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NATURAL FIBRE REINFORCEMENT POLYMER COMPOSITES-A REVIEW

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ABSTRACT

In these days natural fiber-reinforced polymer composite are uses in a wide range for both in fundamental research and also for the engineering purpose. They can be easily recycled, and they are cheaper in cost. These composites are having minimum density and less cost as well as good mechanical properties make them an effective due to easy renewability and availability of raw materials. Natural fibres have been used in a place of synthetic fibre in engineering purpose such as cars, coaches of railways and aerospace. Other applications include army, flats, construction industries and packing of a consumer product for ceiling panelling, partition boards. This paper deals with review of different type of natural fibers reinforced polymer composite along with its manufacturing processes and characterization especially coir and jute fibres.

I. INTRODUCTION

Composites like natural fibres Example - coir, cotton, baggage, jute, bamboo, hemp, wood, corn. Natural fibres' are from the part of the plants. Natural fibres are environment friendly in nature; lightweight, hard, renewable, low cost and biodegradable, easily available. They are also used in reinforcement for both matrices -1 thermosetting and 2 thermoplastic matrix. Thermosetting resins like epoxy, polyester, polyurethane, phenolic are widely used composites requiring for high valuable applications. They give a sufficient wide range of properties in particular stiffness and strength at acceptably cheap price levels. Recent natural fibre development in genetic engineering. These composites material gives significant value for improved materials from renewable resources with enhanced support for global sustainability. Natural fiber composites are useful to manufacturing sector because of their minimum density and environmental advantages over conventional composites. These composites give profits to the importance to their non-carcinogenic and bio-degradable nature. Natural fibres composites are much low cost effective in building and construction, packaging, automobile and railway manufacturing unit and storage devices[7] .These composites are large members for replacement of high cost glass fibre for minimum bearing uses. Natural fibres have profits over low density, low cost and high biodegradability [18]. So , the main loss of natural fibre composite are the relatively high moisture absorption then , chemical process are done so as to modify the fibre surface properties.

II. CLASSIFICATION OF NATURAL FIBRES

Fibre is a part of hair-include material which are having continuity of filaments or are in a maximum elongated parts, like a pieces of thread. They can be used into filaments, thread, or rope. They can also be used as a main

part of composites materials. Natural fibres can be matted into sheets to make material such as paper or felt. Figure 1 shows the classification of natural fibre.

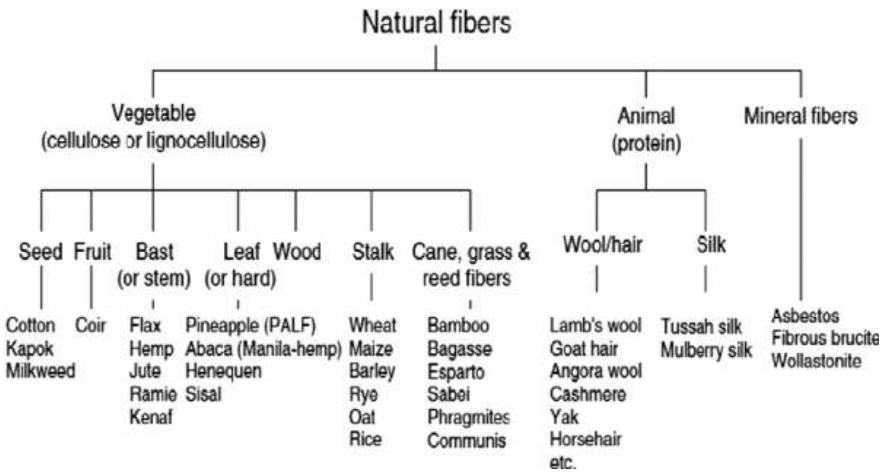
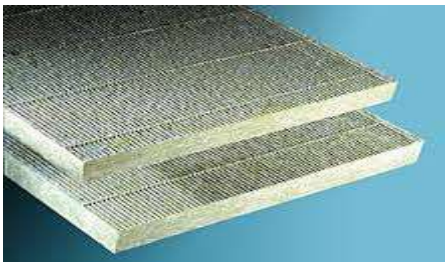


Fig.1: Natural fibers are made from plant, animal and mineral sources[19] .Natural fibers can be classified as follows

[1] Animal Fibres: These are fibres which can be getting from animals body example- wool, silk, avian fiber. It also can be made by sheep's wool, goat hair, horse hair, feathers and feathers fiber etc.

[2] Mineral fibre: Mineral fibres are fibres which are come from naturally based fiber or slightly modified fibre procured from minerals. These can be also be classified ex-asbestos, Ceramic, Metal fibre.



[3] Plant fiber: Plant fibers are generally comprised of cellulose. This fiber can be again classified into following.

a) Seed fiber: Fibers collected from the seed and seed case e.g. cotton and kapok.

b) Leaf fibres: Fibers are easily collect from the leaves ex- sisal and agave.

c) Skin fiber: Fibres are collected from the skin or in a favour of bast surrounding the stem of their given plant. These fibers have effective tensile strength than other naturals fibers then, these fibers are can be used for a durable yarn, fabric, packaging, and paper. Some examples are flax, jute, banana, hemp, and soybean.

d) Fruit fibre: Fibers are collected from the fruit of the plant ex- coconut (coir) fiber.

e) Stalk fiber: Fibers are actually the stalks of the plants such as straws of wheat, rice, barley, and other crops including bamboo and grass. Tree wood is also such a fiber

III. PROPERTIES OF NATURAL FIBER COMPOSITES

Physical and mechanical properties of composites depend upon the one fiber chemical composition (water content, hemicelluloses, cellulose, waxes, lignin, pectin, and other useful properties according to grooving and extraction/ process methods conditions. Condition of grooving recognized as the most effective parameter for the variability of mechanical properties of the fibers. The chemical composition of given natural fibers is summarized in Table 1,

Fiber	Cellulose %	Lignin %	Diameter (μm)	Hemicellulose %	Elongation %
Coir	37	42	100-450	0.15	47
Banana	64	5	50-250	6-19	3.7
Sisal	70	12	50-200	10-14	5.1
Pineapple	85	12	20-80	16-19	2.8
Jute	71	13	15.9-20.7	13-20	3.0

Many factors influence mechanical properties of natural fibers. In many cases, they are different in experimental condition. The mechanical properties of the natural fiber material go on largely in lengths and big in diameters of individual fibers. The density and tensile properties are can be represent in table 2.

Fiber	Density	Young's modulus (GPa)	Tensile strength (MPa)	Elongation at break (%)
Flax	1.54	27.5–85	345–2000	1–4
Ramie	1.5–1.56	27–128	400–1000	1.2–3.8
Hemp	1.47	17–70	368–800	1.6
Jute	1.44	10–30	393–773	1.5–1.8
Sisal	1.45–1.5	9–22	350–700	2–7
Coconut	1.15	4–6	131–175	15–40
Cotton	1.5–1.6	5.5–12.6	287–597	7–8
Nettle	1.51	24.5–87	560–1600	2.1–2.5
Kenaf	1.2	14–53	240–930	1.6
Bamboo	0.6–1.1	11–17	140–230	–
E-glass	2.5	70	2000–3500	2.5
Carbone	1.4	230–240	4000	1.4–1.8

IV.NATURAL FIBER REINFORCEMENT COMPOSITE

this research is mainly for composites related to the plant fibers, which are moulded with resins. The natural fiber composites are seen as potential materials for many engineering applications. The coir, jute and bagasse are discussed in details as follows:

4.1 Coir

coir comes from the husk of coconut fruit fiber. Coir has much effective life as compared to other natural fibers just because of their high lignin content. Coir fiber can be reinforced 1-thermoset and 2-thermoplastic resins. The one of the basic mechanical property of the composite dependent to the interfacial adhesion of a fiber to the matrix material. Coir fiber can give very good interfacial adhesion when it goes under dry conditions. Adhesion characteristics of coir fiber with polyester matrix are tested different aging solutions. Coir fiber reinforced polymer composites are made for socio-economic and industrial applications for example inner part of automotive, paneling and roofing as building materials, tank, packing material, helmets and postboxes, mirror casing, paper weights, cover of projector, voltage stabilizer cover . They are large efficient and superior in reinforcement condition when we compare this to other reinforcement composites. Indeed the important disadvantage of coir fibres are high moisture content. This can be easily controlled by some chemical treatment. The difference between the reinforcing agent and the matrix are the key issue in terms of whole performance. The effectiveness of coir fiber reinforced epoxy composites were goes under alkali treatment and fibre length. Coir fibers were treated with sodium hydroxide (Noah) one, four, six, eight and 10 % for 10 days. Fiber length was 20,30 and 40 mm. Alkali are treated with composite along with increased fiber had better impact strength (31 KJ/m2). Coir fiber length 30 mm and 8% alkali concentrations had better results. Again in treatment coir based composite performed better Coir fiber reinforced polypropylene composite was tested. Coir fiber and and their flexural properties were satisfied in between 41 to 61 wt%. However increment of coir fiber content the flexural strength goes to the lower side. The main reasons for lower flexural strength were insufficient for matrix to complete all the surface of the coir fiber. Optimal composite and fomulation of panel for automobile inner part applications was mixture of 61 wt% coir fiber, 38 wt% PP powder and 3 wt% MAPP [2] mechanical properties than untreated coir based composite[1][2][3][12]

4.2 JUTE FIBER

Jute fiber reinforced polymer composite Jute has characteristics like a wood as it is a bast fiber. Jute is always having a greater aspect ratio, maximum strength to weight ratio, good insulation properties. Jute fiber reinforced polymer composite has used for door, window, furniture, corrugated sheet, I-shaped beam, trenchless rehabilitation of underground water pipes and drain pipes, false roofing, floor tiles .The jute fiber reinforced

polypropylene composites mechanical properties is can be easily analyzed. These are part of fiber treatment by washing, mercerization and bleaching. Tensile modulus and tensile strength are increased with increasing percentage of weight fraction and Noah percentage of fibers in a pp matrix. The highest tensile strength and tensile modulus were 31.49 Mpa and 277.80 Mpa respectively . Jute fiber reinforced epoxy of composites can be analyzed with effect of higher fiber orientation. The fiber orientations were1) 0/90°, 2)15°/-75°,3) 30°/-60° and4) 45°/-45°. The high strength and stiffness can be found at 0/90° fiber orientation. Compressive test of jute composite are goes under testing and it found higher strength as compared to bamboo fiber reinforced epoxy composites . The alkali treated jute fiber reinforce composites showed improved mechanical properties. The improvement was maximum for the composite prepared with 4 hrs alkali treated jute fibers . Jute fibers were reinforced with polypropylene and polyethylene. Jute fiber of 1 mm and 3 mm fiber length were used to fabricate using compression molding process. Degradation rate was designated in terms of weight loss for both composites.

V. CONCLUSION

The present overview on the progress of natural fiber reinforced composites. Manufacturing sector is in constant search of new materials to lower costs and profit margins. Due to the more uses of petroleum based products and the need to find renewable resources. Cost and energy can be easily taken as the Natural fibers advantages over traditional reinforcing fibers such as carbon and glass. In these days research is going on for the replacement of traditional materials with bio-composites. with the combination of different natural fibers we can easily found to give better mechanical and physical properties.

Limitations in order to exploit the full potential of natural fibers. At 1) there is a need for the proper fiber surface treatment should be developed and implemented. 2) properties of composites are greatly depended on the volume percentages of fibers and resin. The quality at fiber matrix interface should be improved. Our first priority is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites manufacturing unit.

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