A Comparative Study of Mechanical Properties of Bamboo Fiber (Schizostachyum Lumampao) as An Alternative Eco-Composite Material And Fiberglass

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Abstract - Natural fibers such as bamboo are biodegradable, environmentally friendly, and renewable raw materials. Natural fibers have excellent thermal insulation and excellent mechanical properties. Bamboo gives us a sustainable resource for producing wood for construction and other commodities. A composite material is a material consisting of two or more constituents with different characteristics and complementary features, resulting in a new material having unique and outstanding properties compared with its original constituents. The researchers utilized an experimental approach in dealing with the processes and procedures of the study. Experimental design methods allow the experimenter to understand better and evaluate the factors that influence a particular system. The research shows the analysis about selected mechanical properties of Bamboo Fiber as an alternative eco-composite material and its comparison to fiberglass. The researchers studied the mechanical properties of the Bamboo fiber with resin when subjected to a series of strength tests that was conducted by the Standard and Testing Division (STD) under the Industrial Technology Development Institute - Department of Science and Technology (ITDI - DOST) – Taguig City. The selected mechanical properties of bamboo fiber were the origin of the study which the researchers assumed as the essential factors for a composite namely Izod Impact Test, Charpy Impact Test, Tensile Strength Test, and Compression Test. Based on the results of the different tests conducted on the specimens, researchers concluded that treated bamboo fiber's mechanical qualities are insufficient to serve as an alternative eco-composite to fiberglass..

Keywords *– Bamboo Fiber; Eco-composite material, Mechanical Properties, Aircraft Materials, Aircraft Composites*

Introduction

A composite material is a material consisting of two or more constituents with different characteristics and complementary features, resulting in a new material having unique and outstanding properties compared with its original constituents. Two basic constituents of composite material are matrix and reinforcements, which are essentially insoluble to each other. The matrix serves as a binder for the reinforcements that encase the composite material, while the reinforcements provide the composite's shape and internal structure. (Shah et al. 2016). These composite materials are widely used on aircraft structures. It can be used on engine blades, brackets, interiors, nacelles, propellers/rotors, single-aisle wings, wide-body wings, and other parts of an aircraft.

Natural fibers are increasingly viewed as a potential alternative to synthetic fibers: glass fiber as reinforcements for composite materials. Low cost, low density, high strength-to-weight ratio, resistance to fracture during processing, low energy content, and recyclability are some of their advantages. A variety of parameters can influence or modify the characteristics of natural fiber-based composites, including fiber combinations, processing methods, fiber volume fraction, aspect ratio, and water absorption.

Researchers have noticed that synthetic fibers are the fibers commonly applied to the composite materials used on aircraft. And, we have conducted research on bamboo to become an alternative fiber to be applied to the composite materials. The high strength-to-weight ratio of bamboo has attracted the attention of researchers seeking to exploit its composite potential. BFRP is an eco-composite that is lightweight, environmentally friendly, and has comparable strength to conventional materials.

Bamboo is a natural material with mechanical qualities equivalent to those of conventional fibers. It is lightweight, tough, flexible, has high tensile strength, and has a lower cost. Bamboo fiber is an eco-friendly material because it comes from a natural plant that was grown in our tropical country. The natural bamboo fibers have great mechanical properties, which is a good alternative to synthetic fibers like glass.

The bamboo culm's strength is made up of numerous bamboo fibers aligned longitudinally along its length. The bundles of bamboo fibers are components of the vascular bundles scattered within the culm's diameter. Several investigations into the microstructure of bamboo culms have determined that the distribution of vascular bundles within the diameter and along the length of the culm follows specific patterns. The size of vascular bundles is smaller in the outer section, near the epidermis of the culm, and bigger in the middle, near the hollow part.

The number of vascular bundles grows from the middle to the outside portion of the culm. Vertically, the size of vascular bundles decreases. from the bottom to the top with the increasing percentage of fiber bundles. However, aging does not affect the percentage of fibers significantly (Shah et al. 2016).

Schizostachyum Lumampao (buho) is usually found in La Union, Laguna, Abra, and Ilocos Norte in the Philippines. The majority of the Schizostachyum Lumampao were those that naturally grow in woods. S. Lumampao is frequently utilized in the production of bamboo matting known as "sawali," a material woven from thin strips that is commonly used as a building material in rural regions. They are also often used to weave baskets, fences, spears, fish pens, flutes, handicrafts, and for a variety of other applications such as building, playbook panels, and paper pulp. (Roxas, 2012)

Choosing the right age for bamboo is important since it might affect the product's strength. Because bamboo's cellulose concentration decreases with age, its chemical composition suffers as well. Bamboo's stiffness and yellow color are due to lignin. Because lignin is particularly resistant to different alkalis, no treatment can completely remove it. (Subash et al. 2017)

Materials and Methods

The samples were made from; extracted raw bamboo fiber, raw bamboo fiber mixed with resin and hardener, and fiberglass with resin. The researchers bought a fiberglass kit that contains Polyester resin, hardener, and cloth, which are the raw materials needed to produce a synthetic fiber. Raw bamboo culm was harvested from a local farm in Laguna. To be able to extract raw bamboo fibers, caustic soda (NaOH) was bought. Polyester resins were also prepared to be applied with the raw bamboo fibers extracted. These materials are enough and they have the characteristics needed to produce the proposed eco composite material.

Results and Discussions

Table 2
Izod Impact Test: Impact Resistance of Bamboo Fiber with Polyester Resin

Izod Impact Test								
Sample Code	Izod Impact Strength (J/m)		Mean Dimension (mm)		No. of Specimen Failed at			
	M	SD	w	d	C	H	P	N
PPT-2022-1413*	82.4	53.8	4.46	10.2	5	0	0	0

SAMPLE CODE: PPT-2022-1413: Bamboo fiber

Legend:
w – Width under the notch
d – Depth under the notch
M – Mean
C – Complete Break
H – Hinge Break
SD – Standard Deviation
P – Partial Break
N – Non-Break

Table 2 shows the impact resistance of the bamboo fiber based on Izod impact strength based on the results of conducted on the specimens, the Bamboo Fiber averaged 82.4 J/m with mean dimension of width under the notch of 4.46 mm and depth under the notch of 10.2 mm, and a standard deviation of 53.8 J/m. Five (5) specimens of bamboo fiber failed at complete break.

The results of the izod impact test that was conducted on the Bamboo Fiber with Resin showed that it had a very low Izod Impact Strength which translates to less resistance to impact. Izod impact test is used to identify its significance on aircraft composites by evaluating the specimen’s impact toughness and resistance.

Table 3
Charpy Impact Test: Shock Resistance of Bamboo Fiber with Polyester Resin

Charpy Impact Test									
Sample Code	Charpy Impact Strength, (kJ/m^2)		Mean Dimension (mm)			No. of Specimen failed at			
	Mean	SD	b	h	l	C	H	P	N
PPT-2022-1415*	4.25	1.89	11.0	4.17	80.6	5	0	0	0

SAMPLE CODE: PPT-2022-1415: Bamboo fiber

Legend:
b - Width of specimen
h - Depth/ thickness of specimen
l - Length of specimen
1 – Specimen Type
e - Direction of Blow (Edgewise)
A – Type of Notch (Type A)
SD – Standard Deviation

C – Complete Break P – Partial Break H – Hinge Break N – Non-Break

Table 3 shows the shock resistance of the bamboo fiber based on the results of Charpy impact strength conducted on the specimens, the Bamboo Fiber averaged 4.25 kJ/m2 with mean dimension of; width of specimen of 11.0 mm, thickness of specimen of 4.17 mm, and length of specimen of 80.6 mm. and a standard deviation of 1.89 kJ/m2. Five (5) specimens of bamboo fiber failed at complete break.

The results of the charpy impact test that was conducted on the Bamboo Fiber with Resin showed that it had a very low charpy impact strength which translates to less resistance to shock. Charpy impact test is used to identify its significance on aircraft composites by evaluating whether the specimen is tough or brittle.

Table 4
Compression Test: Compressive Strength of Bamboo Fiber with Polyester Resin

Compression Test								
Sample Code	Compressive Strength (MPa)		Compressive Strength at Yield (MPa)		Modulus of Elasticity (GPa)		Mean Dimension (mm)	
	M	SD	M	SD	M	SD	W	T
PPT-2022-1416[A]	31.7	8.94	31.7	8.94	0.738	0.167	13.7	13.9

SAMPLE CODE: PPT-2022-1416: Bamboo fiber

Legend:
W – Width
T- Thickness
M - Mean
SD – Standard Deviation

Table 4 shows the compressive strength of the bamboo fiber based on the results of compression test conducted on the specimens, the Bamboo Fiber averaged 31.7 MPa and a standard deviation of 8.94 MPa. In terms of Compressive Strength at Yield, the Bamboo Fiber averaged 31.7 MPa and a standard deviation of 8.94 MPa. In terms of Modulus of Elasticity, the Bamboo Fiber averaged 0.738 GPa and a standard deviation of 0.167. In terms of Mean Dimension, the Bamboo Fiber averaged a width and thickness of 13.7 mm and 13.9 mm.

The results of the compression test that was conducted on the Bamboo Fiber with Resin showed that it had a very low compressive strength which translates to low compressive strength. Compression test is used to identify its significance on aircraft composites by evaluating specimen's capacity to withstand loads before failure.

Table 5
Tensile Test: Tensile Strength of Bamboo Fiber with Polyester Resin

Tensile Test								
Sample Code	Tensile Strength (MPa)		Tensile Stress at Break (MPa)		Tensile Stress at Yield (MPa)		Tensile Strain (Elongation) at Yield (%)	
	M	SD	M	SD	M	SD	M	SD
PPT-2022-1412	23.5	15.6	23.5	15.6	47.4①	-	0.712①	-
Sample Code	Tensile Strain (Elongation) at Break (%)		Modulus of Elasticity (GPa)		Mean Dimension (mm)		No. of Specimen Failed	
	M	SD	M	SD	W	T	WGL	OGL
PPT-2022-1412	0.712	0.298	4.16	2.26	13.9	4.66	2	3

SAMPLE CODE: PPT-2022-1412: Bamboo fiber

Legend:
W – Width of Specimen
T - Thickness of Specimen
WGL - Within Gage Length
OGL - Outside Gage Length
M – Mean
SD – Standard Deviation

Table 5 shows the tensile strength of the bamboo fiber based on the results of compression test conducted on the specimens, the Bamboo Fiber averaged 23.5 MPa and standard deviation at 15.6. In terms of Tensile stress at break, the Bamboo Fiber averaged 23.5 MPa and standard deviation at 15.6. In terms of Tensile Stress at Yield, only 1 value out of the total number of Bamboo Fiber specimen was tested which averaged 47.4 MPa. In terms of Tensile Strain (Elongation) at Yield, only 1 value out of the total number of Bamboo Fiber specimen was tested which averaged 0.712%. In terms of Modulus of Elasticity, the Bamboo Fiber averaged 4.16 GPa and a standard deviation of 2.26 GPa. In terms of Mean Dimension, the Bamboo Fiber averaged a width of 13.9 mm and thickness of 4.66 mm. In the No. of Specimen Failed, 2 specimens from the Bamboo Fiber are Within Gage Length and 3 are Outside Gage Length.

The results of the tensile test that was conducted on the Bamboo Fiber with Resin showed that it had a very low tensile strength which translates to low tensile strength. Tensile test is used to identify its significance on aircraft composites by evaluating a specimen's ability of a material to resist tearing due to tension.

Table 6
Izod Impact Test: Impact Resistance of Fiberglass

Izod Impact Test								
Sample Code	Izod Impact Strength (J/m)		Mean Dimension (mm)		No. of Specimen Failed at			
	M	SD	w	d	C	H	P	N
PPT-2022-1417**	606	28.1	4.50	10.2	0	0	5	0

SAMPLE CODE: PPT-2022-1417: Fiberglass

Legend:
w – Width under the notch
d – Depth under the notch
M – Mean
C – Complete Break
H – Hinge Break
SD – Standard Deviation
P – Partial Break
N – Non-Break

Table 6 shows the impact resistance of the fiberglass based on Izod impact strength based on the results of conducted on the specimens, the fiberglass averaged 606 J/m with mean dimension of width under the notch of 4.50 mm and depth under the notch of 10.2 mm, and a standard deviation of 28.1 J/m. Five (5) specimens of fiberglass failed at partial break.

The results of the izod impact test that was conducted on the Fiberglass showed that it had a high Izod Impact Strength which translates to high resistance to impact. Izod impact test is used to identify its significance on aircraft composites by evaluating the specimen's impact toughness and resistance.

Table 7
Charpy Impact Test: Shock Resistance of Fiberglass

Charpy Impact Test									
Sample Code	Charpy Impact Strength, (kJ/m^2)		Mean Dimension (mm)			No. of Specimen failed at			
	Mean	SD	b	h	l	C	H	P	N
PPT-2022-1418**	102	12.2	10.9	4.25	81.0	0	2	3	0

SAMPLE CODE: PPT-2022-1418: Fiberglass

Legend:
b - Width of specimen
h - Depth/ thickness of specimen
l - Length of specimen
1 – Specimen Type
e - Direction of Blow (Edgewise)
A – Type of Notch (Type A)
SD – Standard Deviation

C – Complete Break P – Partial Break H – Hinge Break N – Non-Break

Table 7 shows the shock resistance of the fiberglass based on the results of charpy impact strength conducted on the specimens, the fiberglass averaged 102 kJ/m2 with mean dimension of; width of specimen of 10.9 mm, thickness of specimen of 4.25 mm, and length of specimen of 81.0 mm. and a standard deviation of 12.2 kJ/m2. Two (2) specimens of fiberglass failed at Hinge break and the other three (3) specimens failed at Partial break.

The results of the charpy impact test that was conducted on the Fiberglass showed that it had a high charpy impact strength which translates to high resistance to shock. Charpy impact test is used to identify its significance on aircraft composites by evaluating whether the specimen is tough or brittle.

Table 8
Compression Test: Compressive Strength of Fiberglass

Compression Test								
Sample Code	Compressive Strength (MPa)		Compressive Strength at Yield (MPa)		Modulus of Elasticity (GPa)		Mean Dimension (mm)	
	M	SD	M	SD	M	SD	W	T
PPT-2022-1419[B]	117	10.9	-	-	4.62	0.325	14.2	14.0

SAMPLE CODE: PPT-2022-1419: Fiberglass

Legend:
W – Width
T- Thickness
M - Mean
SD – Standard Deviation

Table 8 shows the compressive strength of the fiberglass based on the results of compression test conducted on the specimens, the fiberglass averaged 117 MPa and a standard deviation of 10.9 MPa. In terms of Compressive Strength at Yield, the fiberglass averaged 117 MPa and a standard deviation of 10.9 MPa. In terms of Modulus of Elasticity, the fiberglass averaged 4.62 GPa and a standard deviation of 0.325. In terms of Mean Dimension, the fiberglass averaged a width and thickness of 14.2 mm and 14.0 mm.

The results of the compression test that was conducted on the Fiberglass showed that it had a high compressive strength which translates to high compressive strength. Compression test is used to identify its significance on aircraft composites by evaluating specimen's capacity to withstand loads before failure.

Table 9
Tensile Test: Tensile Strength of Fiberglass

Tensile Test								
Sample Code	Tensile Strength (MPa)		Tensile Stress at Break (MPa)		Tensile Stress at Yield (MPa)		Tensile Strain (Elongation) at Yield (%)	
	M	SD	M	SD	M	SD	M	SD
PPT-2022-1414	152	11.1	152	11.1	151④	12.8④	2.07④	0.151④

Sample Code	Tensile Strain (Elongation) at Break (%)		Modulus of Elasticity (GPa)		Mean Dimension (mm)		No. of Specimen Failed	
	M	SD	M	SD	W	T	WGL	OGL
PPT-2022-1414	1.97	0.256	11.5	0.873	13.6	4.51	4	1

SAMPLE CODE: PPT-2022-1414: Fiberglass

Legend:
W – Width of Specimen
T - Thickness of Specimen
WGL - Within Gage Length
OGL - Outside Gage Length
M – Mean
SD – Standard Deviation

Tables 9 show the tensile strength of the fiberglass based on the results of compression test conducted on the specimens, the fiberglass averaged 152 MPa and standard deviation at 11.1 MPa. In terms of Tensile stress at break, the fiberglass averaged 152 MPa and standard deviation at 11.1 MPa. In terms of Tensile Stress at Yield, four (4) out of the total number of fiberglass specimens was tested which averaged 151 MPa and standard deviation of 12.8 MPa. In terms of Tensile Strain (Elongation) at Yield, four (4) out of the total number of fiberglass specimens was tested which averaged 2.07 % with a standard deviation of 0.151%. In terms of Tensile Strain (Elongation) at break, fiberglass specimens were tested which averaged 1.97 %. In terms of Modulus of Elasticity, the fiberglass averaged 11.5 GPa and a standard deviation of 0.873 GPa. In terms of Mean Dimension, the fiberglass averaged a width of 13.6 mm and thickness of 4.51 mm. In the No. of Specimen Failed, 4 specimens from the fiberglass are within Gage Length and 1 is Outside Gage Length.

The results of the tensile test that was conducted on the Fiberglass showed that it had a high tensile strength which translates to high tensile strength. Tensile test is used to identify its significance on aircraft composites by evaluating a specimen's ability of a material to resist tearing due to tension.

Table 10
Comparative Values of Izod Impact Test: Impact Resistance Between Bamboo Fiber with Polyester Resin and Fiberglass

Izod Impact Test								
Sample Code	Izod Impact Strength (J/m)		Mean Dimension (mm)		No. of Specimen Failed at			
	M	SD	w	d	C	H	P	N
PPT-2022-1413*	82.4	53.8	4.46	10.2	5	0	0	0
PPT-2022-1417**	606	28.1	4.50	10.2	0	0	5	0

SAMPLE CODE: PPT-2022-1413: Bamboo fiber
PPT-2022-1417: Fiberglass

Legend:
w – Width under the notch
d – Depth under the notch
M – Mean
C – Complete Break
H – Hinge Break
SD – Standard Deviation
P – Partial Break
N – Non-Break

Table 10 shows the results of the Izod Impact Test conducted on the specimens, in terms of the Izod Impact Strength the Bamboo Fiber averaged 82.4 J/m and a standard deviation of 53.8 J/m The Fiber Glass averaged 606 J/m and a standard deviation of 28.1 J/m. In Mean Dimension, the bamboo fiber averaged a width of 4.46 mm and depth of 10.2 mm. the fiberglass averaged a width of 4.50 mm and depth of 10.2 mm. In the Number of Specimen Failure, 5 Bamboo Fiber specimens are under Complete Break and 5 Fiberglass specimens are under Partial Break. Based on the findings, there is a difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample is more effective over the other. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the Izod Impact Test done by DOST ITDI-STD.

Based on the findings, there is a significant difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample is more resistant to impact. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the Izod Impact Test done by DOST ITDI-STD.

Table 11
Comparative Values of Charpy Impact Test: Shock Resistance Between Bamboo Fiber with Polyester Resin and Fiberglass

Charpy Impact Test										
Sample Code	Charpy Impact Strength, (kJ/m^2)		Mean Dimension (mm)			No. of Specimen failed at				
	Mean	SD	b	h	I	C	H	P	N
PPT-2022-1415*	4.25	1.89	11.0	4.17	80.6	5	0	0	0
PPT-2022-1418**	102	12.2	10.9	4.25	81.0	0	2	3	0

SAMPLE CODE: PPT-2022-1415: Bamboo fiber
PPT-2022-1418: Fiberglass

Legend:
b - Width of specimen; 1 – Specimen Type; SD – Standard Deviation
h - Depth/ thickness of specimen; e - Direction of Blow (Edgewise)
l - Length of specimen; A – Type of Notch (Type A)

C – Complete Break P – Partial Break H – Hinge Break N – Non-Break

Table 11 shows the results of the Charpy Impact Test conducted on the specimens. In terms of the Charpy Impact Strength, the Bamboo Fiber averaged 4.25 kJ/m2 and a standard deviation of 1.89 kJ/m2. The Fiberglass averaged 102 kJ/m2 and a standard deviation of 12.2. In terms of Mean Dimension, the Bamboo Fiber has a width of 11.0 mm, depth of 4.17 mm and length of 80.6 mm. The Fiberglass has a width of 10.9 mm, depth of 4.25 mm and length of 81.0 mm. In terms of Number of Specimens Failed, 5 Bamboo Fiber specimens failed at Complete Break. 2 Fiberglass specimens failed at Hinge Break and 3 failed at Partial Break. Based on the findings, there is a difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample is more effective over the other. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the Charpy Impact Test done by DOST ITDI-STD.

Based on the findings, there is a difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample is more resistant to shock. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the Charpy Impact Test done by DOST ITDI-STD.

Table 12
Comparative Values Of Compression Test: Compressive Strength Between Bamboo Fiber With Polyester Resin And Fiberglass

Compression Test								
Sample Code	Compressive Strength (MPa)		Compressive Strength at Yield (MPa)		Modulus of Elasticity (GPa)		Mean Dimension (mm)	
	M	SD	M	SD	M	SD	W	T
PPT-2022-1416[A]	31.7	8.94	31.7	8.94	0.738	0.167	13.7	13.9
PPT-2022-1419[B]	117	10.9	-	-	4.62	0.325	14.2	14.0

SAMPLE CODE: PPT-2022-1416: Bamboo fiber
PPT-2022-1419: Fiberglass

Legend:
W – Width; M - Mean
T- Thickness; SD – Standard Deviation

Table 12 shows the results of the Compression Test conducted on the specimens. In terms of Compressive Strength, the Bamboo Fiber averaged 31.7 MPa and a standard deviation of 8.94 MPa. The Fiberglass averaged 117 MPa and a standard deviation at 10.9 MPa. In terms of Compressive Strength at Yield, the Bamboo Fiber averaged 31.7 MPa and a standard deviation of 8.94 MPa. In terms of Modulus of Elasticity, the Bamboo Fiber averaged 0.738 GPa and a standard deviation of 0.167. The Fiberglass averaged 4.62 GPa and a standard deviation of 0.325 GPa. In terms of Mean Dimension, the Bamboo Fiber averaged a width and thickness of 13.7 mm and 13.9 mm. The Fiberglass averaged a width and thickness of 14.2 mm and 14.0 mm

Based on the findings, there is a difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample is more effective over the other. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the Compression Test done by DOST ITDI-STD.

Based on the findings, there is a significant difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample has more capacity to withstand loads before failure. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the Compression Test done by DOST ITDI-STD

Table 13
Comparative Values of Tensile Strength: Tensile Test Between Bamboo Fiber with Polyester Resin and Fiberglass

Tensile Test								
Sample Code	Tensile Strength (MPa)		Tensile Stress at Break (MPa)		Tensile Stress at Yield (MPa)		Tensile Strain (Elongation) at Yield (%)	
	M	SD	M	SD	M	SD	M	SD
PPT-2022-1412	23.5	15.6	23.5	15.6	47.4①	-	0.712①	-
PPT-2022-1414	152	11.1	152	11.1	151④	12.8④	2.07④	0.151④

Sample Code	Tensile Strain (Elongation) at Break (%)		Modulus of Elasticity (GPa)		Mean Dimension (mm)		No. of Specimen Failed	
	M	SD	M	SD	W	T	WGL	OGL
PPT-2022-1412	0.712	0.298	4.16	2.26	13.9	4.66	2	3
PPT-2022-1414	1.97	0.256	11.5	0.873	13.6	4.51	4	1

SAMPLE CODE: PPT-2022-1412: Bamboo fiber
PPT-2022-1414: Fiberglass

Legend:
W – Width of Specimen; T - Thickness of Specimen; WGL - Within Gage Length; OGL - Outside Gage Length; M – Mean; SD – Standard Deviation

Tables 13 shows the results of the Tensile Tests conducted on the specimens, the Bamboo Fiber averaged 23.5 MPa and standard deviation at 15.6 while the Fiberglass averaged 152 MPa and standard deviation at 11.1 in both Tensile Strength and Tensile Stress at Break. In terms of Tensile Stress at Yield, only 1 value out of the total number of Bamboo Fiber specimen was tested which averaged 47.4 MPa, for the Fiberglass, the average of 4 individual values out of the total number of specimens tested which averaged 151 MPa and a standard deviation of 12.8. In terms of Tensile Strain (Elongation) at Yield, only 1 value out of the total number of Bamboo Fiber specimen was tested which averaged 0.712%, for the Fiberglass, the average of 4 individual values out of the total number of specimens tested which averaged 2.07% and a standard deviation of 0.151%. In terms of Tensile Strain (Elongation) at Break, the Bamboo Fiber averaged 0.712% and a standard deviation of 0.298%. The Fiberglass averaged 1.97% and a standard deviation of 0.256%. In terms of Modulus of Elasticity, the Bamboo Fiber averaged 4.16 GPa and a standard deviation of 2.26 GPa. The Fiberglass averaged 11.5 GPa and a standard deviation of 0.873 GPa. In terms of Mean Dimension, the Bamboo Fiber averaged a width of 13.9 mm and thickness of 4.66 mm. The Fiberglass averaged a width of 13.6 mm and thickness of 4.51 mm. In the No. of Specimen Failed, 2 specimens from the Bamboo Fiber are Within Gage Length and 3 are Outside Gage Length. The Fiberglass had 4 specimens Within Gage Length and only 1 Outside Gage Length.

Based on the findings, there is a difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample is more effective over. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the various tensile properties under the Tensile Test done by DOST ITDI- STD.

Based on the findings, there is a difference between the average results of the Bamboo Fiber and Fiberglass, indicating that one sample is more resistant to tension. The results show that Fiberglass outperformed the Bamboo Fiber in terms of the various tensile properties under the Tensile Test done by DOST ITDI-STD.

Based on the results of the Test done by DOST ITDI-STD that have been gathered in the experiment and the data are compared, the Bamboo fiber that has been produced still has a long way to go. The difference between the bamboo fiber and the fiberglass which was widely used in making aircraft fairing is fairly far when the results are compared. There are still limitations that were hit as per the experiment due to the process, budget, and some other factors that affects the sample product. Based on the results of the bamboo fiber, it will not be able to reach the proper properties on making an aircraft fairing when compared to the result of the properties of the fiberglass.

Considering the findings on the Izod impact test, Charpy impact test, compression test, and tensile test, they have a large gap between each other. In the izod impact test, the fiberglass had an average impact strength of 606 J/m and a standard deviation of 28.1 J/m, whereas bamboo fiber had an average impact strength of 82.4 J/m and a standard deviation of 53.8 J/m. In the charpy impact test, the standard deviation for the bamboo fiber was 1.89 kJ/m2, and the average was 4.25 kJ/m2. The fiberglass had a standard deviation of 12.2 and an average of 102 kJ/m2. In the compression test, the bamboo fiber had a 31.7 MPa average and an 8.94 MPa standard deviation, while the standard deviation for the fiberglass was 10.9 MPa, with an average of 117 MPa. In the tensile test in terms of tensile strength and tensile stress at break, bamboo fiber had an average of 23.5 MPa and a standard deviation of 15.6, whereas fiberglass had an average of 152 MPa and a standard deviation of 11.

In conclusion, the results that have been stated above, it shows that the bamboo fiber and the fiber glass has outperformed the bamboo fiber in the tests.

Conclusion

The researchers chose to conduct this study because the researchers desire to find out if the bamboo fiber could be an alternate eco composite material. The core idea of the researcher's experimental study is to determine if the bamboo fiber is able to be used as an alternate eco composite material which will be used in making aircraft parts. As future aircraft mechanics and as students who are aware of the environmental damages of synthetic fiber in making fiberglass the researchers decided to tackle this study that can yield a positive effect on the aviation industry as well as our economy. Based on the results released by DOST- ITDI, when it comes to the impact resistance property of the bamboo fiber it is inferior when compared to the fiber glass. Based on the results released by DOST-ITDI, when it comes to the shock resistance property of the bamboo fiber it is inferior when compared to the fiber glass. Based on the results released by DOST- ITDI, when it comes to the compressive strength property of the bamboo fiber it is inferior when compared to the fiber glass. Based on the results released by DOST-ITDI, when it comes to the mechanical property tensile strength property of the bamboo fiber it is inferior when compared to the fiber glass.

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