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NATURAL FIBRE REINFORCED COMPOSITES: THE GREEN ALTERNATIVES FOR VARIOUS INDUSTRIAL AND ENGINEERING APPLICATIONS

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Abstract : As the human civilization rolled on, the needs and necessities of mankind have ever increased. The non-renewable resources at hand are ought to be under pressure of getting exhausted keeping in view the ever increasing population demands. We have tried actively and thoughtfully to recreate fresh resources for various applications to support our lives and necessities. Natural fibre composites are excellent alternatives to sustain our needs through green alternatives. They have the advantage being eco-friendly as well as being sustainable for various necessities. With the rise in environmental concerns and regulations, the natural fibre composites are quite beneficial alternatives paving way for environmental friendly renewable raw materials. This paper evaluates the possible combinations and creations and how successfully they can be put into varied applications. The use of natural fibres like sisal, jute, palm, flax etc in natural fibre composites have come up positively to support various applications ranging from automotive industries to other engineering applications. In addition to being environmental friendly, they have the added advantage of being lightweight, renewable, abundant, cheaper yet relatively good mechanical properties such as tensile and flexural modulus. Natural fibre composites have flexibility in production and pose minimal health hazards and are biodegradable too.

Keywords: NaturalFibreComposites,Environmentalfriendly,Engineeringapplications.

I. INTRODUCTION

Natural fibres made of cellulose or plant matter can be obtained from almost every part of the plant such as the root, stem or shoot, leaf, fruit and bark from many tree species (Figure 1). Fibre can be extracted from a leaf which is fibrous, pliable, strong and green. If the leaf can be wound around a finger without breaking, then it indicates a potential source for making fibre. Natural fibre products have certain distinctive qualities: they share a common language of colour, texture and of belonging to the earth. The appearance, feel, and texture of a bamboo basket are clearly different from that of a plastic bag. Different fibres have varying physical properties of strength, appearance, pliability, colour, texture and fragrance.

Traditional skills and knowledge of working with these materials is an economic activity, often undertaken as an additional activity, to earn a little extra income when there is a break in the agricultural cycle of work. Fibres are obtained by shredding or peeling parts of plants, or pounding them to make threads or by cutting them to make strips. Ancient communities must have used natural fibres to build shelters and thatched roof.

Root	Stem	Branch	Leaf	Fruit/Seed
Khus	Bamboo *Kora* grass Jute Hemp Water hyacinth Banana *Kauna* reed Cane palm *Moonj* grass *Sarkanda* *Wagoo* reed *Sikki* grass *Cannabis/pulla* Wicker *Bhindi* Nettle Flax *Arhar*/Pigeon pea	Willow	Palmyra Palm date Palm coconut Arecanut palm *Sisal* Banana Pineapple Screw pine	Cotton Coir Arecanut

Figure -1 Natural Fibres from different parts of plants.

Our daily observations suggest that almost everybody is so deeply entangled and occupied with one's own self that the caring and sharing for Mother Nature is dwindling under pressure and scarcity. People are negligent of the environmental bliss i.e. the greenery, flowers, rivers, birds, wild animals, mountains. This negligence and ignorance has led to loss of environmental balance and beauty. It is high time that we become more selfless and nurture the nature and maintain its beauty and bliss. If we keep on ignoring the flora and fauna, the natural resources will keep shrinking and its abundance and beauty will remain restricted to the photographs. Still the process of construction and building the necessities of life has to continue unabated. In this context, some thought can be put into replacing or reducing the use of the traditional metals and alloys by materials more nature friendly and economically viable composites which can provide the adequate strength and suitability

Natural vegetative plant fibre durable polymer composites are very much in demand and matter of interest among the materials for scientists and engineers. The composites provide a combination of advanced mechanical property, dielectric and environmental benefits together with renewability and biodegradability. Due to emerging risks like excessive progressing technologies, rising costs of finite resources, the traditional petroleum-based totally plastic, glass or carbon fiber materials are compensated by way of natural / bio-based fibres. These fibre composites are appropriate as wooden substitutes used in the housing and production sector. The use of such natural / bio-fibers with polymers based on renewable sources will allow many environmental problems to be solved. The various types of natural vegetative plant fibre like jute, coir, sisal, pineapple, bamboo, and banana, rice straw, lufa etc., are used as reinforcement of polymer composites now. In recent years, many investigations have been made which brings out the worth of natural fibres against their synthetic equivalents inclusive of glass and/or carbon fibre-bolstered polymer composites.

Figure- 2 Various examples of natural and synthetic fibres

2. Structure and properties of natural fibres

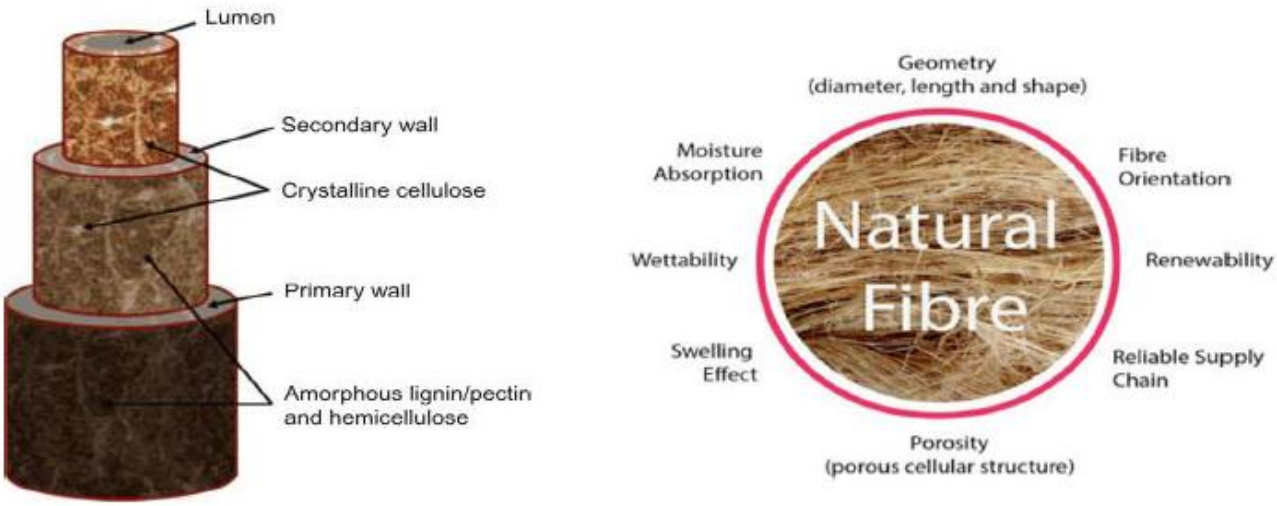

Figure- 3 Structure and the various properties of a natural fibre

The cell structures of natural fibres are layered structures having four different layers each having their unique thickness and chemical composition as well as shown in Figure 3. The cell wall of fibre is composed of the outermost primary wall and the innermost thick middle layer called lumen. In between there are secondary cell walls. A series of cellular microfibrils are helically wound along the middle hollow fibre axis. The structure and the chemical and physical composition are dominantly affected by the age of the plant, species, climate, harvesting time and fibre processing procedures. The microfibrillar angle determines the fibre stiffness and thus spiral oriented microfibrils are more ductile than the parallely oriented ones which are more rigid and inflexible.

There are various categories of natural fibre composite and the basis of classification is summarized in Figure -4. The properties of natural fibres are vividly studied which brings out their possible applications in various engineering domains making best use of the available properties. The advantages, disadvantages and applications of various natural fibres are summarized in the next section as is obtained from various references.

Figure 4 Basis of classification of Natural fibre Composites

3. Comparison table for advantages, disadvantages and applications of various natural fibres (Data collected from various references enlisted at the end of the paper)

Fiber		Advantages, disadvantages, and applications
Coir	Advantages	• High abrasion resistance • Strong and durable • Good acoustic properties
	Disadvantages	Has less cellulose than fibers like flax or cotton, thus making it less flexible
	Applications	Building panels, flush door shutters, roofing sheets, storage tank, helmets and post boxes, projector cover, voltage stabilizer cover, brushes, and brooms
Kenaf	Advantages	• Fast growing • High fiber yield • Low cost and easily available • Relatively low specific weight and perform well in tension
	Disadvantages	• Absorption of moisture in core portions is relatively high • Handling and processing of long fiber bundles is difficult • Exhibiting brittle fracture • Applying binder to long fiber bundle lengths is difficult • High water requirements for growth
	Applications	Packaging material, mobile cases, bags, insulations, clothing-grade cloth, soilless potting mixes, animal bedding, and material that absorbs oil and liquids
Flax	Advantages	• Relatively strong • Can be used to make clothing
	Disadvantages	• Gives off a large amount of dust in the early stages of the isolation process • Low elasticity
	Applications	Window frame, panels, decking, railing systems, fencing, tennis racket, bicycle frame, fork, seat post, snowboarding, and laptop
Jute	Advantages	• Low cost • Can be widely used in agriculture, textile, woven and nonwoven sector
	Disadvantages	• The crease resistance is very low • Lose of strength when wet
	Applications	Building panels, roofing sheets, door frames, door shutters, transport, packaging, geotextiles, and chipboards
Sisal	Advantages	• High specific strength • Easy availability • Good sound absorption properties
	Disadvantages	Restricted maximum processing temperature
	Applications	In construction industry such as panels, doors, shutting plate, and roofing sheets; also, manufacturing of paper and pulp

Fiber		Advantages, disadvantages, and applications
Ramie	Advantages	• High strength • Excellent microbial resistance • Hygienic properties
	Disadvantages	Difficulty in degumming
	Applications	Used in products as industrial sewing thread, fishing nets, and filter cloths. Also made into fabrics for household furnishings and clothing
Hemp	Advantages	• Very strong and does not require pesticides • Requires little fertilizing and grows faster than other natural fibers • Generally drought and light frost resistant
	Disadvantages	• Separation of the fibers from the bast is very labor-intensive • Growth and cultivation restrictions in many countries
	Applications	Construction products, textiles, cordage, geotextiles, paper and packaging, furniture, electrical, manufacture of bank notes, and manufacture of pipes

4. CURRENT TRENDS AND FUTURE SCOPE

The ability of natural fibre-reinforced composites and their applications is realised in nearly every industry including construction, aerospace, automobile, and electronics. Composite substances are more and more used for dielectric applications, that is, applications that make use of electrically insulating behaviour. This is due to the requirement of the digital industry for dielectric substances in electrical insulation, encapsulation, multilayer ceramic chip and capacitors and for piezoelectric, ferroelectric, and pyroelectric devices. Developing an efficient and light weight dielectric material from sustainable resources, such as brown bamboo, rice straw, coconut, palm composites reinforced with natural fibers, is quite appealing from both economic and environmental perspectives. This has led to worldwide focus and application of natural fibre composites for various applications as is shown in the figure below.

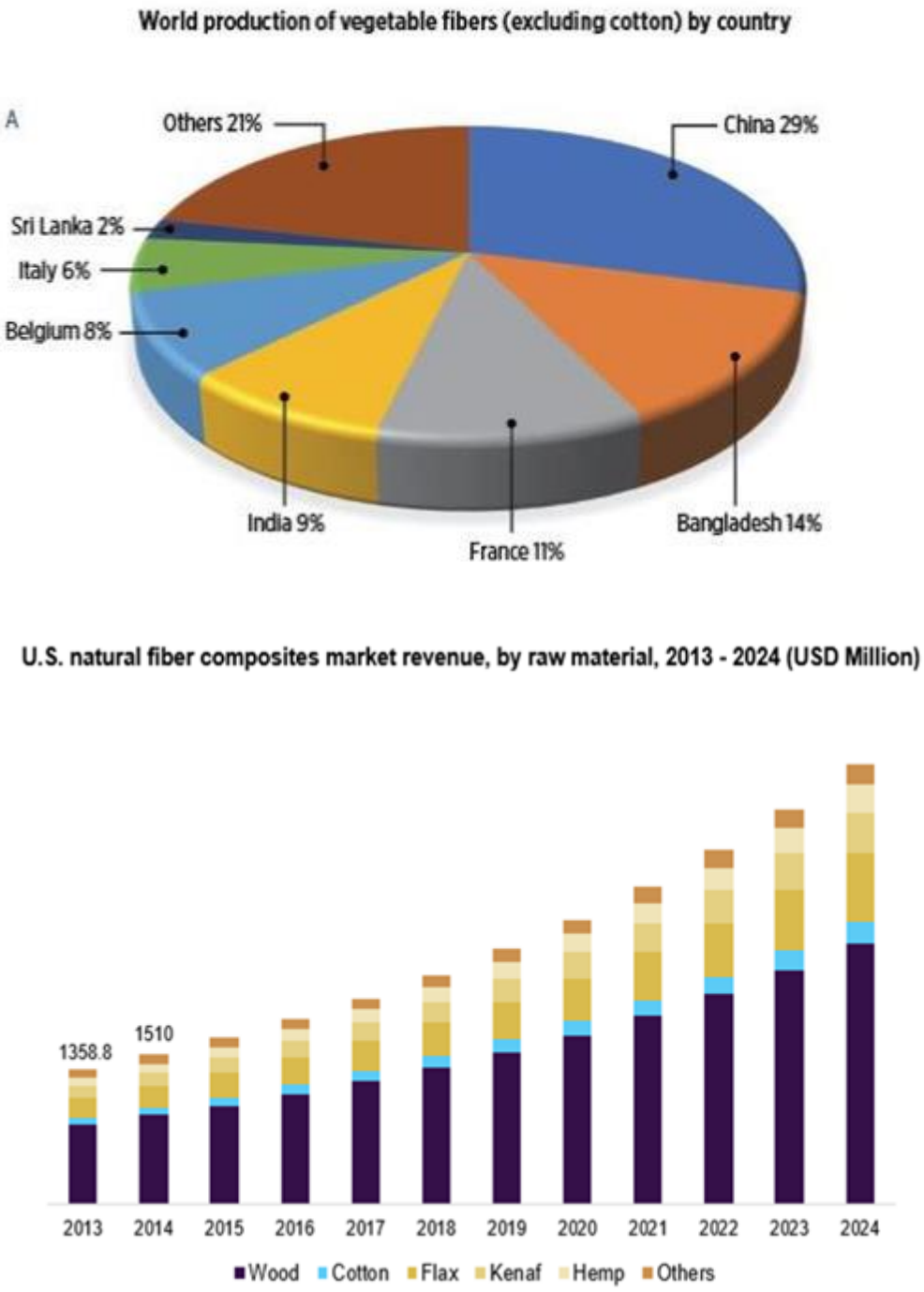

Figure- 5 The Global Scenario

5. Conclusion

As is studied, natural fibre-based composites possess an edge over synthetic fibre based composites due to properties such as low cost, light weight, biodegradability, high thermal and acoustic insulation, high specific strength and stiffness. The synthetic fibres are not an advantageous choice due to high cost, high energy consumption during manufacturing, poor recycling and non-renewable attributes. Thus it can be confirmed that natural fibres fit in our requirement as they will are accompanied with energy recovery, no addition to carbon emissions and lower global warming effects.

6. References

[1] Sani MA, Abi Zaid ABD LATIB, Choy Peng NG, et al. Properties of coir fibre and kenaf fibre modified asphalt mixes. J East Asia Soc Transp Stud 2011; 9: 1274–1285.

[2] Mohammed L, Ansari MNM, Pua G, et al. A review on natural fiber reinforced polymer composite and its applications. Int J Polym Sci 2015.

[3] Sen T and Reddy HNJ. Various industrial applications of hemp, kinaf, flax and ramie natural fibres. Int J Innov Manag Technol 2011; 2: 192–198.

[4] Tahir P, Ahmed AB, SaifulAzry SOA, et al. Retting process of some bast plant fibres and its effect on fibre quality: a review. Bio Resources 2011; 6: 5260–5281.

[5] Rezghi Maleki H, Hamedi M, Kubouchi M, et al. Experimental study on drilling of jute fiber reinforced polymer composites. J Compos Mater 2019; 53(3): 283–295.

[6]H. Ku, H. Wang, N. Pattarachaiyakoop, M. Trada, A review on the tensile properties of natural fiber reinforced polymer composites, Compos. Part B:Eng. 42 (2011) 856–873.