, erosion opposition, improved wear resistance etc.

**1.2 APPLICATIONS OF COMPOSITES**

There are some applications of composite materials which are given below

Because of weight sparing favorable position composites are for the most part utilized in applications like car and air ship where even a little sum in decrease of weight additionally tally. A few employments of composites are depicted underneath:

1. In flying machine it is utilized in the entryway skin on the stabilizer box balance, in lifts, rudder, stacking gear, tail, spoiler, fold body and so forth 20-30% decrease in weight is conceivable by the utilization of composites.

2. In aviation it uses to make space transport, space station where it involves the capacity of weight decrease. It is utilized on the grounds that it demonstrates low estimation of co-productive of warm development.

3. In car it uses to make body outline, suspension segments, motor segments, drive shaft, leaf spring, outside body part and so forth and it performs various capacities, for example, because of its high firmness it has great harm resilience, great surface completion and appearance, weight decrease subsequently higher eco-friendliness.

4. In outdoor supplies it uses to make tennis and racquetball, racquets, golf club shaft, head bike outline, skis, kayak protective caps, angling posts tent shafts and so forth. It is utilized in light of the fact that it structures weight decrease vibration damping plan and has high adaptability.

5. In electrical it used to made printed circuit board, PC lodging, separators, radomes battery plates. Also, it is utilized as a result of compact weight sparing

**1.3 TYPES OF COMPOSITES**

Composite materials are formed from two different materials, matrix and fibrous system. And on the basis of matrix used composites may be categories into three different categories.

1.3.1. Metal matrix composites

1.3.2. Ceramic matrix composites

1.3.3 Polymer matrix composite

**1.3.1 METAL MATRIX COMPOSITES:**

Composites material consists of two or more physical or with chemicals distinct phases. Once metal is employed as a matrix material with any of the reinforcing material it's termed because the metal matrix composites. It shows improved strength, stiffness, creep, hardness, high fatigue resistance and wear and tear resistance than different composites. Due to higher than mentioned reason it's utilized in the combustion of chamber nozzle (in the rocket, area shuttle), housings, tubing, cables, heat exchangers, structural members. Figure 1.2 shows the metal matrix composite material. It depicts the different layers of metal and hardeners.

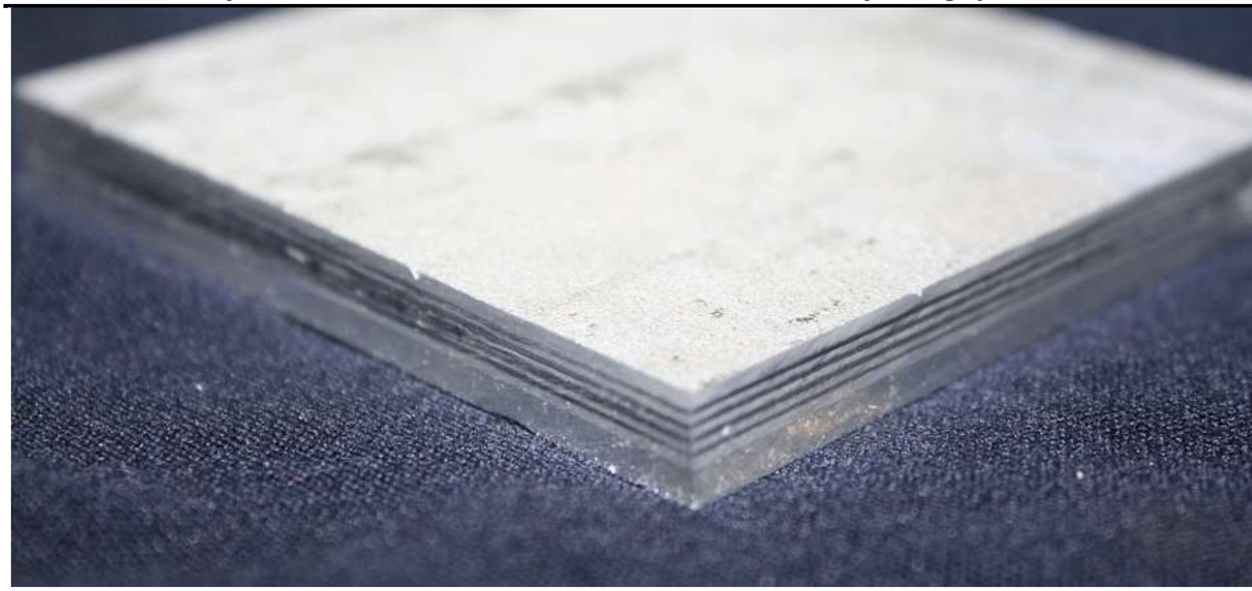


Fig 1.2 Metal Matrix Composite Material

**1.3.2 CERAMIC MATRIX COMPOSITES:**

Ceramic matrix composites are a subgroup of material that contains ceramics as a matrix material. Ceramic matrix composites have ceramic matrix like calcium, alumina and alumino silicate reinforced by silicon carbide. They possess high hardness, strength high service temperature limits for ceramics, denseness and chemical immobility. Fig 1.3 shows the fiber arrangement in ceramix matrix composites. It shows how the particles in continuous fibers are bounded with each other while in discontinuous fibers, the particles are little free.

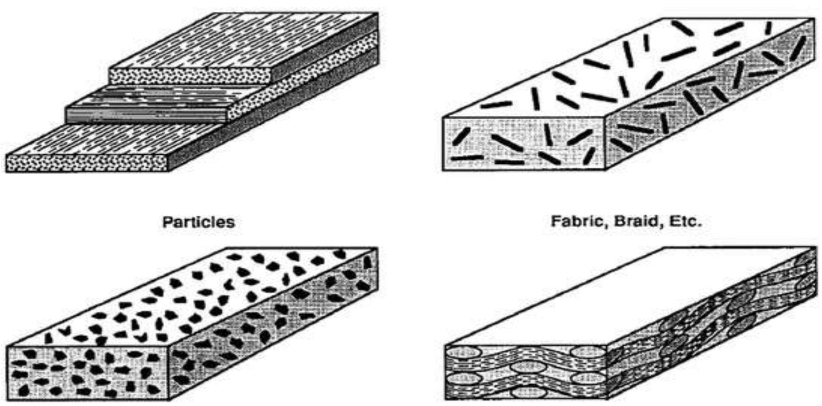



Fig 1.3 Arrangement of fibers in cermaix matrix composite material

**1.3.3 POLYMER MATRIX COMPOSITES**

Polymers make ideal materials as they can be processed easily, possess lightweight, and desirable mechanical properties. It follows, therefore, that high temperature resins are extensively used in aeronautical applications. Two main kinds of polymers are thermosets and thermoplastics. Thermosets have qualities such as a well-bonded three-dimensional molecular structure after curing. They decompose instead of melting on hardening. Merely changing the basic composition of the resin is enough to alter the conditions suitably for curing and determine its other characteristics. They can be retained in a partially cured condition too over prolonged periods of time, rendering Thermosets very flexible. Thus, they are most suited as matrix bases for advanced conditions fiber reinforced composites. Thermosets find wide ranging applications in the chopped fiber composites form particularly when a premixed or moulding compound with fibers of specific quality and aspect ratio happens to be starting material as in epoxy, polymer and phenolic polyamide resins. Figure 1.4 shows kinds of thermoplastics. There are five types of thermoplastics namely Polyethylene, Polystyrene, Polyamids, Nylons and Polypropylne.

Thermoplastics have one- or two-dimensional molecular structure and they tend to at an elevated temperature and show exaggerated melting point. Another advantage is that the process of softening at elevated temperatures can reversed to regain its properties during cooling, facilitating applications of conventional compress techniques to mould the compounds. Resins reinforced with thermoplastics now comprised an emerging group of composites. The theme of most experiments in this area to improve the base properties of the resins and extract the greatest functional advantages from them in new avenues, including attempts to replace metals in die-casting processes. In crystalline thermoplastics, the reinforcement affects the morphology to a considerable extent, prompting the reinforcement to empower nucleation. Whenever crystalline or amorphous, these resins possess the facility to alter their creep over an extensive range of temperature. But this range includes the point at which the usage of resins is constrained, and the reinforcement in such systems can increase the failure load as well as creep resistance. A small quantum of shrinkage and the tendency of the shape to retain its original form are also to be accounted for. But reinforcements can change this condition too. The advantage of thermoplastics systems over thermosets are that there are no chemical reactions involved, which often result in the release of gases or heat. Manufacturing is limited by the time required for heating, shaping and cooling the structures. Thermoplastics resins are sold as moulding compounds. Fiber reinforcement is apt for these resins. Since the fibers are randomly dispersed, the reinforcement will be almost isotropic. However, when subjected to moulding processes, they can be aligned directionally. There are a few options to increase heat resistance in thermoplastics. Addition of fillers raises the heat resistance. But all thermoplastic composites tend to loose their strength at elevated temperatures. However, their redeeming qualities like rigidity, toughness and ability to repudiate creep, place thermoplastics in the important composite materials bracket. They are used in automotive control panels, electronic products encasement etc. Newer developments augur the broadening of the scope of applications of thermoplastics. Huge sheets of reinforced thermoplastics are now available and they only require sampling and heating to be moulded into the required shapes. This has facilitated easy fabrication of bulky components, doing away with the more cumbersome moulding compounds. Thermosets are the most popular of the fiber composite matrices without which, research and development in structural engineering field could get truncated. Aerospace components, automobile parts, defense systems etc., use a great deal of this type of fiber composites. Epoxy matrix materials are used in printed circuit boards and similar areas.

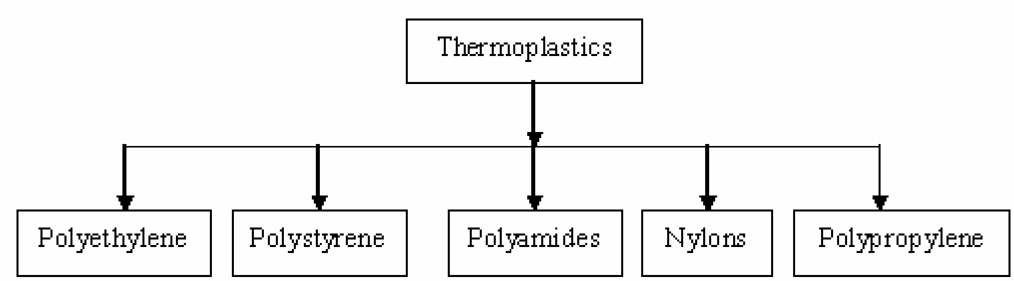



Fig1.4 Types of thermoplastic

Thermosetting resins include polyesters, vinylesters, epoxies, bismaleimides, and polyamides. Thermosetting polyesters are commonly used in fiber-reinforced plastics, and epoxies make up most of the current market for advanced composites resins. Initially, the viscosity of these resins is low; however, thermoset resins undergo chemical reactions that crosslink the polymer chains and thus connect the entire matrix together in a three-dimensional network. This process is called curing. Thermoses, because of their three-dimensional cross-linked structure, tend to have high dimensional stability, high-temperature resistance, and good resistance to solvents. Recently, considerable progress has been made in improving the toughness and maximum operating temperatures of thermosets. Figure 1.5 shows some kinds of thermosets. They are epoxy, phenolic polyamide resins and polyester.

Direct condensation polymerization followed by rearrangement reactions to form heterocyclic entities is the method generally used to produce thermoset resins. Water, a product of the reaction, in both methods, hinders production of void-free composites. These voids have a negative effect on properties of the composites in terms of strength and dielectric properties. Polyesters phenolic and Epoxies are the two important classes of thermoset resins. Epoxy resins are widely used in filament-wound composites and are suitable for moulding prepress. They are reasonably stable to chemical attacks and are excellent adherents having slow shrinkage during curing and no emission of volatile gases. These advantages, however, make the use of epoxies rather expensive. Also, they cannot be expected beyond a temperature of 140ºC. Their use in high technology areas where service temperatures are higher, as a result, is ruled out. Polyester resins on the other hand are quite easily accessible, cheap and find use in a wide range of fields. Liquid polyesters are stored at room temperature for months, sometimes for years and the mere addition of a catalyst can cure the matrix material within a short time. They are used in automobile and structural applications. The cured polyester is usually rigid or flexible as the case may be and transparent. Polyesters withstand the variations of environment and stable against chemicals. Depending on the formulation of the resin or service requirement of application, they can be used up to about 75ºC or higher. Other advantages of polyesters include easy compatibility with few glass fibers and can be used with verify of reinforced plastic accoutrey. Aromatic Polyamides are the most sought after candidates as the matrices of advanced fiber composites for structural applications demanding long duration exposure for continuous service at around 200-250ºC. Figure 1.6 depicts polymer matrix composite. For the formation of a matrix composite, one need fiber and matrix. Composites are made by adding fiber and matrix together.

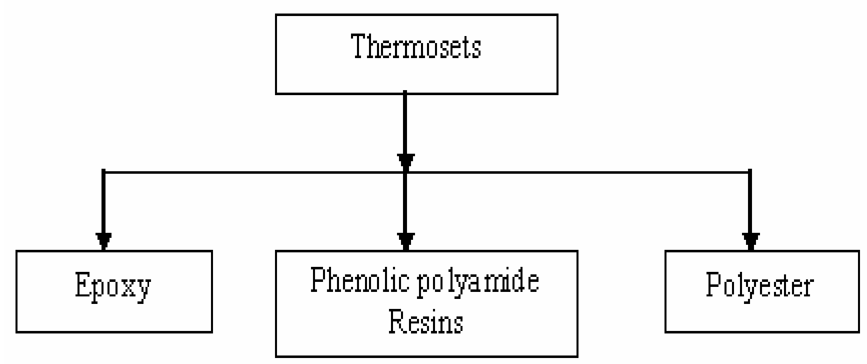



Figure 1.5 Thermoset Materials

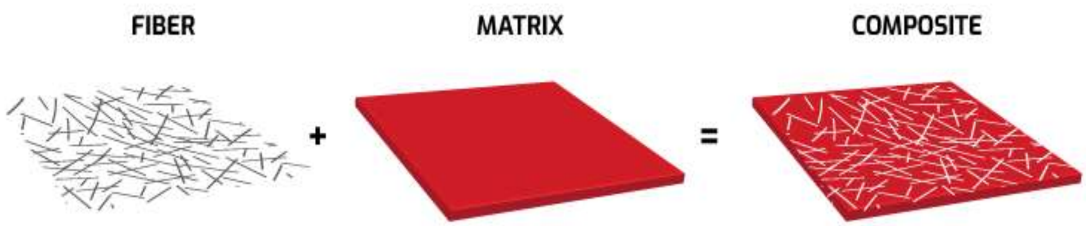



Fig 1.6

Polymer Matrix composite

**1.4 NATURAL FIBERS USED FOR POLYMER COMPOSITE**

Natural fibers have good prospective as reinforcements in polymer (thermoplastics, thermosets, and elastomers) composites. Because of high specific properties and low density of natural fibers, composites based on these fibers have very good implications in industry. The use of natural fiber composites has been studied by many researchers. Saravana Bavan and Mohan Kumar have studied the potential use of natural fibers in composite materials, their availability, processing features, mechanical and physical properties, and some of their applications in India. Lehtiniemi et al. have studied the natural fiber-based reinforcements in epoxy composites processed by filament winding. Nunna et al. have studied the significant aspects of natural fiber-based hybrid composites which are found to be predominantly affected by factors which include variation in fiber volume/weight fraction, variation in stacking sequence of fiber layers, fiber treatment, and environmental conditions. The technological development depends on advances in the field of materials. Whatever the field may be, the final limitation on advancement depends on materials. Composite materials, in this regard represent a constant endeavor of optimization in materials. The idea of natural fiber composites is not a new or recent one. Nature is full of examples where in the idea of composite materials are used. The coconut palm leaf, for example, is nothing but a cantilever, using the concept of fiber reinforcement

**1.4.1 CLASSIFICATION OF NATURAL FIBER**

Natural FIBER can be classified into two major categories:

• Animal fiber (Wool/ Hair, Silk, Goat Hair, Horse hair, Lamb wool Mulberry etc.)
• Mineral fiber (Asbestos, fibrous, tremolite)
• Vegetable fiber are further classified as:
• Primary plant fiber (form plant which are grown for fibers)
• Secondary plant fiber (form the waste product of plant)

Mainly, there are six types of plant fiber named as; bast fiber (flax, hemp, , jute, etc.), leaf fiber (sisal, banana, Abaca), fruit fiber (cotton, coir), grass fiber (bamboo, Indian grass), straw fiber (corn, rice, Wheat) and other like wood pulp and roots .

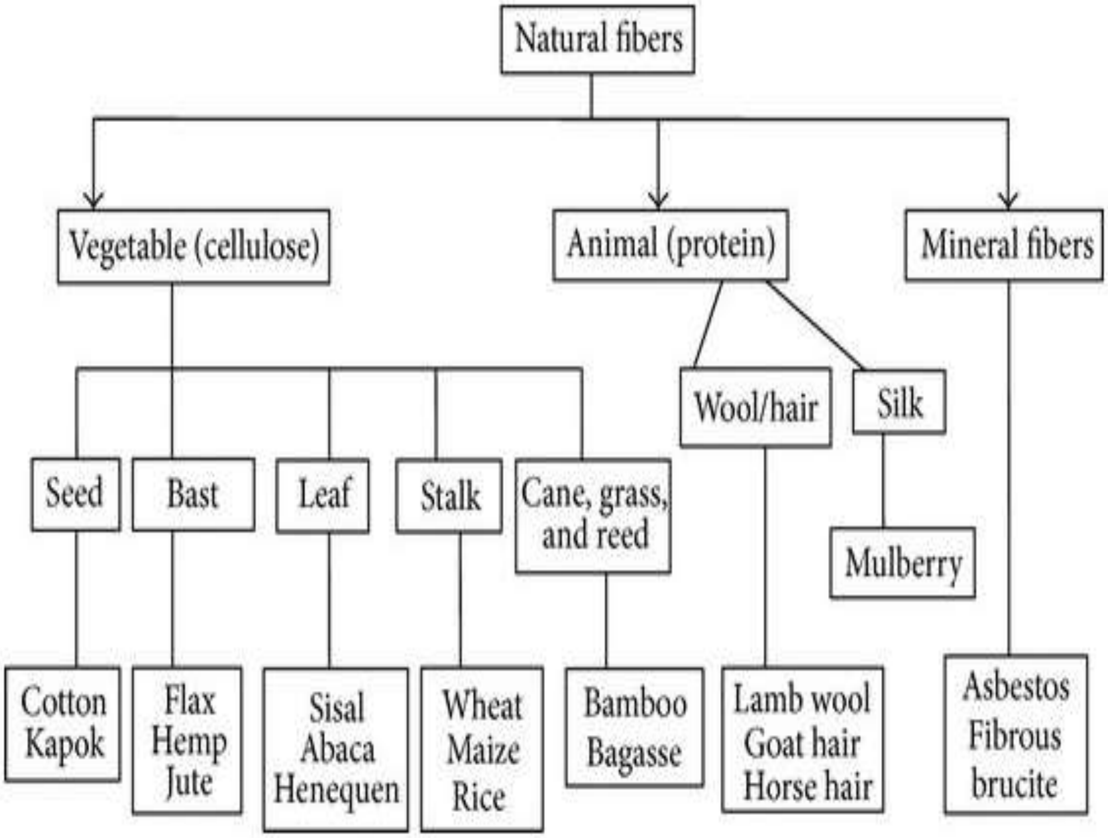



Figure 1.7 Classification of natural fiber composites

Table 1.1 Properties of some selected natural fiber

| Fibre | Density (g/cm$^3$) | Elongation | Tensile strength (MPa) | Elastic modulus (GPa) |
|---|---|---|---|---|
| Cotton | 1.5-1.6 | 7.0-8.0 | 400 | 5.5-12.6 |
| Jute | 1.3 | 1.5-1.8 | 393-773 | 26.5 |
| Flax | 1.5 | 2.7-3.2 | 500-1500 | 27.6 |
| Hemp | 1.47 | 2-4' | 690 | 70 |
| Kenaf | 1.45 | 1.6 | 930 | 53 |
| Ramie | N/A | 3.6-3.8 | 400-938 | 61.4-128 |
| Sisal | 1.5 | 2.0-2.5 | 511-635 | 9.4-22 |
| Coir | 1.2 | 30 | 593 | 4.0-6.0 |
| Softwood kraft pulp | 1.5 | 4.4 | 1000 | 40 |
| E-glass | 2.5 | 0.5 | 2000-3500 | 70 |
| S-glass | 2.5 | 2.8 | 4570 | 86 |
| Aramid (std.) | 1.4 | 3.3-3.7 | 3000-3150 | 63.0-67.0 |
| Carbon (std. PAN-based) | 1.4 | 1.4-1.8 | 4000 | 230-240 |

## 1.5 CHEMICAL COMPOSITION OF NATURAL FIBER

### 1. CELLULOSE

Since its segregation by Anselme Payen in 1838, there has been a ceaseless enthusiasm into the structure and properties of cellulose. While these unique examinations were on cellulose from plants, its quality has been appeared in growths, green growth, microscopic organisms and in certain creatures, for example, ocean squirts (ascidians). Cellulose is the real structure square of wood; as in most plants, it makes up somewhere in the range of 40% and half of the dry mass of timber (Desch what's more, Dinwoodie, 1996) and of plants. Glucose ($C6H12O6$) is delivered in plants and trees by the demonstration of photosynthesis. The glucose units are then transported down to the cambial zone where they bond together straightly to shape cellulose. Synthetically, cellulose is the polymer of the hexose, ß-D-glucopyranose, with the polymer joins being between the fourth and the first carbons on the particles.

### 2. HEMICELLULOSE

Hemicellulose, second to cellulose in bounty, contrasts extraordinarily from cellulose. The particles are shorter with a DP of somewhere in the range of 150 and 200 and are developed of various heteroglycan sugar units, contingent on the species from which they are acquired, ie, hardwood, softwood or agrifibers. Just as glucose, hemicellulose can contain principally the mannose and galactose, yet they can likewise contain thepentosesxylose what's more, arabinose. The hydroxyl bunches in the ring structure can likewise be supplanted by methoxyl and acetoxyl gatherings. The contrasting sugars may likewise be available in their uronic corrosive structures.

### 3. LIGNIN

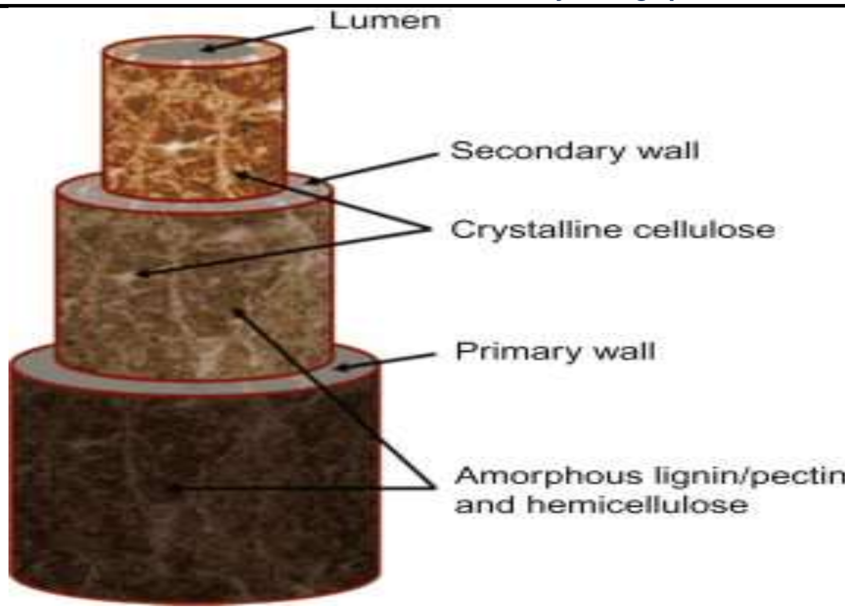
lignin in hardwoods is made out of syringyl and guaicyl units in changing proportions; lignin in softwoods is made out of generally guaiacyl units (over 95%) and little measures of p-hydroxyphenyl units, while the lignin from agroplants contain all three units (H, G, S) in critical sums with various proportions, making its structure progressively unpredictable (del Río et al., 2012). Additionally, lignin presents distinctive cross-connecting degrees and structure unbending nature, contingent upon the sort and the substitution degree. Throughout the years, there have been a scope of strategies created for the extraction of lignin from bio-based materials. The extraction of lignin, ordinarily from hardwoods with fluid ethanol at high weights and temperatures is known as the Alcell procedure or then again organosolv process, which creates low sub-atomic weight lignin portions (Aronovsky and Gortner, 1936; Kleinert, 1974; Pye and Lora, 1991; Pan et al., 2006). The acidic depolymerization and discontinuity of lignin is ordinarily alluded to as Klason lignin, first created by the Swedish researcher Johan Peter Klason in 1893 for the arrangement of unadulterated lignin from spruce, through prehydrolysis with sulphuric corrosive.

### 4. TERPENES, WAXES, ACIDS AND ALCOHOLS

Because of the biosynthetic pathways of plants, every speices is fit for delivering its claim singular scope of concoction parts. A considerable lot of the scents unmistakable for wood and plant species are because of the mix of these mixes, regularly alluded to as unpredictable natural mixes (VOCs). Among the scope of mixes that involve VOCs are terpenes, waxes, acids and alcohols.

### 5. TERPENOIDS

Terpenoids are a scope of mixes dependent on isoprene units, a C5-building unit gotten normally from mevalonic corrosive. Full subtleties on the biosynthesis of terpenoids can be found in an assortment of productions (eg, Breitmaier, 2006). The nearness of terpenoids inside a plant has been credited as a defensive framework against natural assault or worry amid development, with the differing needs of plant insurance being illustrated by the way that more than 20,000 terpenoids are known and ordered. They are created in cell organelles, to be put away inside a structure until required. The degree of variety is an aftereffect of the polymeric properties of the C5 units. Ordinarily, monoterperoids (C10 mixes) and sesquiterpenoids (C15 mixes) are known as basic oils, while diterpenes (C20 mixes), as a result of their higher atomic loads, are known as tars.




1.8 Chemical composition natural fiber

**1.6 JUTE FIBER**

Jute is multicelled in structure. Jute fiber is commonly gotten from the steam of a jute plant. It is a yearly plant that develops to 2.5-4.5 m and twists in monsoon. Jute is a lingo cellulosic fiber since its significant synthetic constituents are lignin and cellulose. The warm and electrical conductivity, natural corruption, inclination to mold and moths, capacity to shield from warmth, cold and radiation, response to sun and light, and so on are controlled by cell constitution and morphology. The chemical composition of the jute fiber has been accounted for by numerous scientists. Among various normal strands, jute filaments are effectively possible in fiber and texture frames with great warm and mechanical properties. The characteristic properties of jute fiber, for example, low thickness, high ductile modulus and low extension at break and its particular solidness and quality tantamount to those of glass fiber draws the consideration of the world. Over several years it has been utilized in the uses of ropes, beds, sacks and so forth. High quality and new employments of this fiber can make more opening for work in the country part . Jute has likewise got applications in the vehicle business and pressing materials. Dissimilar to cotton and the vast majority of the sustenance crops, jute does not require any pesticides and compost and thus is a ―pure green‖ agro-item. Riverflats, melancholies and saline-soluble base soils are especially appropriate for the jute ranches. Jute is generally developed in nations like India, Bangladesh, China, Nepal and Thailand. About 95% of the worldwide generation of jute filaments is delivered by these nations.

**1.6.1 STRENGTH OF JUTE AS REINFORCING MATERIAL FOR COMPOSITE**

1. Jute is bio-degradable.
2. Jute poses no threat to the atmosphere as a result of it neither emits deadly gases nor harmful chemicals.
3. Jute won't cause the issues just like the artificial material in waste management cycles through emitting venturous gases throughout combustion of lowland sites.
4. Jute makes sturdy and powerful composite, handling of that is simpler.
5. Plethoric handiness of jute fiber.

Fig 1.9 Raw Jute fiber

### 1.7 HEMP FIBER

Hemp has been cultivated for a minimum of 6000 years and it's going to be one of the oldest non-food crops. The foremost usual purpose of hemp cultivation is to isolate the fibers present within the bark on the hemp stem surface, for production of ropes, textiles and paper. Other helpful materials from hemp are the seed, which can be used for oil production and cannabinoids for medical, religious and recreational functions. Hemp originates from Central Asia however has been cultivated from Equator to the polar circle. Plant breeding of hemp has been performed in eastern and central Europe (de Meijer, 1995) to extend the fiber yield and obtain very low contents of psychoactive substances. Legal cultivators for fiber production have thereby been obtained. The biomass yield in hemp is high, and hemp improves the soil structure (du Bois, 1982). The tall plant stems of hemp suppress weeds effectively and diseases and pests are rarely recorded. Thereby addition of pesticides isn't required. It has additionally been reported that hemp produces many times more of the necessary fiber element, cellulose, than crops like corn, kenaf and sugar cane. Cellulose is of interest, since it has very high theoretical strength and obtainable strength (8 GPa) (Lilholt and Lawther, 2000). However, the strength of single fibers of hemp is just 800-2000 MPa. It's still a high strength compared to 500-700 MPa, that could be a typical fiber strength obtained with plant fiber reinforced composites nowadays (Madsen and Lilholt, 2003). It's suspected that fiber damage introduced throughout processing of hemp for creating yarn and eventually composite processing decreases the fiber strength. So it's of interest to work out the potential for hemp fibers in composites using as gentle pre-treatment conditions as possible to keep the fibers intact. Thorough characterization of the fibers is required to explain how fiber damages affect the fiber strength. Hemp fibers have also gained interest to be used in composite materials due to concern about how the high production and disposal of artificial fibers affects the environment

#### 1.7.1 STRENGTH OF HEMP AS REINFORCING MATERIAL FOR COMPOSITE

1. Hemp fiber is highly cost-effective.
2. It has high tensile strength and stiffness.
3. It is ideally suited for needle-punched nonwoven products.
4. It has been effective replacement for glass fiber.
5. It reduces moulding time
6. It reduces weight in finished part.
7. It is easy to process and recycle.
8. It can be customized to meet a variety of specifications and different manufacturing systems.
9. Its consistent quality and availability of supply is possible.

## 2. MATRIX

The matrix properties decide the opposition of the PMC to the majority of the degradative procedures that in the long run reason disappointment of the structure. These procedures incorporate effect harm, delamination, water assimilation, chemical attack, and high-temperature creep. In this way, the grid is normally the powerless connection in the PMC structure. The network period of commercial PMCs can be delegated either thermoset or thermoplastic.

### 2.1 EPOXY

Epoxies are best known for their superb bond, compound and warmth obstruction, mechanical properties, and extraordinary electrical protecting properties. The synthetic obstruction of epoxies is astounding against fundamental arrangements (best decision for salt water tanks). Epoxies are more costly than polyesters, and cure times are longer, however their all-encompassing scope of properties can make them the cost/execution decision for basic applications. The epoxy pitches are framed by a response of an epoxide (like epichlorohydrin) with a hardener or polyamine (like triethylenetetramine) that has gigantic cross-connecting to make an exceptionally extreme but then solid polymer. The thickness of epoxies is another progression higher than polyesters or vinyl esters. Most epoxies begin in the scope of 900 centipoise. Traits of epoxy gums incorporate very low shrinkage, great dimensional steadiness, high temperature obstruction, great weariness and adherence to fortifications. Given the broad twofold holding of the sap, ordinary shrinkage is not exactly may be normal dependent on its quality. Epoxy gums zone unit low relative atomic mass pre-polymers or higher relative sub-atomic mass polymers that generally contain at least 2 epoxide groups. The epoxide bunch is furthermore for the most part refered to as a glycidyl or oxirane group.
A wide vary of epoxy resins are created industrially. The raw materials for epoxy production are nowadays mostly crude derived, though some plant derived sources are currently changing into commercially on the market (e.g. plant derived glycerin wont to build epichlorohydrin).

Epoxy resins are compound or semi-polymeric materials or AN Oligomer, and per seldom exist as pure substances, since variable chain length results from the chemical action reaction won't to manufacture them. High purity grades may be created sure applications, e.g. employing a distillation purification method. One drawback of high purity liquid grades is their tendency to make crystalline solids because of their extremely regular structure, that need melting to modify process.

An important criterion for epoxy resins is that the epoxide cluster content. this can be properly expressed because the certain quantity of substance of epoxide teams within the material B into consideration, calculated because the magnitude relation of the quantity of substance of epoxide teams during this material B, n(EP), divided by the mass m(B) of the fabric B into consideration, during this case, the mass of the organic compound. The SI unit for this amount is "mol/kg", or multiples thence. Deprecated quantities that are still in use area unit the supposed "epoxide number" that is (not variety and will so not be cited per se, but) the magnitude relation of the quantity of substance of epoxide teams, n(EP), and also the mass m(B) of the fabric B, with the SI unit "mol/kg", or the supposed "epoxide equivalent weight", that is the magnitude relation of the mass of a sample B of the organic compound and also the quantity of substance of epoxide teams gift therein sample B, with the SI unit "kg/mol". The supposed "epoxide equivalent weight" is solely the inverse of the supposed epoxide variety.

**2.2 SPECIFICATIONS OF EPOXY**

Table 2.1 Specifications of Epoxy

| | |
|---|---|
| Glass transitiontemperature (Tg) | 120 - 130 °C |
| Tensile strength | 85 N/mm² |
| Tensile Modulus | 10,500 N/mm² |
| Elongation at break | 0.8% |
| Flexural strength | 112 N/mm² |
| Flexural Modulus | 10,000 N/mm² |
| Compressive Strength | 190 N/mm² Coefficient of linear |
| Water absorption | 24 hours at 23°C 5-10 mg (0.06-0.068%) |

**2.3 PROPERTIES OF EPOXY**

The primary reason for epoxy's quality is its excellent mechanical strength. Fastening is commonly the sole various. Epoxy is sort of invariably cheaper and quicker than fastening. Epoxy conjointly has glorious resistance to chemicals. When setting, there's no worry of a chemical process which will weaken the seal. It conjointly resists heat. That resistance makes it ideal for physics and electrical systems and different industrial applications. Those who use epoxy are conscious of the excellent mechanical strength and low hardening contraction. They conjointly apprehend the epoxy resins are well-balanced industrial materials and suited to a broad vary of applications.

Engineers are round-faced with issues regarding cooling, electrical insulation, adhering dissimilar substrates, lightweight weight, sound wetting, vibration, and reduction corrosion. It looks needs to be thought-about, as well as, grouping prices. Epoxy is AN adhesive formulation that meets all of these issues. Its thermal and electrical properties, strength, and sturdiness are what epoxy is noted for. Those properties in conjunction with the resistance to immersion and hostile chemical vapor are the rational epoxy usually is chosen by engineers.

Performance properties control by epoxy is:

- Biocompatibility
- Environmentally friendly
- Flame resistant
- Food Safe


Fig 2.1 Epoxy Resin

.

**3. LITERATURE SURVEY**

This chapter includes a survey of the past research already available involving the issues of interest. It presents the research works on the natural composites and the effect of various parameters on the performance of composites studied by various investigators. The literature review is done based in the following points.

Nilkanth Panwala and Dr Piyush Jain [1] investigated about the wear behavior of composite material such as function of load, velocity, sliding distance etc. They also checked various test parameters and their interactions about minimum wear rate of composite material.

Satish Pujari , A Ramkrishna [2] reviewed that jute and hemp Fiber composite both have high mechanical & physical properties. Utilization and application of this composite technology is cheaper and gives high performance. Many advantages of these two are such as combining the two useful composites, cheaper manufacturing cost etc. makes them useful in various fields of engineering and high performance applications such as leisure and sporting goods etc.

Unel et al [3] studied abrasive wear behavior of polymeric material. They concluded that the specific wear rate decreases with the decreases in abrasive surface roughness they also concluded that the abrasive wear inclusive micro cracking, micro cutting, micro ploughing mechanism.

K.P. Ashik and Ramesh S. Sharma [4] studied that comparing natural and glass fiber reinforced composite found that natural fiber composite were superior in industrial application they also indicate there is a possibility of jute fiber reinforced polyester composite. So they investigate static and dynamic test through FE simulation.

Saira Taj and Muanwar Ali [5] reviewed that natural fiber when used as reinforcement complete with such technical fibers. These fibers have advantages such as good mechanical properties on the other hand there is disadvantage is difficulty in recycling such as glass fiber.

Kuruvilla joseph, Beena james [6] reviewed the use of Sisal fiber as reforming agent in polymer based composite. These fibers have good potential but due to the low density and high specific properties of these fibers may have very good implications in the automotive and transportation industry.

C.W. Ngoung and D Sujan [7] reviewed that natural polymer composite are more environmental friendly as compare to the polymer composite with synthetic fibers reinforced The advantage of having high hydroxyl content in natural fiber makes a susceptible to water absorption that affects the material mechanical properties.

Begum k & Islam M.A [8] investigated that natural fiber are lighter composite material as compared to synthetic fiber with equivalent mechanical strength. These fibers are biodegradable and their production lead to lower emission then that in the production of synthetic fiber. The production of natural fiber is labor intensive hence it will create employment opportunities and decrease poverty in developing countries.

Oisik das and Loura Tomppo [9] investigated that NFPCS don't possess a similar level of performance as e.g. Glass fiber reinforced composites which is mainly due to the incompatibility between hydrophilic natural fiber and hydrophobic polymer matrix.

Laxman Naik and K Gopal Krishna [10] reviewed the chemical and mechanical properties of like sisal and jute reinforced polymer composite. They are cheap, rich in cellulose, easily removable source with the potential for polymer reinforcement

May pt el [11] investigated that the impact of the interface property from well controlled surface treatment in the case of natural fiber. The fracture behavior and the mechanical properties of a NFPC depend on the properties of the constituents and region of the fiber surface where the stress transfer occurs.

Hemant Patel and Dr. Sharma [12] reviewed that Finite element analysis of jute and banana fiber reinforced hybrid polymer matrix composite and optimization of design parameters using ANOVA technique. In this work, an investigation is carried out on jute fiber the test is performed Universal Testing Machine and the surrounding temperature is $35^0$c a tensile test specimen placing in the testing machine and applying load until it fracture.

Amar Patanai [13] studied the three body abrasive wear and mechanical properties of particulate filled glass epoxy composites their work aimed to study on abrasive wear behavior of randomly oriented glass fiber (RGF) reinforced with epoxy phase in filled with $Al_2o_3$, SiC and pine bark dust.

T Madhusudhan and Keerthi Swaroop G. [14] reviewed that the mechanical properties of untreated / alkali treated, hemp fiber/ epoxy, untreated/ alkali treated hemp fiber/ vinyl ester and treated hemp/ jute/ epoxy were investigated sure. The tensile flexural and impact properties of the composite as a function of fiber content were analyzed.

M.N.M Ansari [15] studied that natural fiber rein forced polymer has beneficial properties such as low density , less expensive and reduced solidity when compare to synthetic product By using natural fiber an reinforcement for polymeric composites introduces positive effect on the mechanical behavior of polymer.

M. Indra Reddy and all [16] studied that Environmental consciousness and an increasing concern with the greenhouse effect have stimulated the construction, automotive, and packing industries to seem for sustainable materials that can replace conventional synthetic polymeric fibers. Natural fibers seem to be a good alternative since they are readily available in fibrous form and can be extracted from plant leaves at very low costs. In this work we have studied the mechanical properties of the composites made by reinforcing Jute, Pineapple leaf fiber and Glass fiber as 1:1:1 ratio into a polyester and epoxy resin. The fiber content in the composite was varied from 0.18 to 0.42 by volume fraction and the variation of mechanical properties such as tensile, flexural and impact properties in each case were studied. The results show that the Jute, Pineapple leaf fiber and Glass fiber reinforced epoxy composite exhibited better mechanical properties than Jute, Pineapple leaf fiber and Glass fiber polyester composite.

U.Magarajan and all [17] Polymer Matrix Composites (PMCs) are the promising materials for numerous engineering applications. In this paper, the static mechanical properties of both Glass Fiber (PMC) and Glass-Jute Fiber (HPMC) reinforced composites were studied and compared experimentally. The hand lay technique was adopted to fabricate the composites. The static mechanical properties namely hardness, yield strength, Ultimate tensile strength, flexural strength and impact were obtained as per ASTM standards. Quantitative comparison of these properties between PMC and HPMC reveals improvement of flexural strength in HPMC.

Taneli Vaisanen and all[18] reviewed that the benefits of using bio-based components rather than using the synthetic ones are better in every term. In this, they tested the hemp fiber by different modification methods with epoxy resin. The results showed that steam treated hemp fiber absorbed least water during 28 days at 65% relative humidity(RH) and 20 Co whereas the enzymatic treatment led to the lowest water absorption values at 85 %(RH) and 20 Co.

M,Indra Reddy and all[19] researched the tensile, flexural and impact energy of composites using Hemp, Jute and Glass fiber in the same ratio i.e. 1:1:1 into an unsaturated polyester resin. In which they found that the tensile, flexural and impact strength rose with increase in fiber content.

Ivana Schwarzova and all [20] reviewed the properties of hemp fiber reinforced composites to be used in civil engineering as a component part of sustainable construction. They also stated that hemp has excellent mechanical properties as a natural fiber. Natural fibers have high strength to low weight ratios and have good sound and thermal insulation properties.

Akash and all [21] investigate the different wt% of sisal /hemp fiber's mechanical properties and moisture absorption when they are reinforced with epoxy resin. A 40 wt% of sisal /hemp fiber reinforced hybrid composite gives maximum flexural and compression strength. They also reviewed that hemp /sisal fiber can be used to low cost bio-composites which gives good strength to weight ratio.

Luca Boccarusso and all [22] investigated the manufacturing of bio-composite with high mechanical properties produced through a new process. Several hemp/bio-epoxy resin grid structures with different density (in the range of 0.47-0.80 g/cm3) and thickness (in the range of 4.3-12.3 mm) were obtained and their properties were greatly checked. The results showed that it can be used as core for sandwich composite structures.

Abdul Qadeer Dayo and all [23] reviewed the effects of fiber diameter and volume % loading increased and hemp fiber diameter decreased, 28.2% higher water uptake was observed on 20 vol % loading as the diameter was reduced from 20 to 80 mesh has been prepared according to ASTM standards and the experiment has been carried out by using universal testing machine (UTM).

Ch. Arun Babu and all [24] evaluated the mechanical properties such as tensile strength, flexural strength and impact strength of the fabricated jute-hemp fibers reinforced hybrid composites.

S.Sair and all [25] reviewed the use of hemp fiber as reinforcement in the preparation of partially biodegradable green composites. They have prepared the composites rigid polyurethane (PU) and hemp fiber (HF) at different loading rates. The results show that, the thermal conductivity of composites increases linearly with density. The mechanical properties of composites with 15% wt fibers loading provided a 40% increase in strength. Therefore, it can be said that it is a good solution for building insulation.

**4. CONCLUSIONS:**

In this review paper, it is concluded that the mechanical and physical properties of hemp and jute fiber have variations. To remove these variations tensile test, flexural test, impact test and thermo gravimetric analysis are to be carried out to remove such variations.

5. **REFERENCES**

1. Nilkanth Panwala of Review- Wear Characteristics of Composite Material of ISSN:2394-1766 (2017)

2. K .Kannnan, S Harikanand of Analysis Mechanical Properties of Jute and Banana Fiber Reinforced Vinyl Ester Composite Of ISSN : 2347- 6710 (2014)

3. Satish Pujari , A Ramakrishna, of Comparison of Jute and Banana Fiber Composite : Review of ISSN :2347- 5161 ( 2014)

4. M.K. Gupta , Ajay Bharti of Natural Fiber Reinforced Polymer Composites : A Review on Dynamical Properties of CTFTTEMS-.ID.555563 (2017)

5. K.P Aashik , Ramesh S Sharma of A Review On Mechanical Properties of Natural Fiber Reinforced Hybrid Composites of Immce.2015.35044

6. Kuruvilla joseph, Romdildo Dias Toledo Filho.of A Review On Sisal Fiber Reinforced Polymer Composites of v.3, n.3, p.367-379 (1999)

7. C.W. Nguong, S.N.B Lee of A review on Natural Fiber Reinforced polymer Composites of World Academy Of Science , Engineering and Technology, 73 2013

8. Saira Taj, Munawar Ali of natural Fiber Reinforced Polymer Composites of sci 44(2): 129-144.2007(2007)

9. Begum K. and Islam M.A. of Natural Fiber as a Substitute to Synthetic fiber in Polymer Composites A Review Of ISSN 2278-9472 (2013)

10. Taneli Vaisanen , Oisik Das of A Review on New Bio Based Constitute for natural fiber polymer composites of 149(2017)582-596 (2017)

11. D. Chandramohan, K. Marimutha of A review on natural fibers of IJRRAS 8(2) (2011)

12. M. Thiruchitrambalam, A Athijaya of A review on the natural fiber- reinforced polymer composites for the development of roselle fiber- mreinforced polymer composite of journal of natural fibers volume 7, 2010- issue 4 (2010)

13. L Laxman Naik, K Gopal Krishna of A Review on mechanical properties of sisal and banana reinforced composite of ISSN 2091-2730 (2015)

14. Laydh Mohammed, MNM Ansari of A Review on Natural Fiber reinforced polymer composite and its application of IJPS 243947 (2015)

15. Hemant Patel , Prof Ashish Parakhe Of Mechanical Behaviours of Banana and sisal hybrid composites reinforced with epoxy resin of ISSN – 2394-3629 (2016)

16. Prof T Madusudan, Krthi Swaroop G of A review on mechanical properties of natural fibers reinforced hybrid composites of ISSN: 2395-0072 (2016)

17. Sapuan SM, Harimi M, Maleque MA. Mechanical properties of epoxy/coconut shell filler particle composites. Arab J Sci Eng 2003;28(2B):171–81.

18. Luo S, Netravali AN. Mechanical and thermal properties of environmentally friendly green composites made from pineapple leaf fibres and poly(hydroxybutyrate-co-valerate) resin. Polym Compos 1999;20(3):367–78.

19. Belmares H, Barrera A, Monjaras M. New composite materials from natural hard fibres. Part 2: Fatigue studies and a novel fatigue degradation model. Ind Eng Chem Prod Res Dev 1983;22:643– 52.

20. Casaurang M, Herrera P, Gonzalez I, Aguilar VM. Physical and mechanical properties of henequen fibers. J Appl Polym Sci 1991;43:749–56.

21. Ahmed EM, Sahari B, Pedersen P. Non-lineabehaviour of unidirectional filament wound COTFRP, CFRP, and GFRP composites. In: Proceedings of World Engineering Congress, WEC 99, Mechanical and Manufacturing Engineering, KualaLumpur; 1999, p. 537–43

22. Khalid AA, Sahari B, Khalid YA. Environmental Effects on the Progressive Crushing of Cotton and Glass Fibre/Epoxy Composite Cones. In: Proceedings of the Fourth International Conference on Advances in Materials and Processing Technologies, 98, Kuala Lumpur; 1998, p. 680–89. Fuad MYA, Rahmad S, Azlan MRN. Filler content determination of bio-based thermoplastics composites by thermogravimetric analysis In: