

Experimental Examination of Mechanical Analysis on Pandanus Odorifer Fiber Reinforced Polymer Composites

Jothiraj Palaniappan, Vignesh S, Winowlin Jappes J T

Abstract: The advancement in the polymeric science and materials have led to the conglomeration of the both entities to a different wide variant of composite materials. The advancement have made it very clear with the enunciation of the various composites with varied matrix and binders. The objective of this work is to prepare a low weight composite material with natural fiber for packaging applications. Pandanus odorifer with the low density polyester resin composites were chosen and prepared and characterized for various mechanical properties such as tensile and impact test to ensure its endurance in the applications.

Keywords: Polymeric Composite, Mechanical Studies and Pandanus Odorifer.

I. INTRODUCTION

The fiber reinforced polymeric composite have made a vibrant materials substitution in all aspect of material science whereby it have made it clear to the way of the various materials with the desired properties of structures. Even to the cause of failure and its redundancy is evaluated in terms of vibration analysis [1]. The addition of the polymeric composite with the inclusion of the fiber matrix have widely influenced the tensile property of the materials. The uniqueness of the materials are rendered by the independent tensile characteristics of the matrix materials [2]. To improve the mechanical strength of the fiber thereby to inculcate the higher strength to the mass ratio is elucidated with the chemical treatment which includes the alkaline and saline treatment. The alkaline and saline treatment have led to the significant improvement and mechanical strength of the materials of the fiber. Even the impact behavior of the materials have been effected due cause of treatment in lower residual stresses [3]. The advancement of the usage of the desired composite in the high temperature application is studied via the basalt as the filler materials and the analysis of the materials strength studies reporting the higher tensile strength [4]. The improved mechanical strength of the carbon

fibers increased by 66% and the flexural modulus by 72%, while inter laminar shear strength by 25% [5]. The overview of all those mechanical strength of the natural fiber is elucidated in the paper. [6,7]. The investigation of the mechanical properties of the developed natural fiber to include the biodegradability materials enhancing the fiber composite structural stabilities [8]. The mechanical properties of the hemp fiber polymeric thermoplastic polyurethane composite was studied and its flexural strength was enhanced by 193.2%. [9]. The inherited effect of the mechanical and chemical properties of the red mud assisted polyester epoxy bamboo was studied emphasizing the use of 15 wt% filler offered improved result by 10wt% of the filler content [10]. Even the studies of Okra fiber has also elucidated the improved strength [11].

II. MATERIALS AND METHODS

Pandanus Odorifer a higher monopolized species of Pandanaceae family was procured from the local vendors. It is commonly known as screw-pine. Leaves are glucose, 40–70 cm. long. The Resin-Isophthalic polyester resin which is thermo set, capable of being cured from a liquid or solid state when subjected to optimum condition is used as accelerator. Polyester resins, are simply as ‘polyesters’. Styrene is a viscous pale colored liquid of polyester base. The addition of styrene in amounts of up to 50% aids in reducing the viscosity of the resin making it more lean for the molding aspects.. For this research work, the isophthalic resin used as matrix purchased from M/s.vasavibala resin pvt.Ltd, Chennai, tamilnadu, India. Curing is usually regulated by heat, pressure and by addition of various curing agents at room temperature. Epoxies and polyesters react to form an interconnect structure without formulation of any volatile by-product. Epoxies and polyesters can be cured at atmospheric pressures and also at ambient temperature.

Cobalt Napthanate is used for activation of the process and to accelerate the resin at room temperature. They are widely employed catalyst because they are soluble in the non-polar sub states, such as the alky resins or linseed oil as the napthanates mixtures helps to confer high solubility and it is low cost. Compounds containing in the accelerator are manganese and iron. Catalyst-Methyl Ethyl Ketone Peroxide is used to initiate the polymerization and activate the process.

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(MEKP) organic peroxide, a highly explosive similar to acetone peroxide. For a combination of the matrix 100 grams of resin with 1.5ml of Methyl ethyl ketone peroxide (MEKP) and cobalt naphthenate have been used as accelerator and catalyst for room temperature curing.

Table- I: Properties of Resin



Fig.1.Iso phthalic resin



Fig.2. Accelerator



Fig.3. Catalyst

Particulars	Viscosity	Density	Elongation at break	Tensile strength	Young's modulus	Flexural strength	Flexural modulus
Values (Units)	650 (cPs)	1.15 (g/cm ³)	4.8 (%)	41±1.6 (MPa)	968±4.07 (MPa)	61±2.26 (MPa)	2461±2.22 (MPa)

The fibers were randomly aligned, washed with dry air. Those fibers were cut into various desired sizes of 3mm, 4mm and 5mm. The mould (300mm*125mm*3.2mm) was cleaned and polishing wax was applied for the removable of the specimen without any adhesive pull off. Isophthalic polyester resin were mixed with 1.5wt% cobalt naphthenate (accelerator) and 1.5wt% methyl ethyl ketone peroxide was made to curing agent, The Fig.1,2,3 depicts the images of resin, accelerator and catalyst. The treated fibers were arranged in the mould in the form of mat and pressed. The casing is put under load for about 3 to 4 hours for proper curing at room temperature. This is predominantly used manual mixing procedure between the fiber and matrix. After 3 to 4 hours the mould is removed from compression machine. Shown in Fig 4 in the molding machine and Fig 5 is the molded composite compound structure.



Fig 4. Compression molding machine



Fig.5. Fabricated composite sample

breakage of failure points.. Tensile strength is opposite to compressive strength. The UTS is usually found by performing a tensile test and recording the stress versus strain; the highest point of the stress strain curve is the UTS. In the resting the materials or specimen are continuously pulled to its breakage, to find the tensile strength of the fabricated composites in a UTM. The cross head speed of 5 mm/min is maintained according to the ASTM D 638. Fig.6 shows the Universal Tensile testing machine with the prepared specimen Fig 7 and tested specimen at Fig 8.

The following observations are made by the tensile strength making its suitability to the engineering applications, as the addition of the fiber pandanus to the material the tensile strength of the material have shown consecutive increase and thereby attaining the maximum tensile strength of 12.53MPa and the minimum to the 20% addition of the fiber showing 8.66MPa, this is due cause of the modulus of elasticity being increased by the addition of the volume fraction of the fiber, the fibers being promoting the elongation strength of the matrix , since the addition of the elongation depends on the amount of the fiber, in the combination of the matrix and fibers considered for our study the Maximum elongation of the fiber to 20% with 6.43% elongations. This suggest to use the minimum fiber quantity for maximum elongation. It is apprehended that the hydrophilic nature of the fiber is compatible to its application of the hydrophobic polymeric matrix and usually form an aggregate matrix. The aggregate formation leads influence towards the strength in terms of elongation factor and strain to elongation. The tensile strength and modulus increases within the tested increased weight ratio of the fiber specimen. Which makes it evident that the fiber concentration plays a vital role of making the matrix aggregation. Fig 9. Designates the comparison of 1, 2, 3 fiber with 20%, 30%, 40% mass fraction of fiber with both % of elongation and tensile strengths. Table 2 the Tensile Graph by the UTS is evidencing steep curve making the aspect of the limited elasticity.



Fig 6. Universal tensile testing machine



Fig 7. Tensile specimen before test



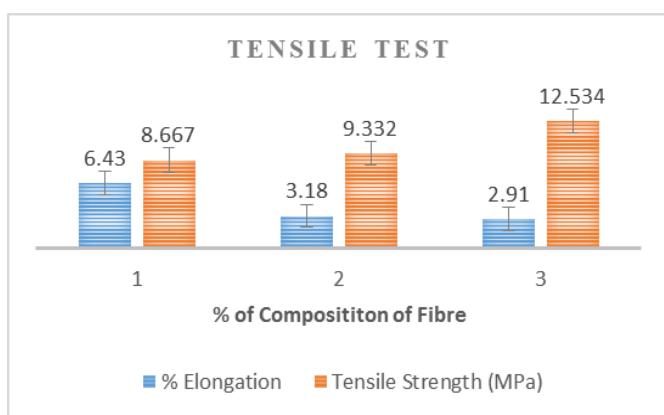
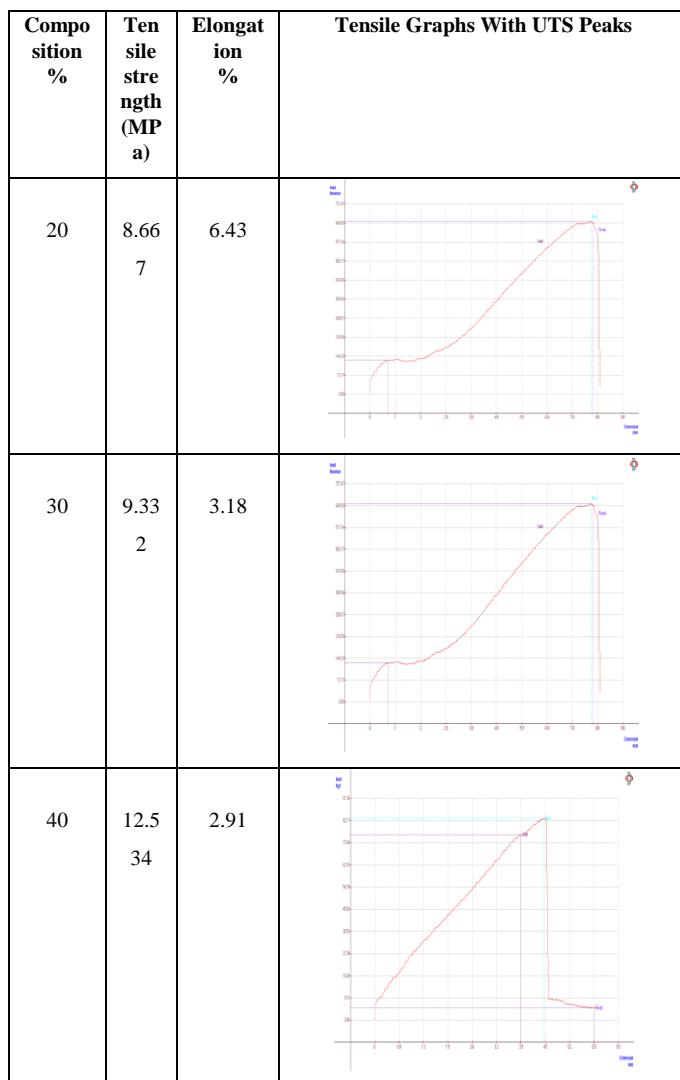
Fig 8. Tensile specimen after test

III. RESULTS AND DISCUSSION

A. Tensile Test

The mechanical testing enables the critic to study the prompt the materials and its relevance to the usage in substitution aspect of the material. The Ultimate strength often refers to the maximum stress that a material can withstand to its

Table II: Graphs and corresponding values of Tensile test



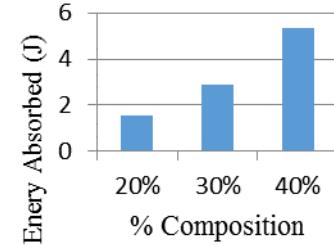
B. Impact Test

The impact test is nomenclature to enumerate the energy associated with the break of specimen which is absorbed by the specimen while breakage. The un-notched Izod impact test is conducted to study the impact energy according to the ASTM D256. The un-notched specimens are cut in to require size and kept in a position as simply supported beam to swing up the pendulum, to break the specimen making the specimen to absorb the energy. The tested specimen values have been tabulated in Table 3. The impact energy (J) is calculated from

the dial gauge, which is being associated with the machine inherited. Nine samples are taken separately for both the base treated and untreated specimens and the results are analyzed and tabulated. The maximum energy absorbed was obtained by the 40% weight of fiber and the minimum energy absorption was obtained 20% weight which defines as the amount of the fiber content increases leading to the increase of the energy absorbed since the impact energy absorption is transferred to the varied amount of the fiber by mass. The breakage energy of the substance with the modulus were corporate to breakage spreading along the specimen. The specimen with less fiber have significantly failed to enunciate the higher order of energy and have failed tremendously due cause of the low energy distribution to the factor of the matrix contents. Whereby the inclusion of the fiber to the volume fraction shows the diversification of the impact along the volume of the fiber making the specimen as a whole to absorb the maximum energy.

Table III. Calculated results from the testing

Composition (%)	Energy absorbed (J)	
	20	30
20	1.550	2.907
30		
40	5.365	



IV. CONCLUSION

To conclude the following observations were made in the investing of pandanus odorifer fiber sheath with all layering sequences: Mechanical properties and chemical properties of the newly identified composite reinforcement, the pandanus odorifer fiber, are found to be having a considerable value. The composites with various fiber lengths and fiber weight percentage where analyzed. The analysis resulted in the identification of the significant increase in the mechanical properties such as the tensile strength as the increase of the fiber content and the decreased % of elongation. Though the dependency is assimilated by the increase of ultimate tensile strength and impact energy in increase of the fiber content and decrease of the % elongation with increase of the fiber contents.

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Membership, achievements, with photo that will be maximum 200-400 words.

AUTHORS PROFILE



Jothiraj Palaniappan has completed his bachelor's degree in the department of Mechanical Engineering under Anna University with First rank and gold medal, proceeded with the degree of masters under the Manufacturing Engineering with First Rank and Gold medal. He is being nominated and selected as the Mentor for change under the NITI-Ayog, Govt. of India for AIM. Has published two papers in peer reviewed journals. Active member in the IAEng. Research interest being inclined towards the advanced materials as shape memory alloys and phase changing materials



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