A REVIEW ON MECHANICAL PROPERTIES OF NATURAL FIBER REINFORCED POLYMER COMPOSITES

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Abstract— *A fiber reinforced polymer composites are structural materials which is embedded is known as reinforcement or interface and embedded is known as matrix. Over the few decades, the fiber reinforced polymer composite materials replaced many of the conventional materials. This is only possible because of adequate advantages offered by fiber reinforced polymer composites over the conventional materials. This article present overview of mechanical properties of natural fiber reinforced polymer composites.*

1. INTRODUCTION

A fiber reinforced polymer composites are structural materials which is embedded is known as reinforcement or interface and embedded is known as matrix. A composite material is a mixture of two or more materials (natural or artificial) in a distinct phase. In microscopic level composite are having only mechanical bonding of materials which are mixed for preparing. If mixed materials are having chemical bonding than it will termed as alloy [1]. Fiber reinforced polymer composite mainly classified in two ways thermoplastic and thermosetting. Thermoplastic materials are widely used as matrices for bio fiber; the usually used thermoplastics for this purpose are poly vinyl chloride (PVC), polypropylene (PP) and polyethylene; while polyester resins, epoxy and phenol are the most commonly used thermosetting materials [2]. Over the few decades, the fiber reinforced polymer composite materials are replaced many of conventional materials. This is only possible because of adequate advantages offered by fiber reinforced polymer composites over the conventional materials. When specific properties are compared these polymer reinforced materials are used in diverse field from appliances to spacecraft [3]. The fiber reinforced polymer composite are mainly made through using two types of fibers for reinforcement purpose one is natural fibers like jute, hemp, kenaf, remie, abacca, agaves, banana, curaua, pineapple, plam, sisal, cotton, coir, wheat, ote, bamboo, reed, rye and corn etc. another is artificial or synthetic fiber like glass fiber, carbon fiber, boron fibers, silica bide fiber, polyethylene fiber and aromatic polyester fiber.[4]The major advantage for using natural fiber is its cost effectiveness, sustainability and density. The natural fibers are naturally grown in a few months and have the potential to be cash crop for local farmers [5].

2. MECHANICAL PROPERTIES OF NATURAL FIBER REINFORCEMENT MATERIALS

The major constituents of natural fibers are cellulose and lignin. The cellulose content in natural fiber is responsible to provide the mechanical properties which are depend on various aspects such as fiber length, fiber aspect ratio, fiber loading or volume fraction of fibers, fiber orientation or inter facial adhesion between the fiber-matrix [6]. Natural fiber composites mechanical properties extremely influenced by the matrix-fiber adhesion property between the polymer matrix and fibers are been reported by many researchers [7].

TABLE 3. PHYSICAL PROPERTIES OF VARIOUS NATURAL FIBERS [8, 9].

Fiber	Tensile strength (MPa)	Young's modulus (GPa)	Elongation at break (%)	Density (g/cm^3)
Abaca	400	12	3–10	1.5
Alfa	350	22	5.8	0.89
Bagasse	290	17	–	1.25
Bamboo	140–230	11–17		0.6–1.1
Banana	500	12	5.9	1.35
Coir	175	4–6	30	1.2
Cotton	287–597	5.5–12.6	7–8	1.5–1.6
Curaua	500–1,150	11.8	3.7–4.3	1.4
Date palm	97–196	2.5–5.4	2–4.5	1–1.2
Flax	345–1,035	27.6	2.7–3.2	1.5
Hemp	690	70	1.6	1.48
Henequen	500 ± 70	13.2 ± 3.1	4.8 ± 1.1	1.2
Isora	500–600	–	5–6	1.2–1.3
Jute	393–773	26.5	1.5–1.8	1.3
Kenaf	930	53	1.6	–
Nettle	650	38	1.7	–
Oil palm	248	3.2	25	0.7–1.55
Piassava	134–143	1.07–4.59	21.9–7.8	1.4
Pineapple	1.44	400–627	14.5	0.8–1.6
Ramie	560	24.5	2.5	1.5
Sisal	511–635	9.4–22	2.0–2.5	1.5

TABLE 2 FLEXURAL PROPERTIES OF NATURAL FIBERS [10,11,12]

Fibre	Flexural Strength (MPa)	Flexural modulus (GPa)
Palmyra	59.19	3.54
Bamboo	40-50	4-5
Sisal	29.28-62.50	1.29-3.16
Curaua	200-250	12-20
Jute	60-80	6-8
Coir	29.226	-
Banana	57.33	8.9
Pineapple	80.2	1.3
Rice husk	19.43	2.86
Kenaf	19.43	18.72
Flax	200-250	20-25

TABLE 3 IMPACT STRENGTH OF NATURAL FIBERS [13,14]

Fibre	Impact Strength (KJ/m^2)
Coir	11
Banana	13.25
Jute	13.44
Flax	70-80
Coconut	8.36
Ukam	9.89
Sisal	8.36
Hemp	7.41

3. APPLICATION

Natural fibers plays very important role in the development of biodegradable fiber reinforced composite material to resolve the current environmental and ecological problems. Fiber reinforced composite made though natural fibers having extensive applications such as low cost housing, consumer goods, civil structures, industrial and automobile vehicles etc. [1,3,4]

Disadvantages

Natural cellulosic fibers are hydrophilic and absorb moisture. The moisture content in the fibers can vary between 5 and 10%. This can lead to dimensional variations in composites and also affects the mechanical properties of the composites. The natural fiber reinforced composites are less effective in mechanical properties. [3]

4. CONCLUSION

The different mechanical properties of natural fiber reinforced composite varies with use of different fiber and as varying matrices materials. The mechanical properties of fiber mainly depends upon type of fiber, fiber cross section area, fiber length, origin age of fiber, density, structure of fiber, environmental condition and preceding methods. The different matrices system is having different properties. Natural fiber shows adequate properties while it is used with polymer composites as reinforcement. Natural fiber reinforced composites are having their significant position in industry due to their high specific properties, light weight, low cost, easy availably and environment friendliness. This article shows that natural fibers are having good mechanical properties and this fiber reinforced composite can be used in different applications.

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