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MECHANICAL PROPERTIES OF BIODEGRADABLE COMPOSITES FROM PALF MAT AND POLYLACTIC ACID

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Abstract

Biodegradable or green composites are attracting more and more attention due to their ability to replace traditional composites and their environmental friendliness. Green composites based on polylactic acid (PLA)and pineapple leaf fiber (PALF) mats have been developed. A mechanical process was used to rapidly extract PALF from fresh leaves, with low environmental impact and high fiber yield. morphology, traction etc. The study focused on mechanical tests, specifically tensile, impact, flex and water absorption tests. Experimental modeling was performed using different ratios of coco and polylactic acid. The fibers were cut to a predetermined length of 3mm and attached to PLA. A compression molding machine is used to apply pressure and heat, which puts more stress on the fiber. The optimal ratio was determined from the analysis results of the pineapple fiber mat in combination with 100% polylactic acid.

Keywords: Pineapple Leaf Fiber Mat (PALF), Polylactic Acid (PLA), Tensile strength (T S),Flexural Strength (FS),Compressive Strength (CS), Impact strength, Water Absorption.

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1.INTRODUCTION:

Unfortunately, While fiber reinforced polymers (FRP) are commonly used in engineering applications, particularly those that require high strength and rigidity, traditional FRPs can present significant problems when recycled or reused after their useful life. Mainly due to non-biodegradable fibers and matrices. Although conventional FRPs often present significant challenges in terms of reuse or recycling at the end of their useful life, mainly due to non-biodegradable fibers and matrices, they are still used in various engineering applications, especially where high strength and rigidity are required . necessary. In the 1990's, the Based on thermoplastic resin, the development of wood flour (WF) reinforced composites is reported. Currently, partially biodegradable and environmentally friendly Many natural fibers, including flax, ramie, and jute, are used to make composite materials. Biodegradable polymers (derived from starch, cellulose or vegetable oils) 8 - 11 . These compounds have good mechanical properties. The performance of green materials depends on the properties of the natural fibers used as reinforcement composites. The most notable property of green composites is their complete biodegradability, causing minimal environmental damage when they break down into carbon dioxide and water. Green composites have some disadvantages, including lack of flexibility, high rate of moisture absorption, and degradation due to biological attack. The present study provides an overview of current knowledge and findings on green polylactic acid (PLA). Mechanical properties of composite materials and their impact strength, flexural strength, compressive strength and tensile strength. In addition, some fundamental issues related to the development of such composites are addressed.

Therefore, the toughness transverse rupture stress composites are strongly is influenced by the properties of the fibre/resin interface. fiber properties, resin properties and fiber/resin interface properties together - are necessary to produce high strength composites. Currently, most fibers and resins come from take decades to degrade in a typical environment. Thermoset resin compounds cannot be reclaimed or recycled, but a small percentage of these thermoset compounds are pulverized for filling purposes or burned to provide heat energy. At the end of their useful lives, most of these thermoset chemicals are landfilled. Conversely, incineration produces hazardous gases and requires expensive scrubbers. Incinerating disposing of waste is both expensive and environmentally unfriendly. Future projections suggest that disposal techniques for these materials will become more expensive as global environmental regulations tighten and landfills shrink.

2.COMPOSITE MATERIAL:

Use of composite materials many advantages and can be used in a variety of applications. Because of their extreme lightness and low density, composites are easily formed into complex shapes and block constructions. These materials have improved friction and wear properties with high specific stiffness, creep resistance and strength. Due to their low thermal expansion and electrical conductivity, composite materials have good damping properties and good fatigue resistance.

2.1 NATURAL FIBER

In recent years, natural fibers have emerged as an alternative to expensive, non-renewable and abrasive synthetic fibers. This is the fundamental drive to focus on a permanent supply of natural fibers. Low cost, easy to manufacture and less polluting.

3. LITERATURE REVIEW

R. Baskar , S. Dinesh et al (2020Composite materials are more advantageous than traditional materials (iron, steel, etc.) because of their light weight, better fatigue behavior and longer service life.

Naga Venkata Sai Charan. V Akhil\. Aetal (2021): Composites are chosen primarily for their ability to maintain relative stiffness, strength, and component weight. To distinguish the mechanical properties of alkali-treated hybrid composite laminates, this article analyzes the two types. Different types of manufacturing processes also affect the properties of composite laminates. The results of several machine tests carried out confirm this.

4. MATERIAL SELECTION:

4.1. PINEAPPLE MAT:

Composites are chosen primarily for their ability to maintain relative stiffness, strength, and component weight. To distinguish the mechanical properties of alkali-treated hybrid composite laminates, this article analyzes the two types. Different types of manufacturing processes also affect the properties of composite laminates. The results of several machine tests carried out confirm this. One of the commonly accessible waste products is pineapple leaf fiber (PALF), although research on this is still lacking. The rational and reasonable use of PALF for various applications follows from a thorough analysis of its chemical, physical and mechanical properties.

Fig No:1 Pineapple Leaf Fibre Mat

Expensive and non-renewable synthetic fiber can be replaced by PALF as a new raw material source for industry. A detailed examination of the basic facts of PALF and a comparison of its chemical, Mechanical and physical properties comparable to other natural fibers. However, few studies have been conducted on PALF that elucidate interfacial adhesion between fibers and fiber reinforcement compatibility. In addition, it summarizes the latest research Applications of PALF-reinforced polymer composites and their thermal, mechanical and physical properties.

4.2.POLYLACTIC ACID:

A thermoplastic monomer made from durable organic materials like sugar cane or cornstarch is called polylactic acid, or PLA for short. Unlike most plastics, which are made by distilling and polymerizing petroleum from fossil fuels, PLA is made from biological resources.

Polylactide (PLA) is a renewable biomass polyester typically made Sugar beet pulp, corn, tapioca, or other fermented vegetable sources.

- PLA is a thermoplastic with high elasticity and high resistance.

- It is comparable to polystyrene (PS) in terms of stiffness and strength at room temperature.

Fig No:2 Polylactic Acid

5.Mechanical And Water Absorption Test:

5..1. Tensile Test :

One of the mechanical tests used to evaluate how a material would behave under a load is such a test. The samples are created in accordance with ASTM D3039 specifications, measuring 250x25x3mm, with a crosshead speed of 3 mm/min.

Fig No:3 Tensile Test

It was examined in a computerized all-purpose testing apparatus. The samples are placed onto the apparatus prior to testing, and using a hydraulic system, they are grasped to prevent dislocation. Each sample tested is indicated for its quality. For each composition, a total of four samples were examined; the average value is used for the analysis.

S No	MATERIAL		PEAK LOAD (N)	% OF ELONGATION	UTS(N/ mm²)
	PALF	PLA			
1	0	100	246.408	0.660	6.318
2	10	90	368.331	1.510	9.442
3	20	80	490.255	2.360	12.567

Table No:1-Tensile Test Result

5.2. Flexural Test:

This test establishes how much a material will bend when subjected to a load. The samples are constructed in compliance with ASTM D790 requirements and feature 125x13x3mm dimensions with a crosshead speed of 2 mm/min.

Fig No:4 Flexural Test

Each sample's testing outcomes are documented using a computerized universal testing device. Four samples were utilised to evaluate each composition, and the analysis used the average value.

S No	MATERIAL		PEAK LOAD(N)	FS(Mpa)	FM(Gpa)
	PALF	PLA			
1	0	100	15.461	9.910	929.576
2	10	90	43.139	27.653	1150.775
3	20	80	70.818	45.396	1371.973

Table No:2 –Flexural Test Result

5.3: compression Test:

The purpose of this test is to predict how the substance will react under compression samples.

Table No:3-Compression Test Result

The test 150* 25* 3 mm dimensions are produced in line with ASTM D3410 standard.

A computerized universal testing apparatus was used to evaluate it, and the results for each sample were recorded. Four samples were utilized to evaluate each composition, and the average was used for the analysis.

5.4. Impact Test:

This test establishes the amount of tensile strength an object can resist when loaded. The samples for this test have dimensions of 65 * 13 * 3 mm and were produced in line with ASTM D256 requirements.

Fig No:5 Impact Test

The Izod impact test was digitized, and the data for each sample were recorded. Four samples of each composition were evaluated in total, and the average value is used for the analysis.

S No	MATERIAL		IMPACT STRENGTH
	PALF	PLA	
1	0	100	0.30
2	10	90	0.25
3	20	80	0.21

S.No	MATERIAL		PEAK LOAD(N)	CS(N/mm²)
	PALF	PLA		
1	0	100	457.657	6.102
2	10	90	584.293	7.789
3	20	80	710.950	9.476

Table No:4-Impact Test Result

5.5 Water Absorption:

This test allows for the determination of the material's Resistant to water absorption. rehearse are 20*20*3mm in size and made in line with ASTM D5229 requirements.

S.No	MATERIAL		WEIGHT OF SPECIMEN(gms)		% of Water Absorption
	PALF	PLA	BEFORE	AFTER	
1	0	100	1.6	1.8	12.5
2	10	90	1.7	1.95	14.7
3	20	80	1.8	2.17	17.2

Table No:5-Water Absorption Test Result

The samples immersed in distilled water at room temperature for two days. before the alterations are discovered. After being removed after a certain period of time, the samples are cleaned using a cloth, and their weight is then determined. The formula below, where Wb stands for the final weight after immersion, Wa for the sample's beginning weight,and W for the percentage of water absorbed, can be used to determine how much water was absorbed in a sample.

6.CONCLUSION:

As per the aim of these research pineapple mat and polylactic acid based composite material has been examined and the results were tabulated. The specimen for these testing prepared with the manual method. The specimens was prepared in three different weight ratio of pineapple mat 100% & polylactic acid 0%, pineapple mat 90% & polylactic acid 10%,pineapple mat 80% & polylactic acid 20%. Specimens were prepare for basic mechanical test of tensile, impact and hardness. From the test results table here the research concluded polylactic acid 80% with pineapple 20% producing maximum strength compare than other propositions

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