DEVELOPMENT AND CHARACTERIZATION OF COMPOSITE MATERIAL WITH GLASSFIBER AND PINEAPPLE LEAF FIBER (PALF)

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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.

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, flexural and compressive strength tests were carried out by UTM (Universal Testing Machine) and impact strength test was carried out by charpy impact testing machine. It is found that, the flexural, impact, compressive and 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 cyaneoethylation 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 moulding 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 moulding 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 100^0c 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

IV. EXPERIMENTS CONDUCTED:

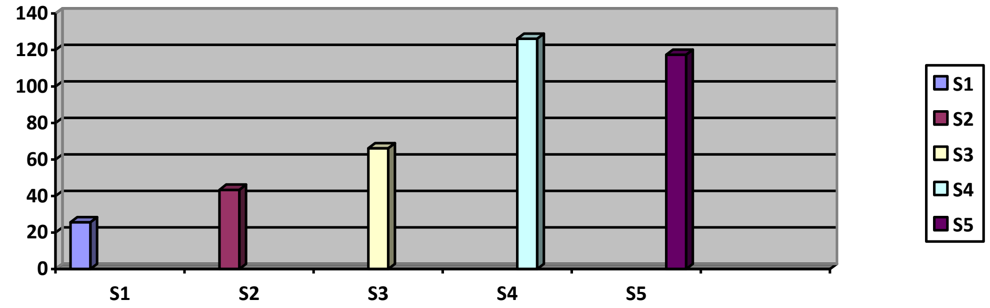
- Tensile test
- Compressive test
- Flexural test
- Impact test

TEST	SIZE	STANDARDS
Tensile test	150x15x3mm	ASTMD-3039-76
Compressive test	15x10x10mm	ASTMD-3410-695
Flexural test	150x15x3mm	ASTMD-5943-96
Impact test	120x13x3mm	ASTMD-256-88

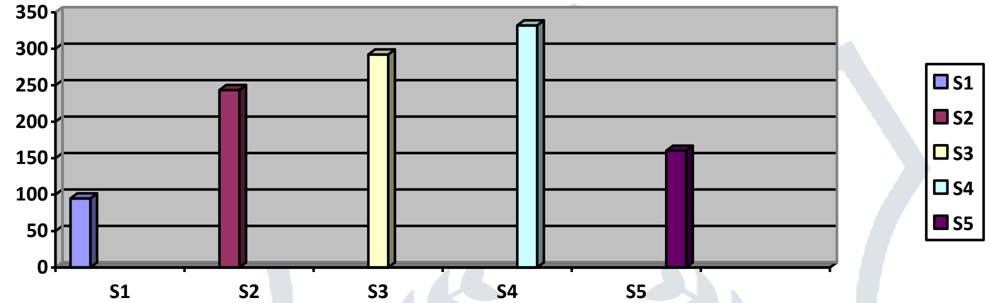
- Tensile, compressive and flexural strength are done with Universal Testing Machine.

V. RESULTS AND DISCUSSIONS:

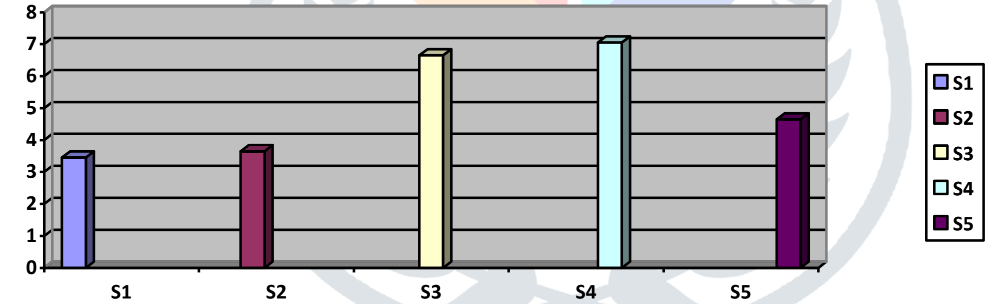
TENSILE:



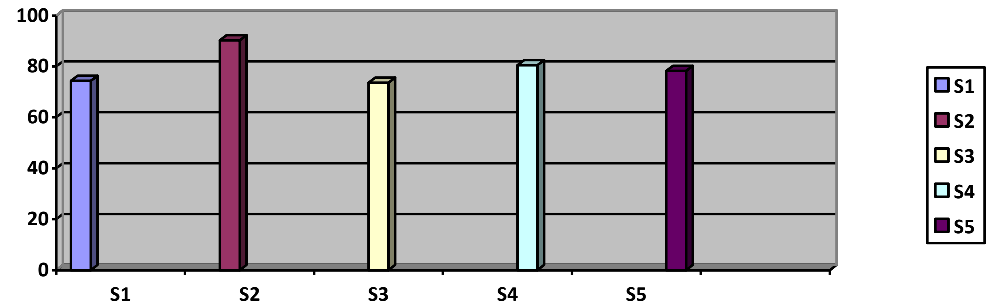
FLEXURAL:



IMPACT:



COMPRESSIVE TEST:



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 25% of glassfiber and 75% of PALF in total weight percentage of composite material gives the best compressive strength property compared to the 100% of glassfiber. The compressive strength of glassfiber is 80.53mpa and the tensile strength of 25% of glassfiber and 75% of palf is 90.22mpa which is higher than the pure glass fiber, hence the glass fiber can be replaced with PALF for the applications where compressive strength is criteria.

VII. REFERENCES:

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