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RESEARCH ARTICLE

Characterization of Cellulosic Fibres from Coconut Peduncle Leaf Stalk Fibres (CPLSF)

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ABSTRACT

In this examination the Mechanical Properties of Coconut Leaf Stalk Fibre Peduncle is found for the various lengths (3mm, 6mm, 9mm) are taken and treating with two different process. One set of fibre is washed with the distilled water and another set of fibre is treated with sodium hydroxide (NaOH) solution to increase the strength of the fibre. Here the NaOH mixer is about 5% are considered. After treatment the fibre are dried for 2 days and cut to the required sample size. All sample composite materials were made using the standard die (hand layup method) and samples were cut using high-pressure water jet cutter as per ASTM standard. The test was taken with ASTM D638, ASTM D790 and ASTM D256 standard Universal testing machine (UTM). The result exemplify that the 6 mm alkali-treated CPLSF (6 NTCPLSF) composite exhibited the maximum tensile strength of 26.14MPa, the flexural strength of 79.81MPa and impact strength (Izod) 9.7 kJ/m^2.

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Introduction

Over a previous multi decade many examination goes on composite material for the substitution of existing designing materials. The composite materials have developed quickly to serious degree and supplant most designing materials. Today composite materials contains numerous materials in everyday use and furthermore getting utilized in modern applications while composites have effectively demonstrated their value as weight saving materials the current test is to shape them sturdy in extreme conditions to trade different materials and furthermore to frame them financially ability. Because of its light weight and ease, a composite material has given an approach to businesses.

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Literature Review

The ecological investigation has brought about upgrading the consideration in common fiber-supported polymer materials. The current common strands like jute, coir, sisal and banana are an alluring and biological trade to glass filaments for support of polymer-based composites. The customary strategies for retting, for example, water retting, dew retting and compound retting are utilized to common filaments however as of late chemicals have been assessed to supplant as of now utilized techniques. [1]. A composite material is a material produced using at least two constituent materials with altogether unique physical or synthetic properties that, when joined, produce a material with attributes not quite the same as the individual segments [2]. The benefits of minimal effort, low thickness, high solidarity to-weight proportion, and protection from breakage during preparing, low energy substance and recyclability [3]. Midrib of coconut palm leaves (MCL) was explored with the end goal of advancement of common fiber built up polymer network composites. Another characteristic fiber composite as MCL/polyester is created by the hand lay-up strategy, and the material and mechanical properties of the fiber, lattice and 12 composite materials were evaluated [4]. The extricated fiber was inspected for its Fiber Richness, Fiber Yield, actual properties, Chemical properties, Physico-mechanical, Tensile Strength. The fiber microstructure and utilitarian components were recorded utilizing Scanning Electron Microscope and IR spectroscopy [5]. Common strands are presently viewed as a genuine choice to glass fiber for use as fortifications in composite materials. Their benefits incorporate minimal effort, low thickness, high solidarity to-weight proportion, protection from breakage during preparing, low energy content and recyclability [6]. Regular strands have gotten considerably more consideration than at any other time from the examination local area everywhere on the world [7]. Unsaturated polyester was utilized as network, and composites were set up by trim in an open form and pouring the resin [8]. Composites were manufactured by hand layup strategy followed by pressure shaping cycle utilizing unsaturated polyester as framework. Two kinds of composites were created, one by utilizing treated nonstop palmyra palm leaf tail fibers [9]. Characteristic strands will play a significant job in the arising "green" economy dependent on energy proficiency, the utilization of inexhaustible materials in polymer items, modern cycles that diminish fossil fuel by-products and recyclable materials that limit waste [10].

Tabulation

Table 1. Mechanical properties of CPLSF

Properties	Unit	Non-Alkali Treated CPLSF	Alkali Treated CPLSF
Source of material	Seethapal, Western Ghats, South India.		
Average diameter	μm	300-320	270-290
Density	g/cm^3	1.2	0.9
Cellulose	%	58.58	28.00
Hemicelluloses	%	22.8	20.8
Lignin	%	13.48	1.3
Wax	%	0.35	0.12
Tensile strength	MPa	276±33	310±45
Tensile Modulus	GPa	8.99±1.2	9.982±1.42
Strain at break	%	3.08±0.56	2.12±0.38

Materials and Methods

The Leaf Stalk is taken from the coconut tree which contains flexible white filaments. Coconut trees are normally tall and it contains numerous stringy layer in the (Peduncle) and the part is been cut and the fibre is being separated from that part.

Composites: A composite material is made by joining at least two materials to give an extraordinary mix of properties, one of which is comprised of firm, long strands and the other, a cover or 'lattice' which hold the filaments.

Composites Properties: Common strands are currently considered as a proper option in contrast to optical fib cyclability. Joining of characteristic strands with optical fibre additionally diminishes, because of their benefits, which incorporate ease, high solidarity to-weight proportion, and use of optical fibre. In this examination, half and half glass-sisal-fibre composites were created utilizing the hand lay-up technique.

Epoxy resins: Epoxy pitches are described by the presence of very one 1; 2-epoxide bunches per atom. Cross-connecting is accomplished by presenting curatives that respond with epoxy and hydroxyl bunches arranged on contiguous chains.

Reinforcement: The goal of the support during a material is to build up the mechanical properties of the gum framework. The entireties of the particular filaments that are used in composites have unmistakable properties at that point influence the properties of the composite.

Experimental: The Coconut fibre (Peduncle) and epoxy were chosen for this undertaking and created with the ASTM standard D638, D790, D256. According to the measurement the Coconut fibre and epoxy composite is produced with various lengths of fibre. The readied examples were tried by utilizing Universal Testing Machine.

Preparation of the fibres: Coconut Leaf Stalk was dried under daylight and strands were extricated physically from the coconut Stalk. To guarantee appropriate cooperation among fibre and lattice material, the external most wax layer of the coir was taken out by absorbing the coir situation.

Fig. 1. Preparation of fibres from coconut peduncles

Methods of preparation: There are two techniques for setting up the fibre one by treating the strands with NaOH arrangement and another is straightforwardly utilizing the fibre the readied filaments were stopped into length strands of about 3mm, 6mm, 9mm and isolated into independent bits. One bit was synthetically pretreated with antacid (NaOH). 5% of NaOH was utilized to treat the filaments in a container for 30 minutes. The filaments were then washed in refined water lastly dried. This was utilized to set up the one piece of fibre.

The second segment of the filaments was untreated, with various lengths of strands (3mm, 6mm and 9mm).

Formulations: As per ASTM Standards, we are making the Die of 300 mm × 300 mm × 3 mm measurement. The Die was made by utilizing Mild steel as a base metal and by placing OHP sheet at both upper and lower face of die the smooth surface of composite material is achieved.

Test Specimen as Per ASTM Standards

Table 2. Dimensions of the Specimen

Test	ASTM Standard	Length [mm]	Width [mm]	Thickness [mm]	Gauge Length [mm]
Tensile Test	ASTM D638	165	12.7	3.2	57
Flexural Test	ASTM D790	125	12.7	3.2	50
Impact Test (Izod)	ASTM D256	63	12.7	3.2	-

Sample Preparations

There are two kinds of strategies we have utilized for our study, they are:

1. Non-Alkali Treated Fibres
2. Alkali Treated Fibres

Non-Alkali Treated Fibres [NTCPLSF]

The Leaf Stalk was straight forwardly separated from coconut leaf stalk (Peduncle). As per the ASTM Standard, a die was prepared for the measurement 300 mm × 300 mm × 3 mm. The fibre length of 3 mm, 6 mm and 9 mm were also called as 3, 6 and 9 NTCPLSF were cut and mixed with the resin. The resin is further mixed with the catalyst and hardener. The combination of the mixed resin is poured over the fibre placed over the die and spreaded over it. Then the resin in the die was dried for 48 hours and kept at room temperature for 2 day to dry the combination and afterward the sample composite material is removed from the die. The sample material was cut according to ASTM Standard.



Fig. 2. Tensile Test Specimen; **Fig. 3.** Flexural Test Specimen; **Fig. 4.** Impact Test Specimen

Alkali Treated Fibres [ATCPLSF]

In Alkali Treatment the fibre was first washed in the 5liters of distilled water for 10 minutes and 5% aq. NaOH was taken (250gram NaOH from 5 liters of distilled water). Then the mixture of the NaOH with the fibre is treated with 25-30 minutes. After that the fibres were removed from the alkali treatment and again washed from the hydrochloric acid to remove the moisture content from the NaOH solution about 3 minutes ant the process is repeated for 2 to multiple times to eliminate squander particles. Then these fibres were dried under the daylight for 48hours.The fibre length of 3mm, 6mm and 9mm were also called as 3, 6 and 9 ATCPLSF, and the fibres were cut into various elements of 3mm, 6mm and 9mm long. Here Epoxy Resin was set up with the combination of Catalyst and Hardener. The fibres of 3, 6 and 9 mm long fibre and weight 50grams are place in the lower plate of die. The combination of the mixed resin is poured over the fibre placed over the die and spreads over it. Then the resin in the die was dried for 48 hours and kept at room temperature for 2 day to dry the combination and afterward the sample composite material is removed from the die. The sample material was cut according to ASTM Standard.

Fig. 5. Tensile Test Specimen

Fig. 6. Flexural Test Specimen

Fig. 7. Impact Test Specimen

Results and Discussion

Table 3. Test Results

S.No	Composite	Tensile Strength (MPa)		Tensile Modulus (GPa)		Flexural Strength (MPa)		Flexural Modulus (GPa)		Impact Strength (kJ/m^2)	
		AT	NT	AT	NT	AT	NT	AT	NT	AT	NT
1	3 mm	22.21	18.2	1.79	1.59	71.92	60.40	3.38	2.49	9.16	6.45
2	6 mm	26.14	22.5	1.89	1.73	79.81	68.62	4.81	3.57	9.76	8.12
3	9 mm	24.06	21.3	1.83	1.64	75.93	66.80	3.84	3.28	9.33	7.63

Tensile Properties

In the Tensile test, the composite was fixed in a required place in the tensile machine and then load was applied on the example. The heap is applied bit by bit on the example. Due to the load applying from the part of the testing fibres mould pieces, the pieces will break and the result will showed from the machine system. We made and cut the composite materials form fibres as per the ASTM standards, for tensile test the fibre molds we done the test in the standard of ASTM D638 standards.

From the above results calculation due to mechanical properties we can hint the alkali and non-alkali treatment measure structure these cycle contrast with non-antacid treatment of 3NTCPLSF, 6NTCPLSF, and 9NTCPLSF of specimens test, every one of the examples gave less tensile strength and tensile modulus than the alkali treatment measure examples of 3ATCPLSF, 6ATCPLSF, and 9ATCPLSF. From those examples of non-alkali components 6NTCPLSF gave high tensile strength and tensile modulus than the 3NTCPLSF and 9NTCPLSF materials and in alkali treatment also the 6ATCPLSF gave high tensile strength and tensile modulus than the 3ATCPLSF and 9ATCPLSF. If we compare the both process of non-alkali and alkali treatment fibre composite materials, the 6ATCPLSF of alkali treated examples gave great and high tensile strength and tensile modulus. So we can utilize the high strength example of 6ATCPLSF in additional applications.

Flexural Properties

In the Flexural test part the same process of Tensile working are happening of applying load to the pieces, but the only think is from the Tensile part it identifies the breaking power from the fibre mould pieces. In the Flexural part due to the applying load, it identifies the flexible power from the fibre mold pieces. We made and cut the composite materials form fibres as per the ASTM standards, for flexural test the fibre molds we done the test in the standard of ASTM D790 standards.

From the above results calculation due to mechanical properties we can hint the alkali and non-alkali treatment measure structure these cycle contrast with non-antacid treatment of 3NTCPLSF, 6NTCPLSF, and 9NTCPLSF of specimens test, every one of the examples gave less flexural strength and modulus than the alkali treatment measure examples of 3ATCPLSF, 6ATCPLSF, and 9ATCPLSF. From those examples of non-alkali components 6NTCPLSF gave high strength and modulus than the 3NTCPLSF and 9NTCPLSF materials and in alkali treatment also the 6ATCPLSF gave high flexural strength and modulus than the 3ATCPLSF and 9ATCPLSF. If we compare the both process of non-alkali and alkali treatment composite materials, the 6ATCPLSF of alkali treated examples gave great and high flexural strength and modulus. So we can utilize the high strength example of 6mm of 6ATCPLSF in additional applications.

Impact Properties

In the Impact test like a pendulum based it will works. It is mainly used to identify the Impact strength of the fibre mould pieces. We made and cut the composite materials form fibres as per the ASTM standards, for impact test the fibre molds we done the test in the standard of ASTM D256 standards.

From the above results calculation due to mechanical properties we could create the composite materials in two parts one is alkali treated composite materials and another one is non-alkali treated composite materials. From the two parts we created the composite materials in 3mm, 6mm and 9mm. In ATCPLSF, We can called the dimensions name in 3 ATCPLSF, 6 ATCPLSF and 9 ATCPLSF and for NTCPLSF We can called the dimensions name in 3 NTCPLSF, 6 NTCPLSF and 9 NTCPLSF. From first we can consider the alkali treated fibre composites, the 6 ATCPLSF gave the high Impact strength compare with other components of 3 ATCPLSF and 9 ATCPLSF and we consider the non alkali treated composite materials in that also the 6 NTCPLSF gave the high Impact power compare with other components of 3 NTCPLSF and 9 NTCPLSF. If we can compare with alkali and non alkali components of 3 ATCPLSF, 6 ATCPLSF and 9 ATCPLSF and 3 NTCPLSF,6 NTCPLSF and 9 NTCPLSF from the result the 6 ATCPLSF fibre length, the mechanical properties increases certain limit. So we can use the 6 ATCPLSF at any further applications.

Conclusion

From the previously mentioned table shows obviously that Tensile strength and modulus, Flexural strength and modulus and Impact strength for treated and un-treated coir strands, soluble base treated fibre of 3 ATCPLSF, 6 ATCPLSF and 9 ATCPLSF were vastly improved as contrast with the non-alkali treated fibre molds of 3 NTCPLSF, 6 NTCPLSF and 9 NTCPLSF. From the test of tensile, flexural and impact, the 6 ATCPLSF gave high strength compare to other components from fibres. From these found result we can use the 6 ATCPLSF at any further applications.

The mechanical properties of polyester composites supported with coir fibre have been contemplated and talked about here. The accompanying ends can be drawn from the current examination. Here, we have utilized haphazardly intermittent fibre design in the composite, with the goal that the proportion of filaments in the composite is high. This examination shows that increment long of fibre builds the elasticity. The NaOH treatment on peduncle fibre would eliminate the contamination and more unpleasant fibre surface may result after treatment. This would expand the cement capacity of the coir fibre with the network in the created composite bringing about great elasticity. The treated fibre has preferred supporting property over un-treated fibre.

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