

A Review on Coir Fiber Reinforced Polymer Composite

U.S. Bongarde¹, B.K. Khot²

^{1,2}Assistant Professor, Department of Mechanical Engineering, Textile and Engineering Institute, Ichalkaranji, 416115, India

Abstract - Due to environmental concern the natural fibers are gaining more importance because of their ecofriendly nature. Natural fiber is abundantly available in nature, the development of natural fiber composites will lead to the replacement of existing materials in various applications. This review paper focuses on the utilization of coir fiber and its present research statue. Also the properties, processing and the various applications of the coir fiber are discussed in this review paper. Coir fiber reinforced polymer composites have found application in furniture, packaging, as filler in different composite materials.

Key Words: Natural fiber, Coir fiber, Polymer composites, application, properties.

1. INTRODUCTION

The attention in natural fiber-reinforced polymer composite materials is rapidly growing both in terms of their industrial applications and fundamental research. They are renewable, cheap, completely or partially recyclable, and biodegradable [1]. Plants, such as flax, cotton, hemp, jute, sisal, kenaf, pineapple, ramie, bamboo, banana, etc., as well as wood, used from time immemorial as a source of lignocelluloses fibers are more and more often applied as the reinforcement of composites [2]. Their availability, renewability, low density, and price as well as satisfactory mechanical properties make them an attractive ecological alternative to glass, carbon and man-made fibers used for the manufacturing of composites [3]. The natural fiber-containing composites are more environmentally friendly, and are used in transportation (automobiles, railway coaches, aerospace), military applications, building and construction industries (ceiling paneling, partition boards), packaging, consumer products, etc. [4, 5]. The classification of fibers shown in figure no.1

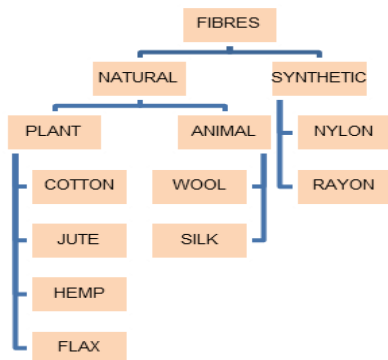


Figure – 1: Classification of fiber

Physical and mechanical properties depend on the single fiber chemical composition (Cellulose, hemicelluloses, lignin, pectin, waxes, water content and other minors) according to grooving (soil features, climate, aging conditions) and extraction/ processing methods conditions [6]. Grooving conditions is recognized as the most influent parameter for the variability of mechanical properties of the fibers. The chemical composition of several natural fibers is summarized in Table 1.

Table - 1: Chemical composition of natural fibers [7]

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, the experimental conditions are different. The greatest differences encountered in extracting data from the literature are on the lengths and diameters of ultimate fibers shown in table 2.

Table - 2: Properties of natural fiber materials [8]

Material	Density (g/cm ³)	Tensile strength (MPa)	Young modulus (GPa)	Failure strain (%)
Flax	1.45	500-900	50-70	1.5-4.0
Hemp	1.48	350-800	30-60	1.6-4.0
Jute	1.3	300-700	20-50	1.2-3.0
bamboo	1.4	500-740	30-50	2
Sisal	1.5	300-500	10-30	2-5
Coir	1.2	150-180	4-6	20-40

2. NATURAL FIBER REINFORCED POLYMER COMPOSITE

In this article reported on coir, jute, sisal, sugarcane, bamboo fibers etc. with polymer composites. Natural fiber reinforced polymer composites manufacturing and testing methods are discussed below.

2.1 Coir fiber reinforced polymer composite

Coir is a fruit fiber. It comes from the husk of coconut fruit. Coir husk fibers are located between the husk and the outer shell of the coconut. The fiber is isolated by dehusking either by hand or with a machine. There are two types of coir fibers: white fiber and brown fiber. The white coir is produced from immature coconuts and is finer, more flexible fiber than brown coir. White coir contains less lignin than brown coir. Brown coir is obtained from mature coconuts and has higher contents of lignin [6]. Coir is an abundant, versatile, renewable, cheap, and biodegradable lignocelluloses fiber used for making a wide variety of products. Coir has also been tested as filler or reinforcement in different composite materials [1, 7]. Coir has more life compared to other natural fibers due to its high lignin content [7, 9]. Coir fiber is very resistant to degradation by saltwater [6]. Coir fiber reinforced with both thermoset and thermoplastic resins. The mechanical property of the composite depends on interfacial adhesion of fiber to the matrix material. Coir fiber showed very high interfacial adhesion under dry conditions. The interfacial adhesion characteristics of coir fiber with polyester matrix were tested different aging solutions [10]. Coir fibers are more efficient and superior in reinforcement performance when compared to other reinforcement composites [11, 12]. However, the main limitations of coir fibers are high moisture content. It can be controlled with chemical treatment. The interface between the reinforcing agent and the matrix are the key issue in terms of overall performance. The performance of coir fiber reinforced epoxy composites are depends on alkali treatment and fiber length. Coir fibers were treated with sodium hydroxide (NaOH) 2,4,6,8 and 10 % for 10 days. Fiber length was 10,20 and 30 mm. Alkali treated composite along with increased fiber had better impact strength (27 KJ/m²). Coir fiber length 30 mm and 8% alkali concentrations had better results [13]. Pretreated coir based composite performed better in mechanical properties than untreated coir based composite [13, 14, 15]. Coir fibers were chemically treated using alkalization CCUV samples and mechanically treated using ultrasonic shockwave-CMUV samples. Each treatment was followed by UV radiation [16]. Treated coir fiber reinforced epoxy composite shows better wear resistance than untreated fiber composites [17].

Coir fiber reinforced polypropylenes composite were tested. Flexural properties of coir fiber pp composite were satisfied in between 40 to 60 wt%. Further increment of coir fiber content the flexural strength decreases. The main reasons for lower flexural strength were insufficient matrix to cover all the surface of the coir fiber. Optimal composite panel formulation for automotive interior applications was mixture of 60 wt% coir fiber, 37 wt% PP powder and 3 wt% MAPP [18]. Coir fiber reinforced epoxy composite was tested for tensile strength. Three interested parameters were selected as fiber volume fraction, curing time and compression load applied during fabrication of the composite [19]. Coconut shell particle-epoxy resin composite

was evaluated water absorption and compressive strength [20]. Mechanical characterization of coir fiber reinforced polyester composite using red mud as filler. The composite specimens were fabricated with 0,10,20,30 and 40 % volume fraction of red mud and coir fiber [4]. The effects of short coir fiber reinforced vinyl ester composites on flexural properties were studied. 20% wt of coir vinyl ester composites exhibited higher percentages of elongation [21]. The effect of fiber length and particulate content on the mechanical behaviors of Coir Polyester composites was studied using ANOVA and Response Surface plots [22]. Coir fiber reinforced epoxy composites were studied for tensile strength. Three interested parameter fiber volume fraction, curing time and compression load applied during fabrication were investigated on composite properties [19]. Short coir fiber reinforced vinyl ester composites were studied for flexural properties. Composites were fabricated with varying fiber percentages (5%, 10%, 15%, 20%, 25% by weight) and laminate thickness (3mm, 3.5 mm, 4 mm, 4.5 mm, 5 mm) [22].

Coir fiber reinforced polymer composites developed for industrial and socio-economic applications such as automotive interior, paneling and roofing as building materials, storage tank, packing material, helmets and postboxes, mirror casing, paper weights, projector cover, voltage stabilizer cover [18]. Coir fiber reinforced polypropylene composites were suitable for electrical applications [16].

3. CONCLUSIONS

The current review emphasizes on development of coir fiber reinforced polymer composites. While coir fiber reinforced polymer composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The various applications of coir fiber are in the field of automotive, packaging, furniture industries. This eco-friendly material has gained key importance due to the need to preserve our environment.

Several limitations must be overcome in order to exploit the full potential of coir fibers. First proper fiber surface treatment should be developed and implemented. Secondly properties of composites are greatly depended on the volume percentages of fibers and resin. The quality at fiber matrix interface should be improved. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry.

4. REFERENCES

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