

Glassfiber and Pineappleleaf Fiber (Palf) Composite Material Characterization with Sem Analysis

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Abstract: - The main objective of this research work is to develop a new composite material using GLASSFIBER and PINEAPPLE LEAF FIBER (PALF) and to study its mechanical properties. Glass fiber reinforced epoxy composites are most widely used as composite materials. Now a day many of the researchers have focused on natural fiber composite materials in order to replace the synthetic fibers due to its eco friendly nature. More over natural fibers are most abundantly available and economical. Pine apple leaf fiber is a natural fiber having good mechanical properties and it is waste material and not yet explored much.

It is revealed from the literature survey that the tensile and flexural strength of the glassfiber composites is less compared to PALF composites. In view of this, with an aim to develop a better composite compared to both, the present investigation has carried out an experimental investigation on composite material by adding glassfiber and PALF to it.

In the present work samples were prepared by using PALF and glassfiber by varying there weight percentage and by retaining the total quantity of fiber as constant, by using hand lay-up technique as per ASTM standards (American society for testing and materials). The developed composite material was subjected to different kinds of tests. The tensile, Impact flexural test were carried out by UTM (Universal Testing Machine) and microscopic structure was carried out by Specified Electron Microscope. It is found that, the flexural ,impact tensile strengths of the composite with both the fibers is found to be higher than single fiber composites.

Keywords- Pineapple leaf fiber (PALF), Glassfiber, composites.

I. INTRODUCTION

Over the last thirty years composite materials, plastics and ceramics have been the dominant emerging materials. The volume and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a significant proportion of the engineered materials market ranging from everyday products to sophisticated niche applications. While composites have already proven their worth as weight-saving materials, the current challenge is to make them cost effective. The efforts to produce economically attractive composite components have resulted in several innovative manufacturing techniques currently being used in the composites industry. It is obvious, especially for

composites, that the improvement in manufacturing technology alone is not enough to overcome the cost hurdle. It is essential that there be an integrated effort in design, material, process, tooling, quality assurance, manufacturing, and even program management for composites to become competitive with metals.

The composites industry has begun to recognize that the commercial applications of composites promise to offer much larger business opportunities than the aerospace sector due to the sheer size of transportation industry. Thus the shift of composite applications from aircraft to other commercial uses has become prominent in recent years. Increasingly enabled by the introduction of newer polymer resin matrix materials and high performance reinforcement fibers of glass, carbon and aramid, the penetration of these advanced materials has witnessed a steady expansion in uses and volume. The increased volume has resulted in an expected reduction in costs. High performance FRP can now be found in such diverse applications as composite armoring designed to resist explosive impacts, fuel cylinders for natural gas vehicles, windmill blades, industrial drive shafts, support beams of highway bridges and even paper making rollers. For certain applications, the use of composites rather than metals has in fact resulted in savings of both cost and weight. Some examples are cascades for engines, curved fairing and fillets, replacements for welded metallic parts, cylinders, tubes, ducts, blade containment bands etc. Further, the need of composite for lighter construction materials and more seismic resistant structures has placed high emphasis on the use of new and advanced materials that not only decreases dead weight but also absorbs the shock & vibration through tailored microstructures. Composites are now extensively being used for rehabilitation/ strengthening of pre-existing structures that have to be retrofitted to make them seismic resistant, or to repair damage caused by seismic activity. Unlike conventional materials (e.g., steel), the properties of the composite material can be designed considering the structural aspects.

II. LITERATURE SURVEY

S.Mishra et al investigated the tensile, impact strength and flexural strength of bio-fibre (pineapple

fibre/sisal fibre) reinforced polymer matrix composite with different modified surface. The surface modification of sisal fibre such as alkali treatment produced optimum tensile and impact strength, while cyanoethylation resulted in maximum increase in flexural strength of hybrid composite

M. R. Ishak et al has studied and compared the mechanical properties of short kenaf bast and core fibre reinforced unsaturated polyester composites with varying fibre weight fraction i.e. 0%, 5%, 10%, 20%, 30% and 40%. The compression moulding technique was used to prepare the composite specimens for tensile, flexural and impact tests in accordance to the ASTM D5083, ASTM D790 and ASTM D256 respectively. The overall results showed that the composites reinforced with kenaf bast fibre had higher mechanical properties than kenaf core fibre composites. The results also showed that the optimum fibre content for achieving highest tensile strength for both bast and core fibre composites was 20%wt. this study also observed that the elongation at break for both composites decreased as the fibre content increased.

F.Z. Arrakhiz et al., have investigated Mechanical properties of Alfa, coir and bagasse fibres reinforced polypropylene (PP) composites. This study observed addition of various amount of reinforcement fibres yielded noticeable increases in both tensile and flexural modulus as well as the torsion parameter. It is also observed that 56–75% increases in tensile modulus by the use of Alfa, coir and bagasse while the flexural modulus increased by 30–47% when compared to neat PP.

Maneesh Tewari et al., this work shows a bagasse-glass fibre reinforced composite material is developed with 15 wt%, 20 wt%, 25 wt% and 30 wt% of bagasse fibre with 5 wt% glass fibre mixed in resin. This study also shows Addition of bagasse fibres decreases the ultimate tensile strength, but addition of glass fibre further increases the ultimate tensile strength in comparison to commercially available bagasse based composite. This study shows that impact strength increases with Bagasse-glass reinforced fibres due to fibre more elasticity. This study also showed Addition of bagasse fibre reduces bending strength, but addition of glass fibre further increases the bending strength in comparison to commercially available bagasse based composite.

III. METHODOLOGY

PREPARATION OF MOULDS:

For making the composites a glass molding box was prepared with 200X200X3 mm mould cavity. The mould cavity is coated with a thin layer of aqueous solution of polyvinyl alcohol which acts as a good releasing agent. Further a thin coating of wax laid over it and finally thin layer of polyvinyl alcohol was applied. Each coat was allowed to dry for 20 minutes at room temperature. The fiber content in all the samples is retained as 20grams which is 10% of the total weight of the specimen.

Another glass molding box was prepared with 150X150X10 mm mould cavity. This is also coated with aqueous solution of polyvinyl alcohol.

SPECIMEN PREPARATION:

S.NO	GLASS FIBER	PINE APPLE LEAF FIBER
1.	0 grams (0%)	20grams (10%)
2.	5 grams (2.5%)	15 grams (7.5%)
3.	10 grams (5%)	10 grams (5%)
4.	15 grams (7.5%)	05 grams (2.5%)
5.	20 grams (10%)	0 grams (0%)

A 3mm thick plate was made from the epoxy and the hardener in the ratio of 100 and 10 parts by weight respectively. Then the mould box was loaded with mould mixture and 20 grams of glass fiber and 0 grams of

pineapple leaf fiber (PALF) and was placed in a vacuum oven maintained at 100°C for 3 hours to complete curing. After curing the plate was removed from molding box with simple tapering and it was cut into specimens for testing.

Similarly other specimens are prepared by varying the weight proportions as shown in above table



Glass mould to prepare composite material



Extraction of pineapple leaf fibre



GLASS FIBRE

IV. EXPERIMENTS CONDUCTED:

- ❖ Tensile test
- ❖ Flexural test
- ❖ Impact test
- ❖ SEM analysis

TEST	SIZE	STANDARDS
Tensile test	150x15x3mm	ASTMD-3039-76
Flexural test	150x15x3mm	ASTMD-5943-96
Impact test	120x13x3mm	ASTMD-256-88

- ❖ Tensile and flexural strength are done with Universal Testing Machine.
- ❖ Impact test are done with charpy impact machine.
- ❖ SEM analysis are done with specified electron microscope



Universal testing machine



Impact Test Equipment

V. RESULTS AND DISCUSSIONS:

TENSILE:

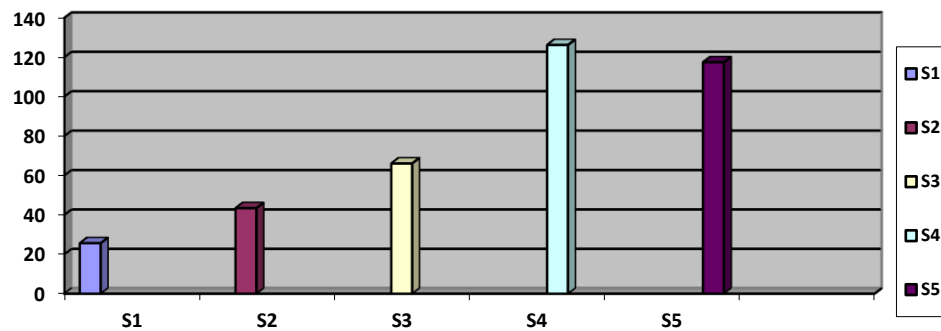


Figure-1 UNITS:Mpa

Figure-1 shows the tensile strength properties of different specimens. The X-axis includes the specimens and the Y-axis includes the tensile strength. The specimen-4 with 15grams of glassfiber and 5grams of PALF gives the better tensile strength when compared to the other specimens and the glassfiber.

FLEXURAL:

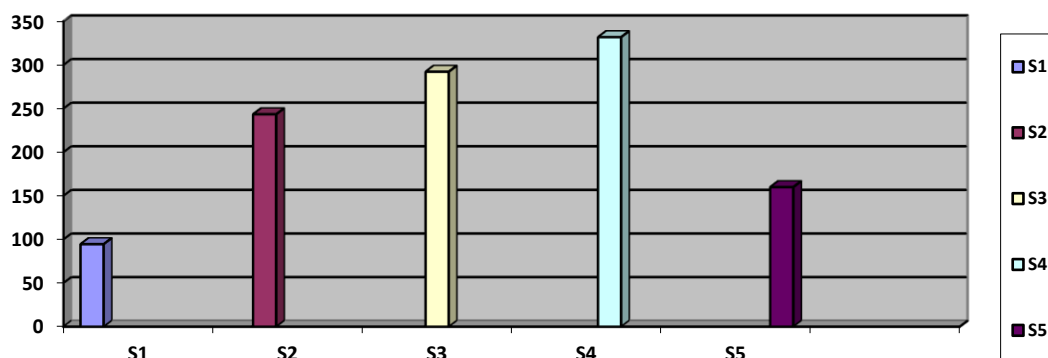


Figure2 UNITS:Mpa

Figure-2 shows the flexural strength properties of different specimens. The X-axis includes the specimens and the Y-axis includes the flexural strength. The specimen-4 with 15grams of glassfiber and 5grams of PALF gives the better tensile strength when compared to the other specimens and the glassfiber.

IMPACT:

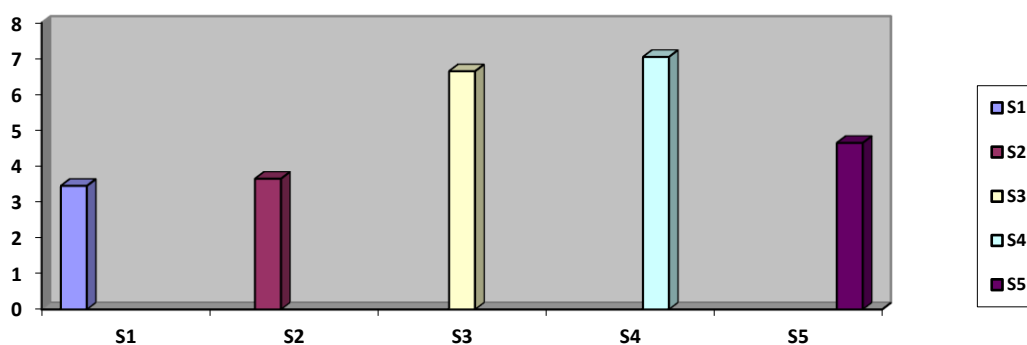


Figure3 UNITS:J

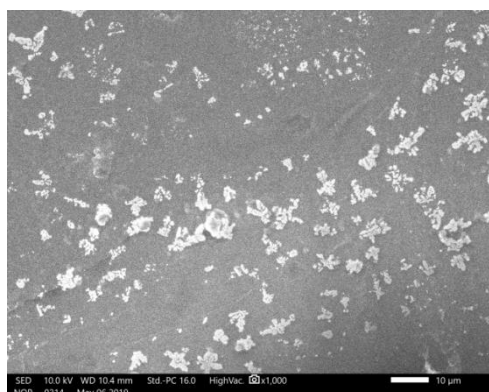
Figure-3 shows impact strength properties of different specimens. The X-axis includes the specimens and the Y-axis includes the impact strength. The specimen-4 with 15grams of glassfiber and 5grams of PALF gives the better tensile strength when compared to the other specimens and the glassfiber.

SEM ANALYSIS

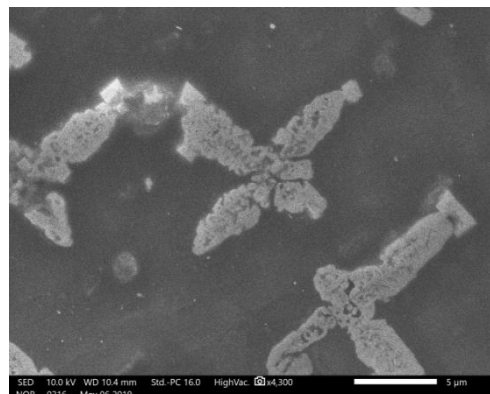
A Scanning electron microscope is a type of electron microscope that produces images of a sample by scanning the surface with a focused beam of electrons. The electrons

interact with atoms in the sample producing various signals that contain information about the surface topography and composition of the sample. To probe the bonding between the reinforcement and matrix. The Scanning electron micrograms of fractured surfaces of glassfiber reinforced epoxy composites were recorded. The micrograms were recorded at different magnifications and regions. the Analysis of the micrograms of the composites prepared under different conditions is presented in the following paragraphs with 20X to 30000x and spatual resolution 10,5,2 respectively.

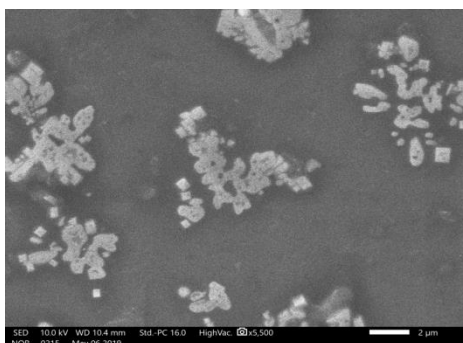
SPECIMEN-1



a



b

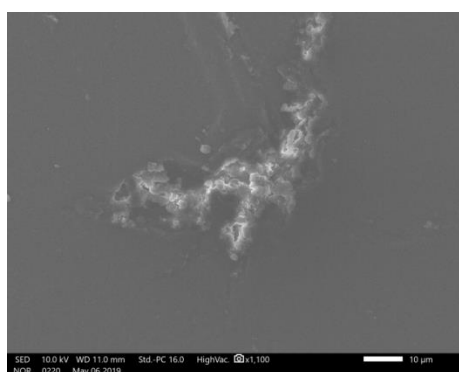


c

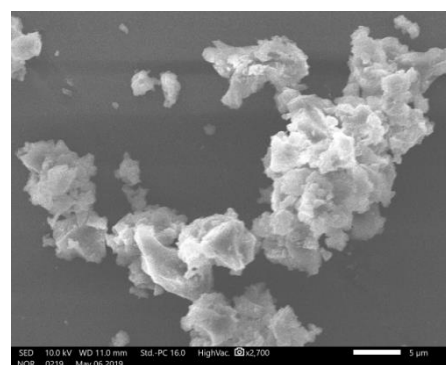
GLASS FIBER	PINE APPLE LEAF FIBER
0 grams (0%)	20grams (10%)

The above figures shows the SEM(Scanning Electron Microscope)Analysis of specimen-1 which shows the micro structure of specimen-1. With three different proportions (10nm,5nm,2nm) with magnification 20X to 30,000X and special resolutions 50nm to100nm and find their microstructure.

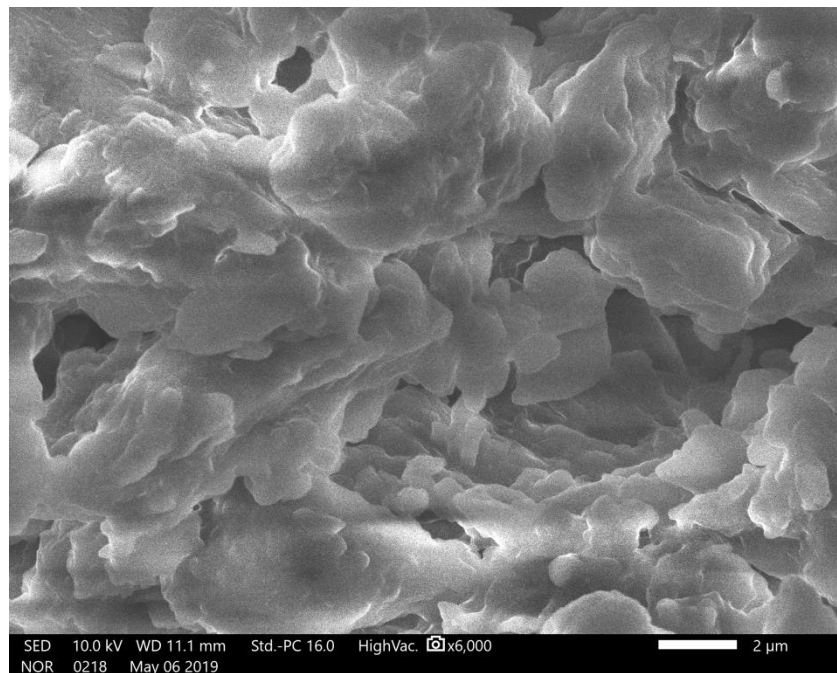
SPECIMEN2



a



b

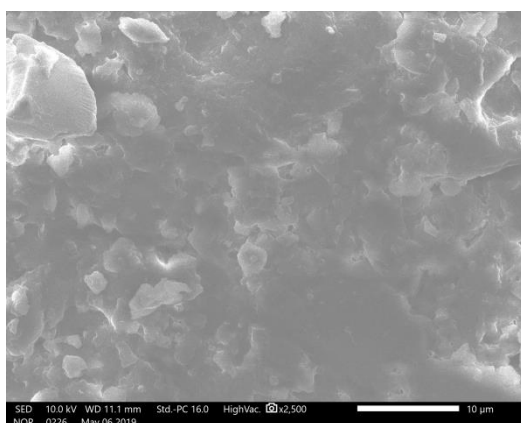


C

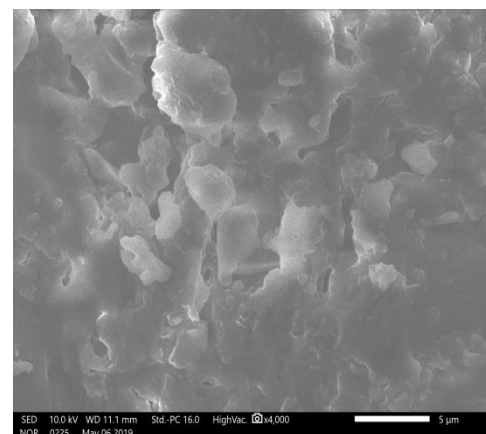
GLASS FIBER	PINE APPLE LEAF FIBER
5 grams (2.5%)	15grams (7.5%)

The above figures shows the SEM(Scanning Electron Microscope)Analysis of specimen-2 which shows the micro structure of specimen-2. With three different proportions (10nm,5nm,2nm) with magnification 20X to 30,000X and special resolutions 50nm to 100nm and find their microstructure.

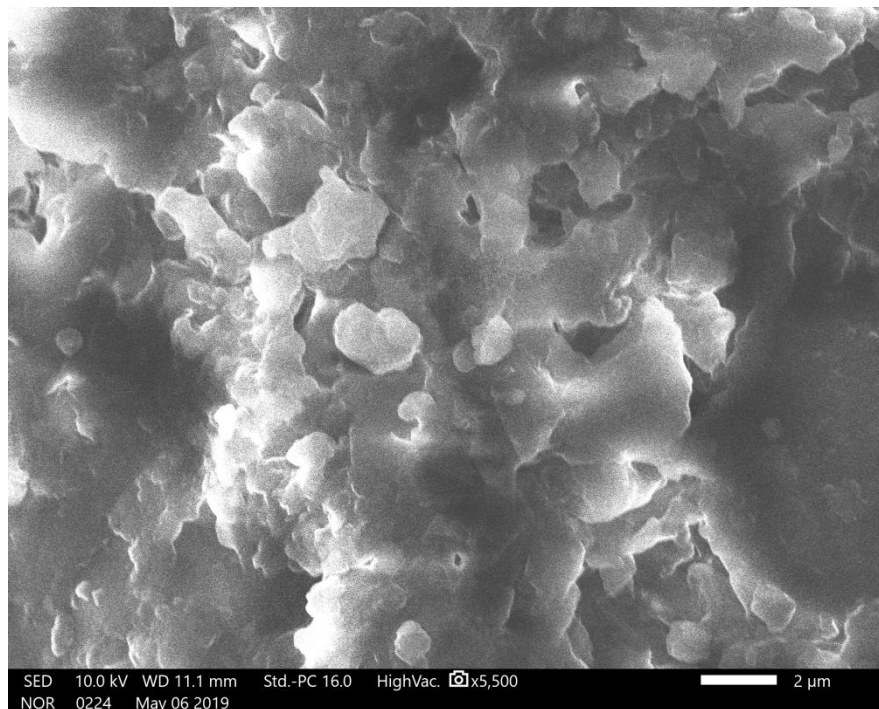
SPECIMEN-3



a



b

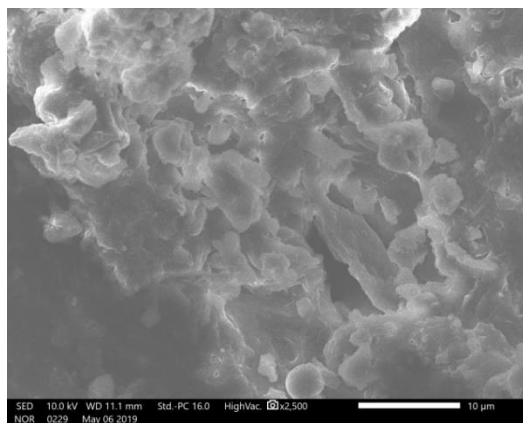


c

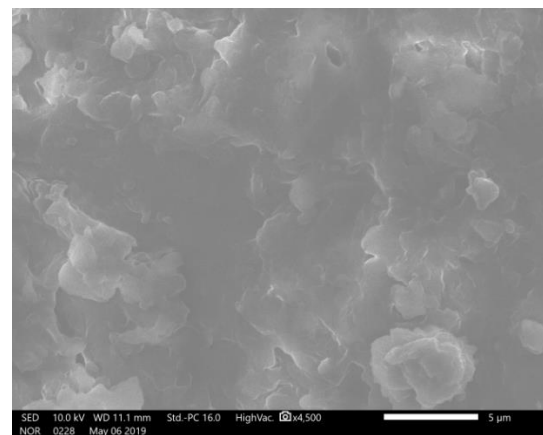
GLASS FIBER	PINE APPLE LEAF FIBER
10 grams (5%)	10grams (5%)

The above figures shows the SEM(Scanning Electron Microscope)Analysis of specimen-3 which shows the micro structure of specimen-3. With three different proportions (10nm,5nm,2nm) with magnification 20X to 30,000X and special resolutions 50nm to 100nm and find their microstructure.

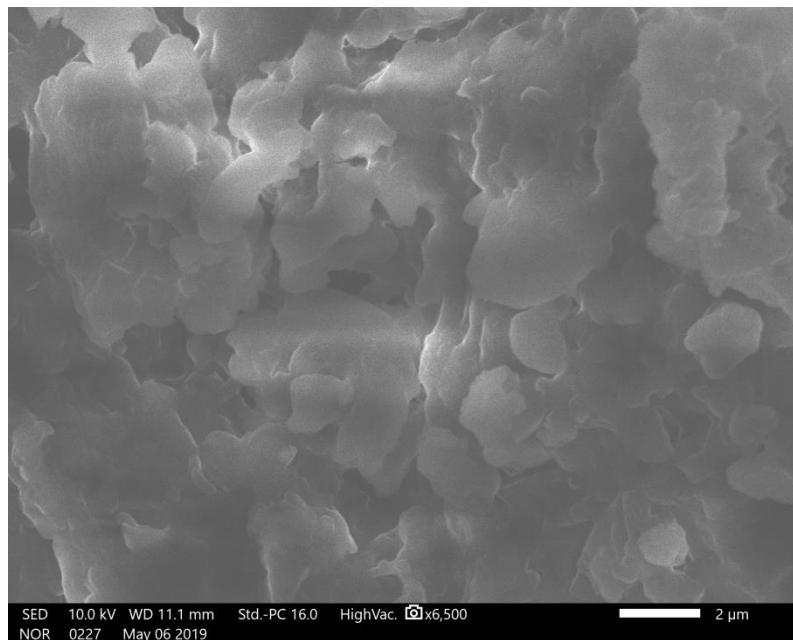
SPECIMEN-4



a



b

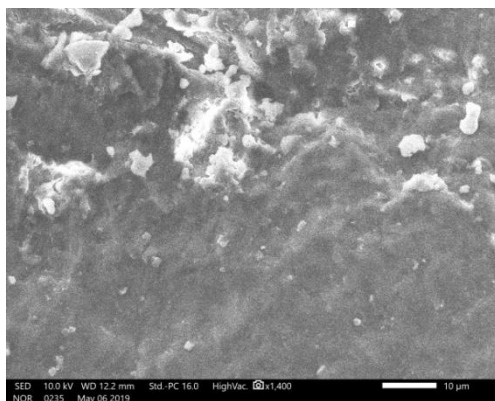


C

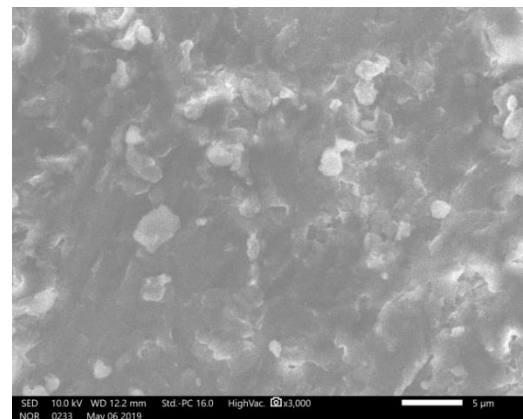
GLASS FIBER	PINE APPLE LEAF FIBER
15 grams (7.5%)	5grams (2.5%)

The above figures shows the SEM(Scanning Electron Microscope)Analysis of specimen-4 which shows the micro structure of specimen-4. With three different proportions (10nm,5nm,2nm) with magnification 20X to 30,000X and special resolutions 50nm to 100nm and find their microstructure.

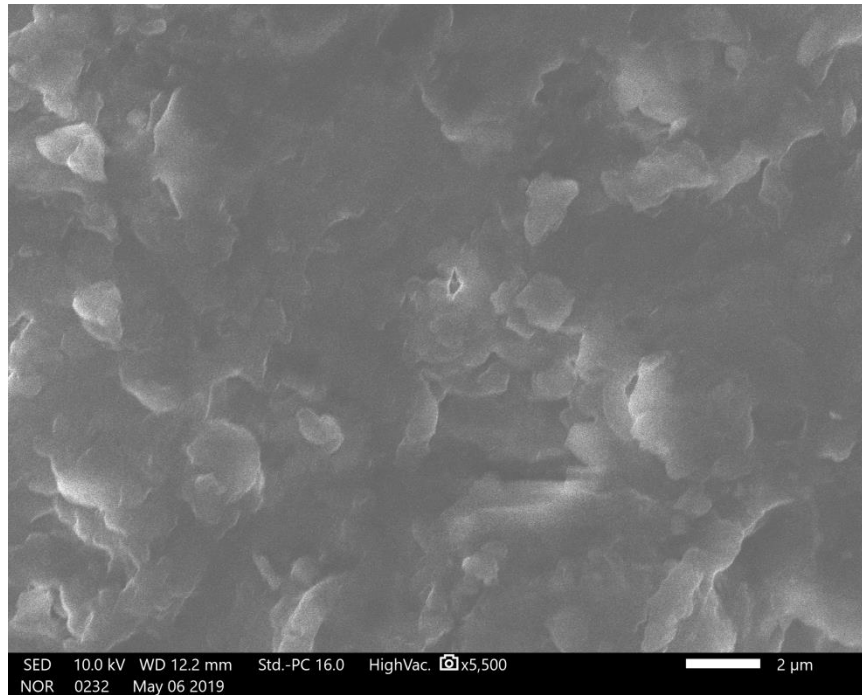
SPECIMEN-5



a



b



GLASS FIBER	PINE APPLE LEAF FIBER
20 grams (10%)	0grams (0%)

The above figures shows the SEM(Scanning Electron Microscope)Analysis of specimen-5 which shows the micro structure of specimen-5.With three different proportions (10nm,5nm,2nm) with magnification 20X to 30,000X and special resolutions 50nm to100nm and find their microstructure.

VI. CONCLUSIONS:

- ❖ The specimen 75% of glass fiber and 25% of PALF in total weight percentage of composite material gives the best tensile strength property compared to the 100% of glass fiber. The tensile strength of glassfiber is 117mpa and the tensile strength of 75% of glass fiber and 25% of PALF is 126.18mpa which is higher than the pure glass fiber, hence the glass fiber can be replaced with PALF for the applications where tensile strength is criteria.
- ❖ The specimen 75% of glassfiber and 25% of PALF in total weight percentage of composite material gives the best flexural strength property compared to the 100% of glassfiber. The flexural strength of glassfiber is 159.99mpa and flexural strength of 75% of glassfiber and 25% of PALF is 331.92mpa which is higher than the pure glass fiber, hence the glass fiber can be replaced with PALF for the applications where flexural strength is criteria
- ❖ The specimen 75% of glassfiber and 25% of PALF in total weight percentage of composite material gives the best impact strength property compared to the 100% of glassfiber the impact strength of glassfiber is 4.6J and the impact strength of 75% of glassfiber and 25% of PALF is 7.0J which is higher than the

pure glass fiber, hence the glass fiber can be replaced with PALF up to certain amount.

- ❖ The specimen 75% of glassfiber and 25% of PALF in total weight percentage of composite material gives the best Microscopic structure compared to the 100% of glassfiber because of its closely packed atoms in structure.

VII. REFERENCES:

- [1] K.Sabeel Ahmed and S.Vijayarangan, Tensile, flexural and interlaminar shear properties of woven jute and jute-glass fabric reinforced polyester composites, Material Processing Technology;2008;207:330-335.
- [2] Maries Idicula, S.K. Malhotra, Kuruvilla Joseph, Sabu Thomas, Dynamic mechanical analysis of randomly oriented intimately mixed short banana/sisal hybrid fiber reinforced polyester composites, Composites Science and Technology;2005;65: 1077-1087.
- [3] Yan Li, Yiu-Wing Mai, Lin Ye, Sisal fiber and its composites: A review of recent developments, Composites science and technology; 2000; 60:2037-2055.
- [4] M. Jawaid, H.P.S. Abdul Khalil, Azman Hassan, Rudi Dungani, A. Hadiyane, Effect of jute fibre loading on tensile and dynamic mechanical properties of oil palm epoxy composites, Composites:Part B;2012;xx:xxx-xxx. Article in press.
- [5] K.Murali Mohan Rao, K. MohanaRao, A.V. Ratna Prasad, Fabrication and testing of natural fiber composites: Vakka, sisal, bamboo and banana, Materials and Design ;2010;31: 508 513.