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Review Article

Approaches of material selection, alignment and methods of fabrication for natural fiber polymer composites: A review

S. Ramu
Saveetha School of Engineering, Saveetha Institute of Medical And Technical Sciences, Chennai (Tamil Nadu), India
N. Senthilkumar*
Saveetha School of Engineering, Saveetha Institute of Medical And Technical Sciences, Chennai (Tamil Nadu), India

*Corresponding author. Email: senthilkumarn.sse@saveetha.com

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Abstract
The recent superiority of the composite materials is cautiously focusing on environmental adoption of natural fiber composites. The major source of the natural fiber materials covered in the globe, especially natural fibers, is plant-based, animal-based and mineral-based. Eco friendly based material can save the environment and recycling of the material is possible, as well as important criteria. Hence engineers ultimately focused on natural fiber polymer matrix materials to save the environment, pollution control, plastic manipulation, etc. The literature work was studied to identify natural fiber material possession. The major goal of the present review was to identify material characterization and appropriate application, mainly offering to enhance mechanical properties, flexural strength, electrical properties, thermal properties etc. The major consequence of the natural fiber is hydrophilic treatment. There is poor interfacial adhesion between the addition/filling substances and poor mechanical characteristics. All of these shortcomings constitute a critical issue. This review presents numerous sorts of natural and synthetic polymers, natural fibres such as jute, ramie, banana, pineapple leaf fibre, and kenaf, etc.; short and long fibre loading methods, fibre fillers in micro and nanoparticle, American society of testing and materials (ASTM) standard plate dimensions, fabrication methods such as hand lay-up process, spray lay-up process, vacuumed-bag, continuous pultrusion, and pulforming process, etc.; industries and home appliances such as automotive parts, building construction, sports kits, domestic goods, and electronic devices. The review lists various material combinations, fibre loading, fillers, and matrix that can aid in the improvement of material properties and the reduction of failures during mechanical testing of composites.

Keywords: Composite Materials, Flexural Strength, Hydrophilic Treatment, Mechanical Properties, Thermal Properties

INTRODUCTION

Over the last few decades, raw materials such as wood, sticks, bricks, stones, animal skins, bones, and so on have been collected from the surrounding nature to prepare composites. The peoples are interested in weaving natural fibres to make cloths with composed materials like silk and cotton. The scientists have observed the need for the materials and predicted to make special synthetic materials. Predominantly synthetic materials from plastics can be the organic and inorganic categories. Customer denoted as synthetic organic plastics and essentially named as Polymers. As it was identified the polymer from the process of polymerization to make the monomers in continuous chain formation in the composition of carbon and hydrogen. Some other elements are contained nitrogen, oxygen, silicon, chlorine etc.

In general polymers are arranged by the process of polymerization and bonded monomers in-line chain mode. Composites are prepared for certain causes and some factor consideration such as customer requirement, environment safety, resource utilization, avoidance of certain hazardous, research interest, cost optimization etc. Different material compositions are invented newly in terms of next-generation material, wherein identified the material composed added or subtracted, binding materials, coring materials, surface polishing materials, some treated surface materials, special coating materials, additives etc. So the engineering side searched for the suitable term called Composite. So certain combination is required for matrix

and reinforcement to make the adscript character of the one material. Based on the material dimension, alignment and angle position will affect the properties of the material (Sai *et al*., 2016).

Usage of the composite is increased day by day and adoption increased throughout the industry and composite are lightweight, have more stiffness, more strength etc. Additionally their corrosion and chemical resistance in nature increases the service life during the cycle. Fig. 1 highlights the application determining excellent mechanical properties and low specific weight and in large scale use of composite materials (in %) as Airbus, Aircraft and Military Vehicles in the Global.

More volumes of materials are tried in the recent natural composites materials prepared along with the matched resin. Especially composite structure compared with wood to meet the effective requirements. Then the research team focused on the next gen of bio composites with the example of fiber-reinforced composite with additional combinations of filler and resin called Hybrid. Dreadful factors were considered to develop new generation lightweight composites (Gowda *et al*., 2018)

INNOVATION OF NEW COMPOSITE MATERIALS

Survival of the literature behind had the experimental idea to innovate new composite materials. As its trending to innovate natural fibre-based composite to improve all technical characters, some of the materials are default nature among novelty have started from polymer composites ceramic matrixes. Both oxide and non-oxide materials are primarily developed to improve the Ceramics toughness and additional well-designed bond matrix and reinforcement can sustain maximum-temperature (Naslain *et al*., 2016).

Pioneers are notable established multifunctional composite materials and structures (MFCMS). MFCMS are reviewing various functions and trapped areas of primary structural functions such as stiffness, strength, stability, self-healing capability, etc. When comparing the mechanical qualities of the AL-WC material to the basic material aluminium alloy, the microstructure images were revealed dispersion of the reinforced particles hardly measured roughness value. Scanning Electron Microscope (SEM) analysis revealed reinforcement dispersion in the matrix as well as aggregation at positive locations. Surface toughness was evaluated using the micro-hardness method used to find material transmission (Sripathy *et al*., 2021); Narayanan and Nallusamy, 2018). Polymer composite materials are mainly used in automobile and aerospace applications and common made PMCs prepared by polyester polymer resin. The major advantage of PMCs is that they makes them flexible in industrial applications (Pei *et al*., 2016).

Thermoplastic based natural fiber composites

There are three different natural fiber based materials, plant fiber, animal fiber and mineral fiber (Fig. 2). It can be easily accessed from the globe, targeted materials are eco-friendly environmental based and more feasible for biodegradable. Fig. 3 shows polymer category natural polymer and synthetic polymer. But many researchers have developed such materials replace the synthetic materials and focused on developing natural fibre-based composites (Gowda *et al*, 2019 and Berglund, and Ericson, 1995). Advanced composite materials have determined reinforced materials such as organic and inorganic and additional with fillers. Fig. 4 and 5 illustrate polymer materials and macromolecular are called as PC, PES, PE, PEEK etc (Table. 1 and 2). (Hsissou *et al*., 2021) Organics based polymer matrix material different ranges of reinforced agents and fiber contents were composed to improve structural and mechanical properties. The matrix's PMCs role is to bind the fibres together for efficient load transfer between the materials, and matrix reinforced natural composite had better interfacial bonding between the materials and better resistance observed (Cao and Wu, 2008). Unification of the work has disputed (Deborah and Chung, 2017) again ceramic matrix composites, carbon matrix composites, or metal matrix composites. Polymer matrix composite to make easier production and classified different nomenclature of thermoset and thermoplastic materials were composed. Engineering applications such as wide variety of materials are demand for suitable customer criteria and economic factor also involved, overviewed essential need of the material, usage and customer need, mainly satisfied characteristics are material's high chemical resistance, mechanical qualities, and inexpensive cost (Berglund and Ericson, 1995).

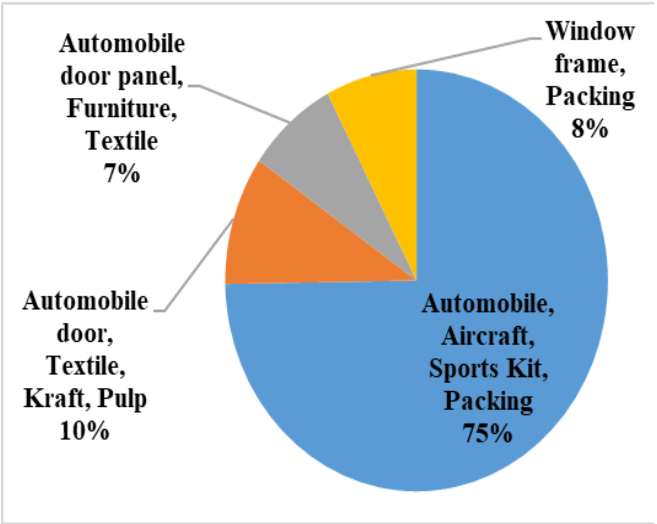

Fig. 1. *Different application categories used in % (Based on Table. 4)*

Table 1. Thermosets traits and uses *(Source: Gowda et al., 2018)*

Thermosets	Traits	Uses
Alkyl (Polyester)	Incredibly strong, moisture resistant, non-biodegradable.	Automotive body panel, industrial equipment housing and coatings.
Epoxy	Electrically insulative, low shrinkage and low density.	Adhesives, industrial equipment housing and aircraft companies.
Phenolic	Excellent dielectric strength, good mechanical strength and dimensional stability, wear resistance.	Electrical switch housing, relays, adhesives (Plywood), Electrical motor components.
Polyimides	Thermal stability, creep resistance, High radiation resistance.	Medical tubing, semi-conductors.
Urea-Formaldehyde	Very hard, scratch resistance material with good chemical resistance.	Electrical barkers, knobs and handles, adhesives, coatings and laminates.

Table 2. Thermoplastic traits and uses *(Source: Gowda et al., 2018)*

Thermoplastics	Traits	Uses
Acrylics	Good impact resistance, UV resistant, Good thermal insulator.	Washbasins and tail lights on automobiles, Swimming pools.
Acrylonitrile-Butadiene-Styrene (ABS)	Outstanding impact strength and high mechanical strength.	Automotive parts, telephone components, door handle.
Nylon	High durability, Water resistant.	Textiles, food packing
Polycarbonate	High hardness and toughness	Electrical and electronic applications.
Polyethylene	More flexural strength, brittle and rigidity.	Packing films, toys, pipes.
Polypropylene	Good fatigue resistance and chemical resistance.	Packing and food service products, radio and TV housings.

Polyethylene as matrix material

Hybridized composite materials result were observed high tensile strength and young's modulus caused by the superior material kenaf lead and similarly improved water absorption and impact properties (Akil *et al*., 2012, and Aji *et al*., 2012). Mechanical properties increase with an increase in coconut fiber reinforcement. Fabricated material high-density polyethylene 1.2% maleic anhydride grafted as a matrix and interfacial adhesion processed by palsule process (Anjali *et al*., 2014). Doum-fibers reinforcing a low-density polyethylene composite improved polymer/fiber adhesion, and evaluated mechanical and thermal properties at 30 wt% and 20wt% fiber loading in young's modulus and flexural modulus respectively. But Doum fiber summation characterized high thermal stability (Arrakhiz *et al*., 2019). The experiment carried over PE-maize fiber with HDPE resin mode to serve thermal conductivity and thermal diffusivity slanted (Trigui *et al*., 2013)

Polystyrene based composites

Experimental work pointed out various method of fibre loadings (10, 20, 30, 40 and 50%) by disguised proportion weight were mixed with high impact polystyrene form bizarre patterns of composites. Various conscious factor were targeted outcome mechanical properties SP fiber with high prominent polystyrene. The selected article (Sapuan *et al*., 2012) results were observed again mechanical properties for the surface modified PALF fillers, differentiated with untreated PALF fillers showed variance in mechanical properties and maximum ranges observed in treated surface, but polymer composite had faced poor dispersion of the fibers and the void content (Samuel *et al*., 2019)

Polycarbonates based composites

Polycarbonate has been used in engineering applications which provide excellent strength. The fibres were isolated from tamarind fruit fiber, chemically processed, and then coated with polycarbonate for surface treatment, which improved thermal stability and tensile strength (Freitag *et al*., 1991)

Polyvinyl chloride based composites

PVC biodegradable materials which have good properties and are more economical. The addition of fillers (Coconut fibre) with polyvinyl chloride/acrylonitrile styrene acrylate performed excellently (Cappucci *et al*., 2009). Adding filler polyvinyl chloride (PVC) to epoxy matrix susceptible weak adhesion and suitability for mechanical property (Firdaus *et al*., 2021).

Thermoset based natural fiber composites

Thermosets polymer major advantage low viscosity and processed by the techniques such as hand layup method, spraying method, a compression injection, resin transfer and pressure bag moulding operations and other methods are cold press moulding, pultrusion,

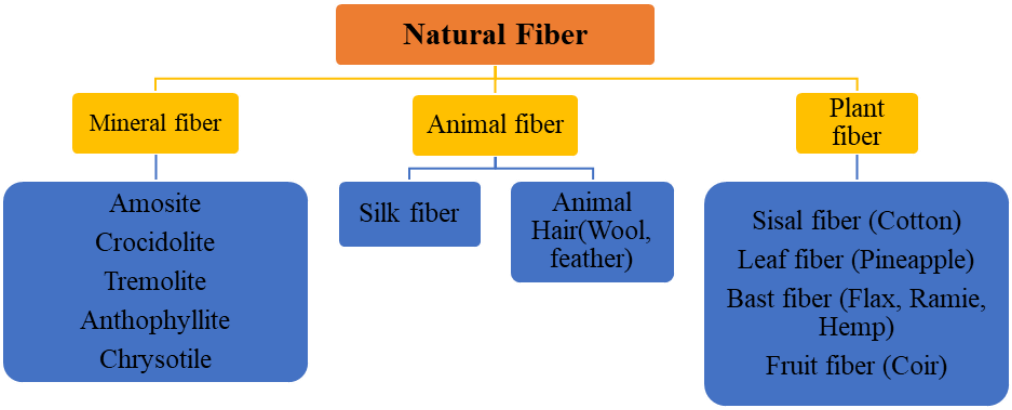

Fig. 2. *Classifications of natural fibers (Source:Mahesh et al., 2021 and Sathishkumar et al., 2014)*

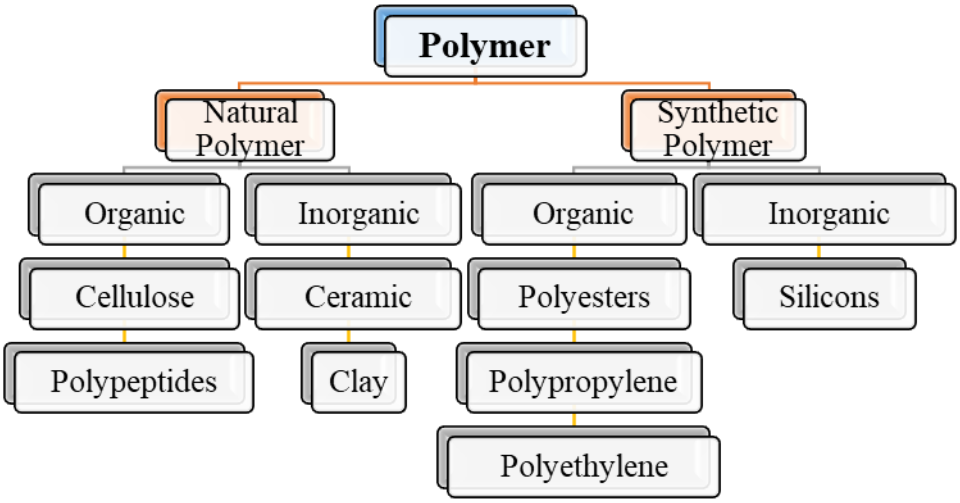

Fig. 3. *Polymer tree (Source: Sathishkumar et al., 2014)*

vacuum forming etc. Fig. 1,Fig. 6 and Fig. 7 shows natural fibre-reinforced materials used as coir, coconut fiber, kenaf, banana, Sisal, pineapple leaf given better mechanical properties and material usage in % (Table. 3). Mechanical properties were optimized fiber length 30 mm, flexural stiffness and strength increases correspondingly (Fairly 30% wt) (Devi *et al*., 1997).

Polymer matrix composites (PMCs):

Polyesters based composites

Polyester based composite materials made uniform mixing of filler and fibres and some applications may non-uniform structure of mixing materials. (Atiqah *et al*., 2014) Unsaturated polyester hybrid composites met characterization of the materials (Flexural, Tensile, Impact and wear) where identified ratio of mixing (70:30) and surface treatment comparisons for filling by kenaf materials (Treated kenaf 15/15 v/v KG fibers). Commonly epoxy resins made the perfect adhesion which improved the characteristic of the composite materials (Liu *et al*., 2009). Three different chemical resistance qualities were established in this work utilising three acids, three alkalies, and three solvents to study EFB/ woven jute/EFB and woven jute /EFB/ woven jute fiber-reinforced hybrid composites. The density and moisture content attributes in hybrid composites had improved, as evidenced by density and moisture content measurements (Jawaid *et al*., 2011). The experiment investigated for similarity in Sugar palm fibre thermoplastic composites and fiber loading as same (Sapuan *et al*., 2021) (10%, 20%, 30%, 40% and 50% by weight of SPF), but consequence had raised water absorption and swelling thickness implied through the immersion period of 168h. Article (Atiqah *et al*., 2014) itself identified 50% fiber loading condition had more issues and tried by Polydrive R600 mixer and addition tried by hot pressing operation to achieve mechanical characterization.

Many researchers explored material combinations primarily, secondary cases mechanical testing. It may fail or success either primary or secondary vice versa. Material processing investigated different composition possibilities, the use of natural fibers to stiffen PMCs, and poor adhesion. The tensile strength-to-weight ratio was achieved through a pairing process involving sisal, jute,

Table 3. Natural fiber mechanical properties

Fibre	Density (g/cm^3)	Tensile Strength (Mp)	Elongation (%)	Young's modulus (GPa)	References
Cotton	1.5-1.6	287-800	7-8	5.5-12.5	Gowda *et al*, 2018
Rice husk	0.67-0.74	19-135	1.4	0.3-2.6	Yasin *et al*, 2010
Date Palm	1-1.20	97-196	2.4-5.0	2.50-5.40	Gowda *et al*, 2018
Hemp	1.47	550-900	1.6	70	Mohanavel *et al*., 2020
Ramie	1.55	400-938	1.2-3.8	61.4-128	Ramamoorthy *et al*, 2015
Oil Palm	0.7-1.55	248	25	3.2	Jawaid *et al*., 2011
Bamboo	0.9	250-850	5.6-8.6	9.8	Cao *et al*., 2008
Banana	1.35	355	53	33.8	Rohan *et al*, 2018
Kenaf	1.2	295-930	1.6-6.9	53	Akil *et al*., 2011
Flax	1.5	88-1500	2.7-3.2	27.6	Jothibasu *et al*., 2018
Pineapple	1.5	170-1672	1-3	82	Samuel *et al*., 2019
Rice	0.9-1.5	100-160	5.4-10.6	0.3-2.6	Yasin *et al*, 2010
Wheat	1.1-1.3	90-150	3.5-6.6	0.2-2.2	Yasin *et al*, 2010
Coir	1.15-1.46	131-220	15-40	4-6	Anjali *et al*., 2014
Sisal	1.45	468-700	3-7	9.4-22	Rohan *et al*., 2018
Jute	1.3-1.49	393-800	1.16-1.8	13-26.5	Gowda *et al*, 2018

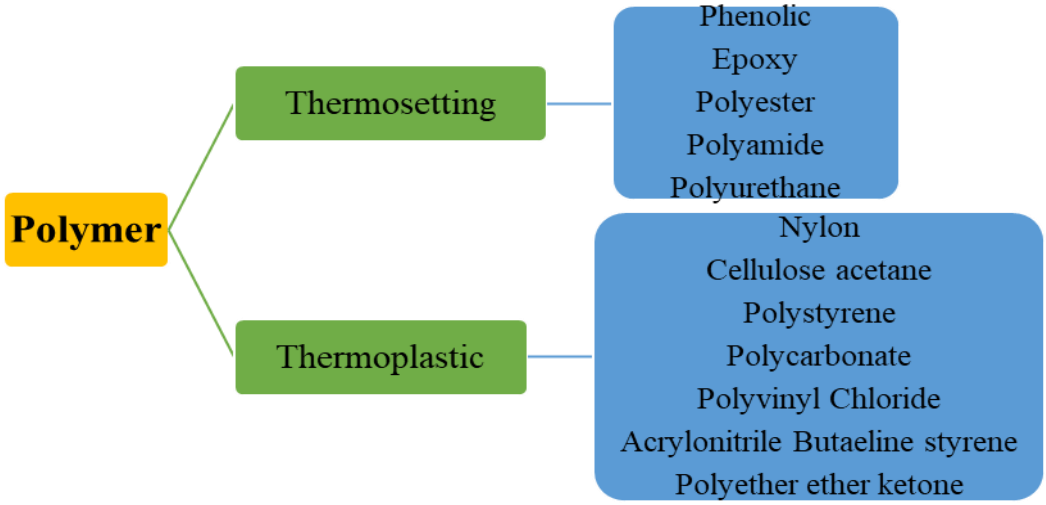

Fig. 4. *Polymers category (Source: Gowda et al., 2018)*

hemp, and glass fibers. (Mahesh *et al*., 2021) & (Syduzzaman *et al*., 2020), Three different combinations were prepared; the GF+H+H+GF sample had a pressure of 219 MPa, but the jute and sisal combination materials gradually decremented (207 MPa & 186 MPa). Compared two different configured material (Hybrid composite) had produced decorate properties and another comparison also was done with single-fiber reinforced composites measured mechanical, thermal, damping properties. When mechanical characters with different fiber contents and related fiber dimensions were examined with treated and untreated fibers, mechanical properties were achieved treated surface than untreated as similar to single fibre reinforced composite (Sathishkumar *et al*., 2014). Cellulose content as present in plant-based fibres, similarly animal-based, getting a large volume of fiber content. Plant-based fibers and other intrinsic advantages, such as superior acoustic and dampening capabilities due to their porous structure, as well as drawbacks, such as poor mechanical, thermal, moisture resistance, and fire resistance (Syduzzaman *et al*., 2020) & (Rohan *et al*., 2018). Polymer-based materials used in biomedical applications and reinforced material synthesized with PMCs effectively. The characteristics of natural fiber-reinforced composites, effects of various fillers and fibers have been reviewed (Ravichandran *et al*., 2020). Hybrid bamboo/glass fiber reinforced polyester (PE)

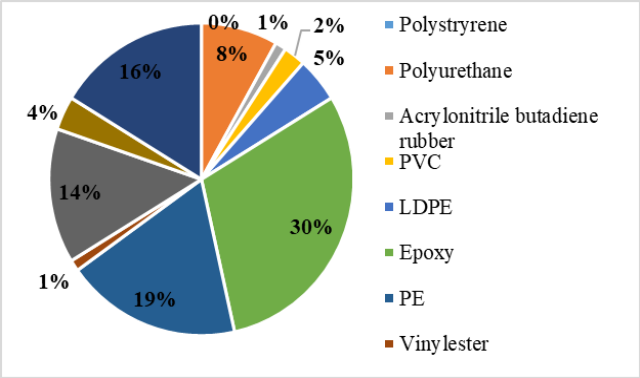

Fig. 5. *Thermoplastics used in % (Source: Mahesh et al., 2021)*

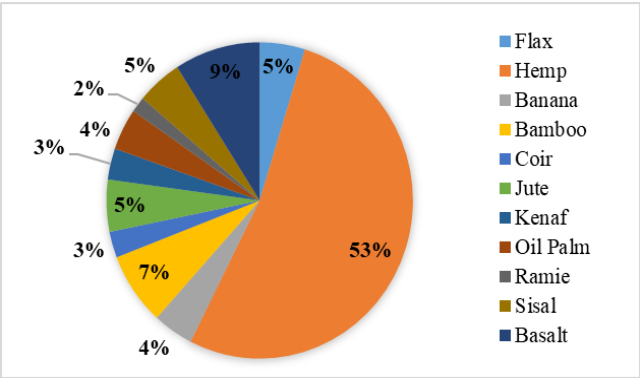

Fig. 6. *Natural Fiber used in % (Based on Table. 4)*

matrix-based composites became fabricated compression moulding and seven different compositions fiber alignment of 30° and 60° formed. ±60° and ±30° various orientation produced to higher tensile strength (63.1 MPa and 77.36 MPa) (Raja *et al*., 2018). Areca Sheath and Flax fibers were treated chemically termed as Sodium Hydroxide, Hydrochloric acid and Benzyl Chloride. NaOH treatment to fiber combination was intellectual benefit and able to enhance mechanical properties than others. Along with noted correct adhesion matrix material most opted due to the surface treatment materials (Jothibasu *et al*., 2018).

Table 4 and 5 show fiber, fiber types, diameter in micron, fabrication technique and applications. The major quest is application pendulous simultaneously engineer side eke have focused materials accessibility on leaf, seed, bast, straw, grass, and wood, as well as animal fibres and fabrication possibilities (Ramamoorthy *et al*., 2015). Reported highly-priced than others, overall performance of the materials higher and expensive rate was moderate for most easy available natural fibers (Flax, ramie, cotton, and hemp fibers) (Pecas *et al*., 2018). Research works have been sorted for customer need, environmental adoption and recycling approximately (Naslain *et al*., 2016). Furthermore, they did not pose any health risks, in contrast to mineral-based fibers and an overview of NFRCs constructed from cellulosic fibers (Huda *et al*., 2008) Demand depending upon the usage of the concern requires eco-friendly materials for different applications. Life-cycle assessment and other nomenclature of green composites are needed to offer a betterment than others. To develop the next generation of materials, the final conclusion must suit certain conditions caused by customers and engineers approached industrial ecology, eco-efficiency, green chemistry, etc., (Trigui *et al*., 2013 and Mohanavel *et al*., 2020).

Interfacial adhesion plant fiber polymer composites

Different fibers loading with influenced various chemical compositions, highly affected characteristics of the material wherein the terminology are cellulose, hemicellulose and lignin (Table.6) (Sapuan *et al*. 2012). Based on the chemical treatment several disadvantages are faced: water absorption, fire resistance and poor mechanical properties, flame retardance, and biodegradability. Few advantages were adopted with this treatment such as adhesion between the materials (Mohammed *et al*., 2015, M. Ramesh *et al*., 2017 and, Sanjay *et al*., 2016). This article innovated the angle between fibre contact and applying load in direction. The direction of the load same and opposite fiber corresponding (L/D) dimensions slim and long variance had revealed mechanical properties with adhesion between the materials (Critical Length) (Machado *et al*.,). Several mechanisms are availed to prepare interfacial bonding mechanism between the fiber and matrix such as Physical and chemical bonding, interdiffusion, Contact bonding assessments etc. (Zhou *et al*., 2016, Suman and Habiba, 2020, and, Lee *et al*., 2021)

Superior material combination for hybrid composites

Table.6 indicates various polymer composite, hybrid polymer composite, additional laminated composite are enumerated. Fig.8 shows evaluation of material characterization and comparison dealt with mechanical properties predominantly. When comparing these data, only two of the three parameters were highly matched (1.

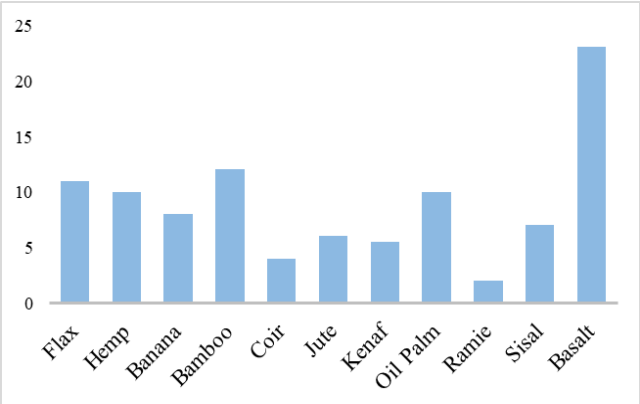

Fig. 7. *Natural fiber used (Source: Mahesh et al., 2021)*

Table 4. Comparisons of fiber, fiber family, diameter, fabrication technique and application

Fiber/Family	Diameter (μm)	Fabrication mode	Application	Reference
Flax/Bast	40-600	Hydraulic Press	Automobile (Door Panel)	Jothibasu *et al*., 2018
Jute/Bast	25-200	Casting Process	Aircraft	Gowda *et al*, 2018
Hemp/Bast	25-500	Hydraulic Press	Sports Kit	Mohanavel *et al*., 2020
Kenaf/Bast	30-50	Hand Lay-up	Aircraft,Building Materials	Akil *et al*., 2011
Ramie/Bast	35-60	Hand Lay-up	Packing materials	Ramamoorthy *et al*, 2015
Sisal/Leaf	50-200	Hot Pressing	Automobile (Door panel)	Rohan *et al*., 2018
Pineapple/Leaf	105-300	Compression moulding	Handmade Products, Textiles	Samuel *et al*., 2019
Banana/Leaf	160-200	Hand Lay-up	Kraft Pulp, Paper, Rope	Rohan *et al*, 2018
Coir/ Fruit/ Seed	100-460	Hand Lay-up	Automobile (Door Panel)	Anjali *et al*., 2014
Oil Palm/ Seed	150-500	Compression moulding	Acoustic Furniture	Jawaid *et al*., 2011
Bamboo/Reeds	10-30	Injection Moulding	Aircraft, Building materials	Cao *et al*., 2008
Bagasse/Reeds	320-400	Injection Moulding	Building materials	Syduzzaman *et al*, 2020
Soft Wood/ Wood	25-35	Closed mould densification	Naval packing, Kraft Pulp	Marion *et al*, 2019
Hard Wood/	50-60	Twin Screw	Window frame, Fencing	Marion *et al*, 2019
Wheat Straw/	20-40	Compression	Window frame	Yasin *et al*, 2010
Rice Straw/Stalk	15-25	Hot Pressing	Window frame, door panel	Yasin *et al*, 2010
Cotton/Seed	12-38	Compression moulding	Textiles, Furniture	Gowda *et al*, 2018

Table 5. Investigations of mechanical properties of plant fiber polymer composite

Fiber	Outcomes	Reference
Coconut	Addition of coconut fiber content increased with resulted mechanical properties also increased. But the examination were analysed for fabrication condition, while made the perfect combinations of epoxy with hardener.	Syduzzaman *et al*, 2020
Rice husk	Addition of glass fiber with different ratio had improved impact strength and tensile strength.	Syduzzaman *et al*, 2020
Hemp	Hemp combination were determined mechanical, thermal, flexural properties, addition of the glass fiber material in hemp can improve extraordinary mechanical property.	Pecas *et al*., 2018
Ramie	Overall performance of the material had reached optimized level and priced of the material more than others.	Pecas *et al*., 2018
Oil Palm	With different weight ratio impact strength were increased in common and especially pure EFB composite had reached highest strength than others	Jawaid *et al*, 2011
Bamboo	Addition of the glass fiber with Bamboo material were examined, where is the tensile strength of the material reached maximum. Different orientation and alignment of the fiber had resulted adequate mechanical properties.	Raja *et al*, 2018
Banana	Associated with the short and long fiber length Mechanical properties were optimized, other properties of flexural strength and stiffness increased.	Devi *et al*., 1997
Kenaf	Kenaf fiber material had achieved better mechanical properties after the surface treatment resulted perfect adhesion between the materials	Liu *et al*., 2009
Flax	Flax fiber need more surface treatment and water absorption technique, after this technique superiorly enhanced mechanical properties.	Jothibasu *et al*., 2018
Pineapple	Based on the fiber dimensions mechanical, flexural strength and stiffness properties were enhanced.	Devi *et al*., 1997
Wheat	Material bonding and combinations of the material also made perfect interlocking between the materials, wherein improved mechanical, tensile, creep resistance.	Yasin *et al*, 2010
Sisal	Sisal combination material had examined mechanical, thermal and damping properties. Among these properties, mechanical property, surface treatment of the material and characterization of the material reached invocated level.	Syduzzaman *et al*, 2020
Jute	Jute combination determined mechanical properties, which is reached more than invocated level.	Syduzzaman *et al*, 2020

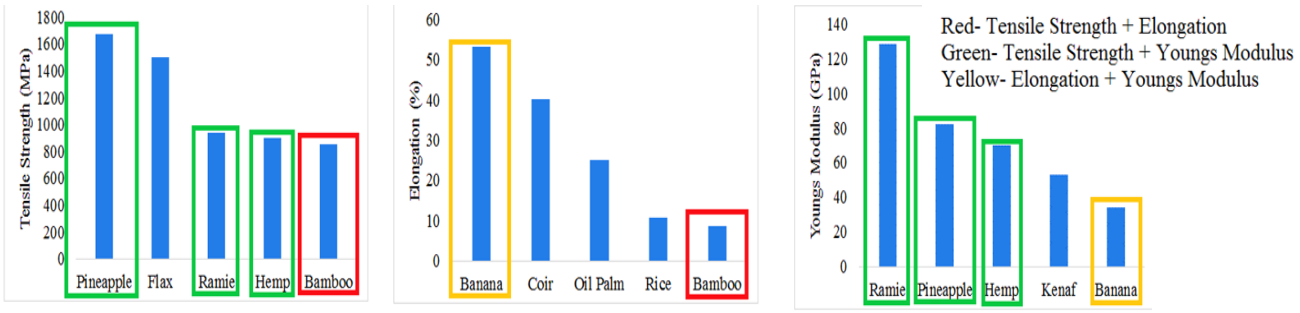

Fig. 8. *Natural fiber material evaluation and superior fibers combination*

Tensile strength+ Elongation, 2. Tensile Strength+ Young's modulus, 3. Elongation+ Young's Modulus). This gives graphical chart strategy, specifications of material and material selection to strike them into the exact application. Further, it shows that Tensile strength + Young's modulus combination have more number of plant fiber materials matched for mechanical character. But in Tensile Strength + Elongation and Elongation + Young's modulus have shown only one combination. Superior content have met Tensile strength + Young's modulus "Ramie and Pineapple" predominantly. Another material combination Elongations + Young's modulus "Banana" significantly. Fig.9 proves four different material combinations (1. PALF + Ramie, 2. PALF+ Hemp, 3. Hemp+ Ramie and 4. Bamboo + Banana) termed as Hybrid composite. All the fiber materials had superior properties and they can match different combinations to evaluate mechanical characters predominantly.

Conclusion

This review article has shown approximately the category, the different types of composite matrix material, the distinction between matrix and reinforcement, and the various fabrication methods. It is focused on Polymer Matrix Composites (PMCs), which recognises thermoset and thermoplastic substances with classification, properties, and applications. This review will help to create an effective record for analysing appropriate fabrication work and identifying ideal applications as follows:

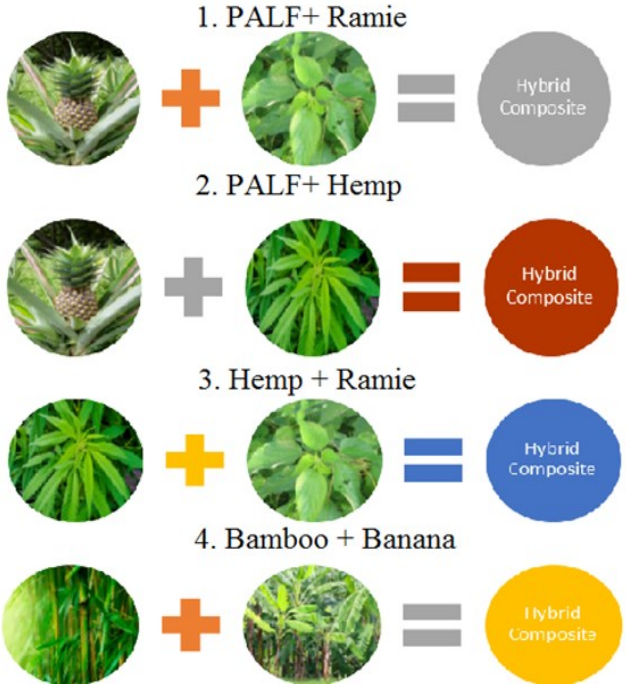

Fig. 9. *Hybrid composite materials*

Table 6. Physical properties of natural fibers

Hybrid	Contents	Cellulose	Hemicellulose	Lignin	Superior Characteristic	References
Pineapple + Ramie	PALF	80%	6-12%	5-12%	Tensile strength and Young's modulus will be favour	Devi *et al*., 1997
Pineapple+ Hemp-	Ramie	76.2%	16.7%	0.7%	Tensile strength and Young's modulus will be favour	Pecas *et al*., 2018
Hemp + Ramie	Hemp	48%	25%	24%	Tensile strength and Young's modulus will be favour	Pecas *et al*., 2018
Bamboo+ Banana	Bamboo	49.3%	18.5%	22.4%	Young's modulus will be favour, Significantly	Raja *et al*, 2018
	Banana	64%	19%	5%	Elongation may favour.	Devi *et al*., 1997

Selection of natural fibers materials used to fabricate for certain quantities that is a high stiffness, less attention and more flexibilities for flexural loading conditions.
Green engineering and green composite adoption are based on the experimental work prediction that may reveal exclusive properties.
Identifying synthetic fibre reinforced polymer composites and fibre treatments, as well as various chemical treatments and matrix combinations, to improve material characterizations.
Two different material combinations can achieve superior properties of a single material, and mechanical properties are primarily affected by material selection (Plant, Animal and Mineral), natural fiber and filler material proportions, and the amount of resin (solution) mixing ratio.

Conflict of interest

The authors declare that they have no conflict of interest.

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