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Epoxy Based Composite Material from Natural Fiber for Helmet Manufacturing

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Abstract:

Recently, composite materials are prepare using natural cellulose fibers with matrix Which have attracted the eye of researchers thanks to their rarity with high specific mechanical strengths, availability, renewability, degradable and being environmental- friendly. This work attempts to form a typical specimen for tensile test and impact test methodology and materials wont to have better mechanical properties also on enhance the compatibility between fibers and therefore the matrix. The composite are prepared with the Epoxy matrix and fibers of sisal using hand lay-up method. The fabricated specimen are planned to gauge its mechanical properties like lastingness, Impact strength and finding application of prepared material.

Keywords: Friction, Tensile test, Epoxy resin, Sisal Fibre, Bending.

OVERVIEW OF COMPOSITES

Over the last thirty years composite materials, plastics and ceramics are the dominant emerging materials. The quantity and number of applications of composite materials have grown steadily, penetrating and conquering new markets relentlessly. Modern composite materials constitute a big proportion of the engineered materials market starting from everyday products to stylish niche applications. While composites have already proven their worth as weight-saving materials, the present challenge is to form them cost effective. The efforts to supply economically attractive composite components have resulted in several innovative manufacturing techniques currently getting used within the composites industry. It's obvious, especially for composites, that the development in manufacturing technology alone isn't enough to beat the value hurdle. it's 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 acknowledge that the commercial applications of composite promise to provide much larger business opportunities than the aerospace sector because of the sheer size of transportation industry. Thus the shift of composite applications as well as production for aircraft industries and other commercial uses has become very prominent in recent years. Increasingly enabled by the introduction of newer polymer resin matrix materials and high performance reinforcement fibers of glass, carbon and agamid, the penetration of these advanced materials has witnessed a mild expansion in uses and volume. The increased volume has been resulted in an expected as well as desired reduction in costs. High performance FRP can now be found in such diverse applications from various field as composite armoring designed to resist explosive impacts, fuel cylinders for gas vehicles, windmill blades, industrial drive shafts and blades, support beams of highway bridges as well as buildings and even paper making rollers. Surely applications, the use of composites rather than metals has actually 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 etc. Further, the need of composite for lighter design materials and more seismic resistant structures of any design has placed high emphasis on the use of newly formed and advanced materials that not only decreases dead weight but also absorbs the shocks & vibration through tailored microstructures of composite. Composites are now extensively getting used for rehabilitation/ strengthening of pre-existing structures that require 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 fabric are of ten designed considering the structural aspects.

A material consists of two or more physically and/or chemically distinct, suitably arranged or distributed phases, with an interface separating them. It's characteristics that aren't depicted by any of the components in isolation. Most ordinarily, composite materials have a bulk phase, which is continuous, called the

matrix, and one dispersed, non-continuous, phase called the reinforcement, which is typically harder and stronger. The function of individual components has been described.

The natural fiber composites can be very cost effective material for following applications:

- Building and construction industry: panels for partition and false ceiling, partition boards, wall, floor, window and door frames, roof tiles, mobile or pre-fabricated buildings which can be used in times of natural calamities such as floods, cyclones, earth quakes, etc.
- Storage devices: post-boxes, grain storage silos, bio-gas containers, etc.
- Furniture: chair, table, shower, bath units, etc.
- Electric devices: electrical appliances, pipes, etc.
- Everyday applications: lampshades, suitcases, helmets, etc.
- Transportation: Aerospace, automobile and railway coach interior, boat, etc.

METHODOLOGY

To review wear of the materials, we must simulate the method of wear and tear during a controlled manner and study the effect on different samples with an equivalent test conditions. a method to perform the wear is with a pin-on-disk test. During this test, the sample to review is mounted on a rotating stage and a pin, or ball, comes in touch with the sample surface, with a known force, to make the wear. A flat or a sphere shaped (kind of circular) indenter is loaded on to the test sample with a precisely known force. The indenter (a pin, a ball or a sphere) is mounted on a stiff lever, designed as a without any kind of friction force transducer. Because the disk is rotated, resulting frictional forces acting between the pin on the disk are measured. A ball or pin for the evaluation of wear and tear loss provides several distinct advantages.

Balls of a wide variety of materials are readily available in various quantities and verities from many suppliers. Their reproducibility and quality are often excellent ensuring easy accurate comparisons. Evaluating as well as calculating the wear of the ball, pin or any kind of sphere provides wear information at the contact point which stays under load during the complete duration of the this test for the composite material. This compared to the bottom material those only experiences wear during a relatively short period of your time. Wear test is administered to predict the wear and tear performance and to research the wear and tear mechanism

FABRICATION OF HELMET USING THESE COMPOSITES

Fabrication of the helmet was administered by adopting the next hand lay process procedure. Initially prepare the mould by using plaster of Paris and sisal fibbers mat. Then a layer of epoxy - LY-556 and hardener HY- 951 mixture is coated inside the plaster of Paris mould shown. Which can placed Sisal fibbers mat sheet inside it. Over the sisal mat once more a layer of epoxy is applied. Now these fibbers are compressed with help of mould inner. To make sure the right bonding between reins forcemeat and fibbers.

Subsequently, allowed for settling time of about 3–4 hours, then mould was released. After releasing well cured and helmet from the mould, the additional projections were cut, filed and smoothened with help of grinding machine to realize the specified shape

MATERIALS USED

1. Epoxy resin(LY- 556)
2. Hardener(HY-951)
3. Natural Fibers (Sisal)
4. NaOH Solution
5.

Actually we had used these materials for production of helmet specimen. On the idea of those properties of the fabric we selected this material. Also as we selected with reference to pries of product.

Testing and Results

Here we are did some mechanical test in workshop for testing the composite material mechanically with the reference of some universal readings.

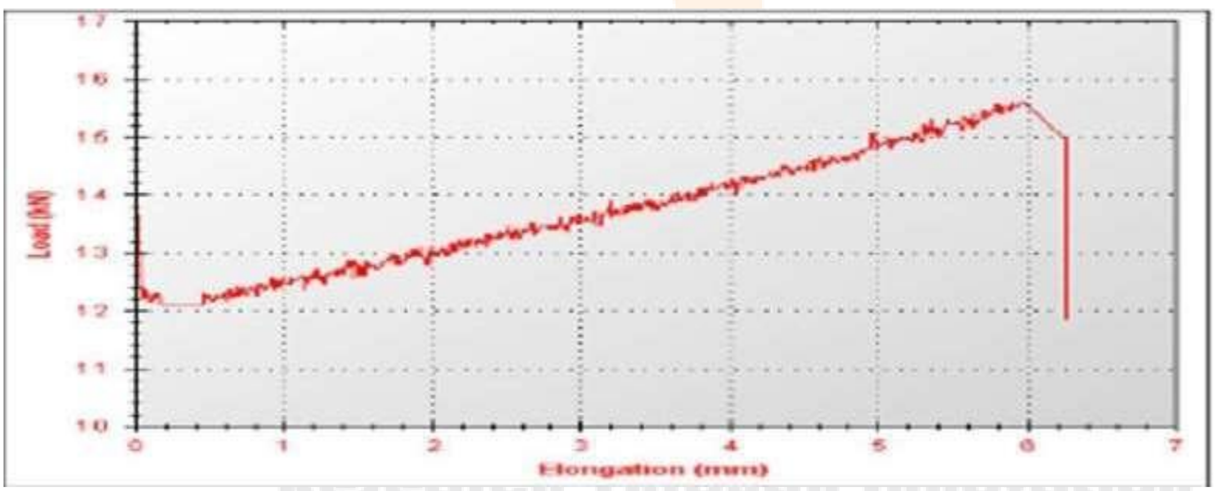
Specimen preparation as per ASTM standards:

The samples are cut to the following dimensions as per ASTM standards for testing.

Sr. No	**ASTM Code**	**Mechanical Test**	**Sample Dimensions (mm)**
1	ASTM-E8	Tensile	70 ×13×6
2	ASTM-D790	Flexural	127 ×12.5× 3
3	ASTM-D256	Impact Charpy Test	55 ×10 × 10
4	ASTM-D256	Impact Izod Test	63.5 ×10.16 ×12.7

Tensile Strength Test

The following graph shows the reading of tensile test of the specimen during the test and we found that some values are given in the table.



Result of Tensile Test

Parameters	**Values**
Load at Yield	0.2 KN
Elongation At Yield	0.490mm
Yield Stress	2.564 N/mm
Load at Peak	0.400 KN

Elongation at Peak	0.550 mm
Tensile Strength	5.128 N/mm2

Load At Break	0.300 KN
Elongation At Break	0.990 mm
% Elongation	5.71%

Result of Bending Test:

Specimen	**Load in KN**
Specimen 1	11.96

Impact Strength Testing of Composites

Specimen	Impact Energy Absorbed in joules
Charpy test	182
Izod Test	62

Friction Test

Pin on disk testing provides a way of characterizing the wear and tear between two materials. Our Engaged Experts use this method to gauge the performance of a "wear couple" or to characterize the performance of various materials against a typical surface.

The FDA and other regulatory bodies will often request mechanical wear testing when the device being tested is introducing a replacement material couple, or if a replacement material interaction hasn't been adequately characterized through mechanical testing alone.

Wear testing is additionally critical for comparing the wear and tear properties of latest devices to a previous generation device. However, it's going to not be cost-effective or maybe feasible, to perform wear testing on a finished product. Pin on disk testing allows for quick simultaneous comparison of multiple materials under controlled conditions. After completing pin on disk testing, our Engaged Experts conduct mass-loss evaluations and particulate analyses of test fluids to characterize wear debris. Additionally, profilometry are often utilized to gauge the changes in surface topography thanks to articulation.

Metallurgical evaluations of the post-test wear scarring also can be performed. In some cases, we will also introduce third body debris to characterize wear under real-world worst-case conditions

Sr. No.	Specimen	Disc Material	Load (Kg)	Speed (rpm)	Time (sec.)
1	Epoxy based Composite Material	Mild Steel	3	500	30
2	Epoxy based Composite Material	Mild Steel	5	600	45
3	Epoxy based Composite Material	Mild Steel	7	700	60

The following graph shows the variation and reading during the test.

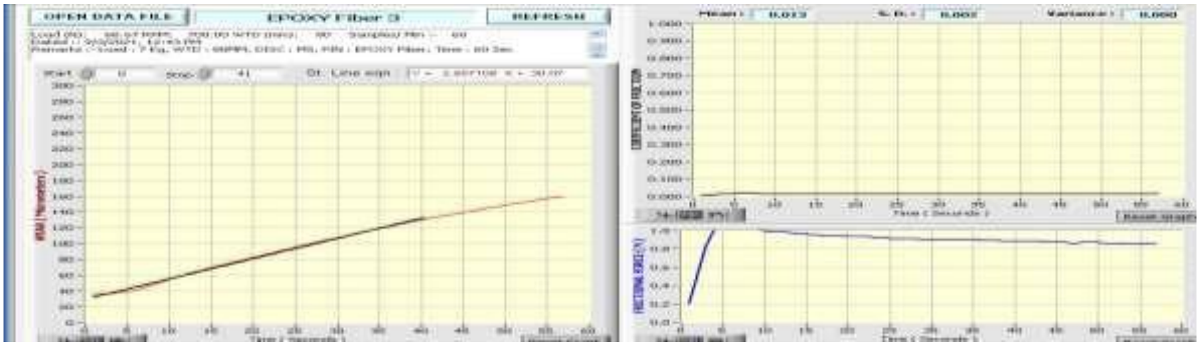


Fig. Wear Vs Time Graph

FUTURE SCOPE

Presently, the most markets for composites are within the construction and automotive sectors. With further developments and enhancements in performance, however, new opportunities and applications will likely arise. Significant opportunities are likely to occur within the built environment as this sector is liable for producing huge volumes of waste at a time when the environmental impact of industries is coming under close scrutiny. for instance , new, 'environmentally friendly' materials are needed for off-site construction methods, improved quality and simple installation and build. However, these opportunities could also be hampered by regulations supported existing materials. A specific area that gives significant potential for growth is within the replacement of preservative treated wood. The introduction of tighter restrictions on the utilization of certain preservatives most notably those containing arsenic, presents an opportunity for composites products in applications where there's a high risk of biological warfare.

Additionally to the present, improvements within the mechanical performance of existing composites through, for instance, the introduction of latest fiber types, processing and additives could end in an expansion in their use into more diverse, and technically demanding, application areas. a neighborhood of note during this respect is that the ongoing research into solvent spinning of liquid crystalline cellulose, which looks promising for producing high -strength fibers. Biotechnology is getting used to switch and/or increase the yield of specific triglycerides and oils in crops for producing resins. These resins also will be inexpensive compared with those available today and, if suitably modified, might be biodegradable. Research is additionally being conducted at various research laboratories to develop new pathways to synthesize inexpensive biodegradable resins with better mechanical properties. Once fully developed, these resins and high-strength fibers hold great promise for replacing many of the synthetic advanced composites currently in use.

There also are opportunities for hybrid materials and products by, for instance, using bio resins and bio plastics as adhesives in situ of current fossil-based adhesives. There also are good prospects for using reclaimed fiber from products like MDF (medium density fiber board) or other wastes transform the pulp and paper industry to manufacture a variety of cost-effective and environmentally effective materials and products. While there's ample opportunity for these product to enter new markets and find new application, it's essential that benefit in terms of cost saving is highlighted and a stronger commercial case for these materials be made

EXPANDUTURE

The entire cost of the only product is goes up to rupees eight thousand. If we are producing that product in great quantity then definitely we'll catch on in very low price. Actually it all depends on the manufacturing the merchandise in great quantity.

CONCLUSION

The natural fibers¬ are successfully reinforced with the epoxy by simple wet hand lay-up technique. The aim of this project is to seek out the tensile, bending, impact strength and friction test of natural fiber reinforced composites. The sisal fibers were successfully wont to fabricate composites with varying the fiber percentage.

The new composite produced with natural fibers as reinforcements gives good mechanical properties as compared with pure matrix material. These composite¬ are often utilized in Aerospace and automobile applications. In the present work, composite with sisal fibers are successfully reinforced with the epoxy by simple and cheap hand lay-up technique. The mechanical testing results of material indicate that, concept of using Sisal fibers is viable for helmet application. However, there's a scope to exchange the epoxy with the other matrix and achieve enhanced mechanical properties of helmet.

So, it's clearly indicates that reinforcement of natural fibers have good and comparable mechanical properties as conventional composite materials.

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