

Mechanical Investigation Of Epoxy Glass And Coconut coir Fiber Composite

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Abstract – *(The present experimental work deals with the study of mechanical properties of coconut coir fiber reinforced with glass fiber epoxy composite laminates. Coconut coir fiber epoxy composites were prepared by hand lay-up technique. Specimens were cut from the fabricated laminate according to the ASTM standards for different experiments like tensile, compression and impact. For tensile, compression and impact, samples were cut in flat bar shape respectively. It was observed that with coconut coir fiber of filler content, coconut which was under several mechanical tests gives the best results for compression strength and tensile strength properties of the composite under consideration)*

Introduction

A composite is a structural material which consists of two or more constituents combined at a macroscopic level. The constituents of a composite material are a continuous phase called matrix and a discontinuous phase called reinforcement.

Examples

(A) Natural Composite

- **Wood:** Cellulose fibers bound by lignin matrix
- **Bone:** Stiff mineral “fibers” in a soft organic matrix permeated with holes filled with liquids

(B) Man-Made Composites

- **Plywood:** Several layers of wood veneer glued Together
- **Fiberglass:** Plastic matrix reinforced by glass fibers

Methodology

The specimens were prepared with the glass fiber epoxy laminates with coconut coir according to the ASTM standard. The specimens were undergoing for mechanical testing by Universal testing machine and Impact testing machine. These results were compared with and without orientation.

1. Importance of The Work

Composite materials have been widely used as structural

elements in aircraft and automobile structures due to their superior properties. Aircraft structure is a huge assembly of skins, spars, frames etc.

General

In recent times laminate composites have been increasingly utilized in such lightweight and high strength structured as ground transportation vehicles, aerospace and space structure. However composite material suffers from some serious limitation. The most significant among them is their response to impact loading. A structure is subjected to an impact force when a foreign object hits it. For instance, the loads imparted by dropped tool on the bonnet cover of car body, bird hit and runway debris on an aircraft engine are typical example of impact loads. The manner in which composite material respond to impact loading and dissipate the incident kinetic energy of the projectile is very different to that of metals. For low and intermediate incident energies of projectile, metals absorb energy through elastic and plastic deformation; its consequences on the load carrying capacity of the components are small. In case of composites the elastic deformations are the major outcome of the energy absorption while the plastic deformation is very minimal. But at high incident impact energies, target perforations may occur and the passages of the impact will generally result in cracking, deboning and sapling. Such damage will degrade the load bearing ability of the composite structure. The impact property of a material is the capacity of the material to absorb and dissipate energies under shock loading. Impact condition may range from the accidental dropping of hand tools to high speed collisions and the response of the structure may range from localized damage to total disintegration of the structure. The present study is taken up to understand the response of fiber reinforced plastic laminated plates under low energy, and low velocity impacts to simulate the case of a cover plate, in an automobile engine

of wing of an aircraft subjected to impact loading. The present study a drop –weight impact testing machine is instrumented such that the load history during the impact can be recorded. Here the specimen itself is instrumented so that the actual deflection and hence the load experienced by the specimen can be recorded. The commercially available impact testing machines are having the sensors provided to the drop weight which is susceptible for sensor failure would give the impact force only. Further these sensors would require sensitivity to sense the impact force. High strain rate or impact loads may be expected in many engineering applications of composite materials. The suitability of a composite for such application is therefore, determined not only by usual parameter, but also by impact or energy absorbing properties. Frequently, an attempt to improve the strength properties results in a deterioration of the impact properties. Thus it is important to have a good understanding of impact behavior of composite for both safe and efficient design of structure and to develop new composite having well impact properties as well as good tensile properties.

Glass

Glass is one of the oldest known man-made materials; the practical strength of glass, however, has always been a limiting and puzzling factor. Still today the mechanical properties of glass fibers are twofold a) a special quality is the high strength b) the brittle fracture is limiting its application. An understanding of the structure of glass in relation to how and why it breaks is crucial in both improving existing applications of glasses and in new functionalities and application of all kinds of glasses, not only fiber glass.

1.2 Composite Material

A composite material is a combination of two or more materials which retain their identities as they act in concert. These materials are usually composed of reinforcement such as a fiber and a matrix such as a resin. Nylon, fiberglass and carbon fibers and polyester, acrylic and epoxy resins are the commonly used composite materials in prosthetics and orthotics. Several factors can greatly effect the strength and performance of composite materials. The adhesion at the interface between the resin and fiber, and the mechanical properties of the resin and fiber, greatly effect composite

performance. The fiber length, orientation and ratio of fiber to resin, and processing techniques used to fabricate the composite also effect composite properties.

Examples of Composite Materials

- Nylon,
- fiberglass
- carbon fibers
- polyester, acrylic
- epoxy resins

Background

Strength of a material is basically the resistance to break. When glass breaks it happens catastrophically – in brittle failure. There are two phenomena that dominate brittle failure; it is fast fracture and fatigue degradation. The failure mechanism is believed to be identical, but the time to failure is different. As mentioned in the previous section in glass the resistance to break is controlled by the possibility of a fracture to initiate and to grow; hence the origin and the intrinsic fracture toughness. Primary focus of the present study is the fast fracture. The theoretical strength is directly related to the stress it requires to break the chemical bonds between two adjacent atoms in the glass structure. This means that the inter-atomic spacing is proportional to the inverse of the theoretical strength. During fracturing two new surfaces are produced as the chemical bonds are broken (increasing the surface area).

1.3 Advantages of composite materials:

- 1.Light weight
- 2.High strength
- 3.Toughness
- 4.Formability
- 5.Affordability
- 6.Corrosion resistance
- 7.Long life
- 8.Easy to change the properties

Laminate materials and methods

Here materials and methods used for the processing of the composites under this investigation. It presents the details of the characterization and tests which the composite samples are subjected to.

GFRP Laminate

In this laminate, Reinforcement - Glass Fiber Reinforcement

Plastic (bi-directional type) E-glass. Matrix- Epoxy with coconut coir Correct ratio of resin and hardener is 10:1 Resin : LY556 Hardener : HY951

1.4 Glass Fiber Reinforcement Plastic

Glass is one of the oldest known man-made materials; the practical strength of glass, however, has always been a limiting and puzzling factor. Still today the mechanical properties of glass fibers are twofold a) a special quality is the high strength b) the brittle fracture is limiting its application. An understanding of the structure of glass in relation to how and why it breaks is crucial in both improving existing applications of glasses and in new functionalities and application of all kinds of glasses, not only fiber glass.

- Fibers of glass are produced by extruding molten glass, at a temperature around 1200C through holes in a spinneret with diameter of 1 or 2 mm and then drawing the filaments to produce fibers having diameters usually between 5 to 15µm
- The fibers have low modulus but significantly higher stiffness
- Individual filaments are small in diameters, isotropic and very flexible as the diameter is small.
- The glass fibers come in variety of forms based on silica(SiO₂) which is combined with other elements to create specialty glass.

Types of Glass Fibers

- E glass - high strength and high resistivity
- S2 glass - high strength, modulus and stability under extreme temperature and corrosive environment.
- R glass – enhanced mechanical properties
- C glass - resists corrosion in an acid environment

1.5 Epoxy

Epoxy is a polymer material, which begins life as liquid and is converted to the solid polymer by a chemical reaction. An epoxy based polymer is mechanically strong, chemically resistant to degradation in the solid form and highly adhesive during conversion from liquid to solid. These properties, together with the wide range of basic epoxy chemicals from which an epoxy system can be formulated, make them very versatile. Epoxy systems physically comprise two essential components, a resin and a hardener. Sometimes there is a third component, an accelerator, but this is not so common. The

resin component is the 'epoxy' part and the hardener is the part it reacts with chemically and is usually a type of 'amine'. Whereas the resin component is usually light, sometimes almost clear colored and near odourfree, hardeners are usually dark and have a characteristic 'ammonia-like' odor. When these two components are brought together and mixed intimately in a prescribed way, they will react chemically and link together irreversibly, and when the full reaction has been completed they will form a rigid plastic polymer material. This polymer is called a 'thermo set' plastic because, when cured, it is irreversibly rigid and relatively unaffected by heat. Epoxy polymers have many uses: as industrial adhesives, or as coatings, or as matrices in which to embed reinforcement fibers to form advanced reinforced plastics, and also as encapsulation media. The uses for epoxies span many markets including aerospace, transport, marine, civil engineering and general industry, and such is the versatility of epoxy's chemistry that chemists are able to fine tune the formulations for a wide variety of specific tasks. Some epoxies, which are used as coatings, are dispersed in solvents, but the majority used for structural applications are solvent-free, and these are the types which require more care in their use and which are featured here.

Uses

The resin and hardener are usually supplied as two liquids in separate containers. To bring about a reaction, not only must they be combined in exactly the right quantities relative to one another (ratio), but the individual molecules must be brought into contact with one another by stirring, in order that the reaction is initiated and the 'cure' can proceed. A little too much of either component will adversely affect the chemical link-up which is taking place (the cure) and the user will soon notice that the material has not 'gone off', the mix remaining softer than it should be.

1.6 Coconut Coir

Coconut coir is one of the most important natural fillers produced in tropical countries like Malaysia, Indonesia, Thailand, and Sri Lanka. Many works have been devoted to use of other natural fillers in composites in the recent past years and coconut shell filler is a potential candidate for the development of new composites because they have high

strength and modulus properties along with the added advantage of high lignin content. The high lignin content makes the composites made with these filler more weather resistant and hence more suitable for application as construction materials. Coconut shell flour is also extensively used to make products like furnishing materials, rope etc. The shells also absorb less moisture due to its low cellulose content the report focuses on studying the effectiveness of coconut shell particles as a source of natural material for reinforcing epoxy resins towards their flexural properties.

Coconut Shell Ash Many researchers have made efforts for preparing carbon black from agricultural by-products such as coconut shell apricot stones, sugarcane bagasse, nutshells, forest residues and tobacco stems. Coconut shells have little or no economic value and their disposal is not only costly but may also cause environmental problems. Coconut shell is suitable for preparing carbon black due to its excellent natural structure and low ash content. Conversion of coconut shells into activated carbons which can be used as adsorbents in water purification or the treatment of industrial and municipal effluents would add value to these agricultural commodities, help reduce the cost of waste disposal, and provide a potentially cheap alternative to existing commercial carbons.

Coconut shell powder is manufactured from matured coconut shells. The manufacture of coconut shell powder is not an organized industry in India. The product finds extensive use in plywood and laminated board industry as a phenolic extruder and as a filler in synthetic resin glues, mosquito coils and agarbathis. Coconut shell powder is preferred to other alternate materials available in the market such as bark powder, furfural and peanut shell powder because of its uniformity in quality and chemical composition, better properties in respect of water absorption and resistance to fungal attack. The product is manufactured in sizes ranging from 80-200 mesh. Keeping in view of the vast industrial uses, the demand for coconut shell powder appears to be promising.

2.1 Process

Coconut shells free from contamination of coir pith, etc., are broken into small pieces and fed into a pulverizer. The powder from the pulverizer is fed into a cyclone and the parallel product is collected in bag filters. The shell powder is then fed

into a vibrating sieving machine and packed according to mesh size requirements for various end uses. The rejects from the sieving machine can be recycled in the pulverizer for size reduction. The main requirements for consistent good quality of coconut shell powder, are proper selection of shell of proper stage of maturity and efficient machinery. Coir or coconut fiber, is a natural fiber extracted from the husk of coconut and used in products such as floor mats, doormats, brushes and mattresses. Coir is the fibrous material found between the hard, internal shell and the outer coat of a coconut. Other uses of brown coir (made from ripe coconut) are in upholstery padding, sacking and horticulture. White coir, harvested from unripe coconuts, is used for making finer brushes, string, rope and fishing nets. Coir fibers are found between the hard, internal shell and the outer coat of a coconut. The individual fiber cells are narrow and hollow, with thick walls made of cellulose. They are pale when immature, but later become hardened and yellowed as a layer of lignin is deposited on their walls. Each cell is about 1 mm (0.04 in) long and 10 to 20 μm (0.0004 to 0.0008 in) in diameter. Fibers are typically 10 to 30 centimeters (4 to 12 in) long. The two varieties of coir are brown and white. Brown coir harvested from fully ripened coconuts is thick, strong and has high abrasion resistance. It is typically used in mats, brushes and sacking. Mature brown coir fibers contain more lignin and less cellulose than fibers such as flax and cotton, so are stronger but less flexible. White coir fibers harvested from coconuts before they are ripe are white or light brown in color and are smoother and finer, but also weaker. They are generally spun to make yarn used in mats or rope. The coir fiber is relatively waterproof, and is one of the few natural fibers resistant to damage by saltwater. Fresh water is used to process brown coir, while seawater and fresh water are both used in the production of white coir. It must not be confused with coir pith, or formerly coco peat, which is the powdery material resulting from the processing of the coir fiber. Coir fiber is locally named 'copra' in some countries, adding to the confusion. Green coconuts, harvested after about six to 12 months on the palm, contain pliable white fibers. Brown fiber is obtained by harvesting fully mature coconuts when the nutritious layer surrounding the seed is ready to be processed

into copra and desiccated coconut. The fibrous layer of the fruit is then separated from the hard shell (manually) by driving the fruit down onto a spike to split it (dehusking). A well-seasoned husker can manually separate 2,000 coconuts per day. Machines are now available which crush the whole fruit to give the loose fibers. These machines can process up to 2,000 coconuts per hour.

2.1.1 Brown fiber

The fibrous husks are soaked in pits or in nets in a slow-moving body of water to swell and soften the fibers. The long bristle fibers are separated from the shorter mattress fibers underneath the skin of the nut, a process known as wet-milling. The mattress fibers are sifted to remove dirt and other rubbish, dried in the sun and packed into bales. Some mattress fiber is allowed to retain more moisture so it retains its elasticity for twisted fiber production. The coir fiber is elastic enough to twist without breaking and it holds a curl as though permanently waved. Twisting is done by simply making a rope of the hank of fiber and twisting it using a machine or by hand. The longer bristle fiber is washed in clean water and then dried before being tied into bundles or hanks. It may then be cleaned and 'hackled' by steel combs to straighten the fibers and remove any shorter fiber pieces. Coir bristle fiber can also be bleached and dyed to obtain hanks of different colors.

2.1.2 White fiber

The immature husks are suspended in a river or water-filled pit for up to ten months. During this time, micro-organisms break down the plant tissues surrounding the fibers to loosen them — a process known as retting. Segments of the husk are then beaten by hand to separate out the long fibers which are subsequently dried and cleaned. Cleaned fiber is ready for spinning into yarn using a simple one-handed system or a spinning wheel. Researchers at CSIR's National Institute for Interdisciplinary Science and Technology in Thiruvananthapuram have developed a biological process for the extraction of coir fiber from coconut husk without polluting the environment. The technology uses enzymes to separate the fibers by converting and solubilizing plant compounds to curb the pollution of waters caused by retting of husks.

3. TESTING OF COMPOSITE MATERIALS

In view of this, the present work is to investigate the

mechanical properties like Tensile, Flexural (compression*) and Impact Strength of glass fiber epoxy laminate with and without Aluminum alloy.

3.1 Tensile Test

Tensile load applied to a composite. The response of a composite to tensile loads is very dependent on the tensile stiffness and strength properties of the reinforcement fibers, since these are far higher than the resin system on its own.

Test was carried out with the help of UTM (Universal Testing Machine)

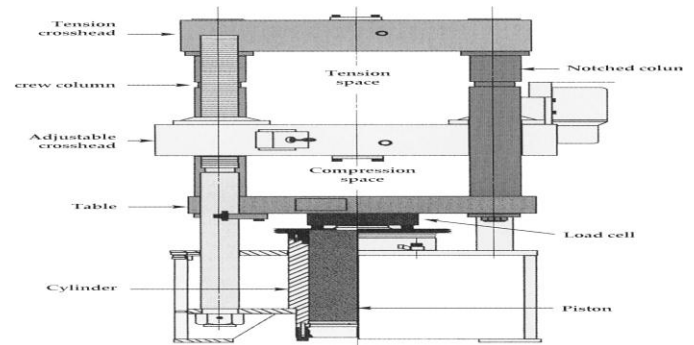


Figure 3.1 Universal Testing Machine

The most common testing machines are universal testers, which test materials in tension, compression, or bending. Their primary function is to create the stress-strain curve described in the following section in this chapter. Testing machines are either electromechanical or hydraulic. The principal difference is the method by which the load is applied. Electromechanical machines are based on a variable-speed electric motor; a gear reduction system; and one, two, or four screws that move the crosshead up or down. This motion loads the specimen in tension or compression. Crosshead speeds can be changed by changing the speed of the motor. A microprocessor-based closed-loop servo system can be implemented to accurately control the speed of the crosshead. Hydraulic testing machines are based on either a single or dual-acting piston that moves the crosshead up or down. However, most static hydraulic testing machines have a single acting piston or ram. In a manually operated machine, the operator adjusts the orifice of a pressure-compensated needle valve to control the rate of loading. In a closed-loop hydraulic servo system, the needle valve is replaced by an electrically operated servo valve for precise control.

3.1.1 Review on Tensile Test

This test is of static type i.e. the load is increased

comparatively slowly from zero to a certain value. Standard specimens are used for the tension test. There are two types of standard specimen are which are generally used for this purpose, which have been shown below:

Specimen 1- GFRP



Specimen 2 – GFRP With Coconut Coir



Figure 3.2 specimens

3.2 Compression Test (Flexure)

A compression test determines behavior of materials under crushing loads. The specimen is compressed and deformation at various loads is recorded. Compressive stress and strain are calculated and plotted as a stress-strain diagram which is used to determine elastic limit, proportional limit, yield point, yield strength and, for some materials, compressive strength. Axial compression testing is a useful procedure for measuring the plastic flow behavior and ductile fracture limits of a material. Measuring the plastic flow behavior requires frictionless (homogenous compression) test conditions, while measuring ductile fracture limits takes advantage of the barrel formation and controlled stress and strain conditions at the equator of the barreled surface when compressions carried out with friction. Axial compression testing is also useful for measurement of elastic and compressive fracture properties of brittle materials or low-ductility materials. In any case, the use of specimens having large L/D ratios should be avoided to prevent buckling and shearing modes of deformation¹. The image at right shows variation of the strains during a compression test without friction (homogenous compression) and with progressively higher levels of friction and decreasing aspect ratio L/D (shown as h/d)

3.3 Impact Test



Fig. 3.3 Impact Testing machine

Impact test type charpy

Static tension tests of the unnotched specimen's do not always reveal the susceptibility of metal to brittle fracture. This important factor is determined in impact tests. In impact tests we use the notched specimen's. This specimen is placed on its supports on anvil so that blow of the striker is opposite to the notch. The impact strength is defined as the energy A , required to rupture the specimen, $\text{Impact Strength} = A / f$ Where f = It is the cross – section area of the specimen in cm^2 at fracture & obviously at notch. The impact strength is a complex characteristic which takes into account both toughness and strength of a material. The main purpose of notched – bar tests is to study the simultaneous effect of stress concentration and high velocity load application. Impact test are of the severest type and facilitate brittle fracture. Impact strength values can not be as yet be used for design calculations but these tests as rule provided for in specifications for carbon & alloy steels. Further, it may be noted that in impact tests fracture may be either brittle or ductile. In the case of brittle fracture, fracture occurs by separation and is not accompanied by noticeable plastic deformation as occurs in the case of ductile fracture.

4. Laminate Preparation

- The laminate size is $300\text{mm} \times 300\text{mm} \times 4\text{ mm}$
- Laminate is a symmetric because the no of layer is 7S.
- The stitching direction is perpendicular to the fiber direction of the 0° surface layers of the laminates.
- An ensuing volume fraction of stitch threads material of about 0.3%.
- In order to reduce fiber distortion in the interior of the laminate. A modified lock stitch adopted for stitching by easing the tension of the needle thread.

Resin

- Resin is to transfer stress between the reinforcement fibers, act as a glue to hold the fiber together.
- Commonly used resin are:
O Epoxy, polyester and vinyl ester
O Epoxy LY556 is selected.

Types of Hardener

- HY951 – at room temperature.
- HT927 – temperature ranging from 80°C - 130°C
- HT974 - temperature ranging from 70°C - 80°C

- HZ978 - temperature ranging from above 100°C

Preparation of Epoxy and Hardener

- Epoxy LY556 and it mixed with Hardener HY951.
- Ratio of mixing epoxy and hardener is 10:1

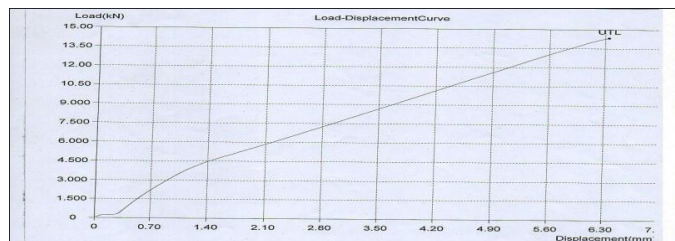
Specimen Preparation For Glass Fiber

- The mould should be well cleaned and dry.
- Release agent is applied.
- The epoxy mixture is uniformly applied.
- First woven mat is laid into the moulded.
- Apply the resin on mat by brush.
- Second mat is laid to first mat
- Repeated the process up to 7 layers
- Mould is closed.
- For second plate add coconut coir in between the mat
- Repeated the process up to 7 layer

5.RESULTS AND DISCUSSIONS

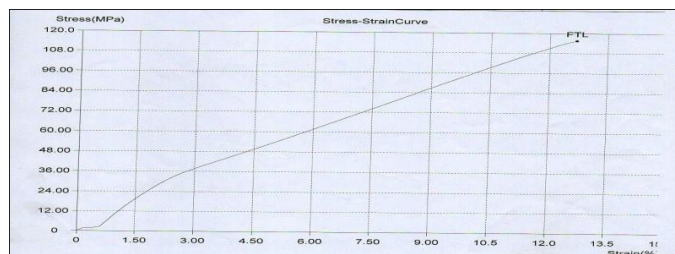
5.1 GFRP Result

5.1.1 Tensile Test on GFRP Laminate



GRAPH 5.1 LOAD VS DISPLACEMENT (TENSILE)

In the above graph displacement taken on x-axis and load can be take on Y-axis. In this sample Glass fiber is taken along with the Epoxy resin .In the above graph the load and displacement can be deformed at the origin. If load will be increase the elongation length of the specimen will be increase . The ultimate tensile load of the specimen is 14.33 KN

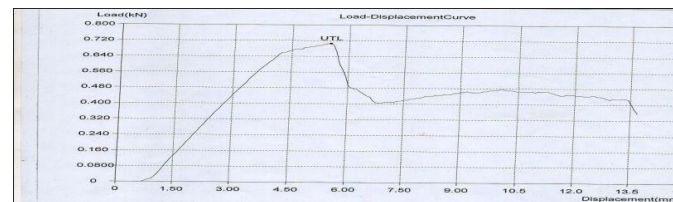


GRAPH 5.2 STRESS VS STRAIN (TENSILE)

The above graph can shows that the stress-strain relation of the Glass fiber along with the Epoxy resin .In the stress-strain curve, if the stress increases the strain is also increases. In the above graph, the origin point of stress and strain is zero. If the

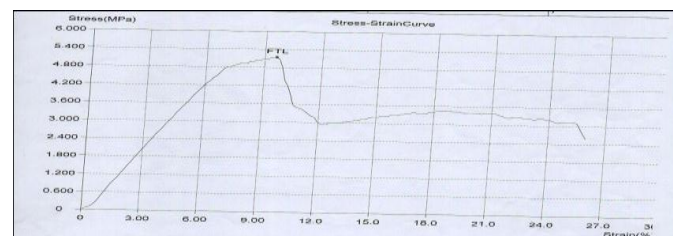
stress is increases to 12.00mpa the strain will also increases to 1.05%.Then the final ultimate tensile strength of that specimen is 116 Mpa.

5.1.2 Compression Test on GFRP Laminate



**GRAPH5.3 LOAD VS DISPLACEMENT
(COMPRESSION)**

In the above graph displacement taken on x-axis and load can be take on Y-axis. In this sample Glass fiber is taken along with the Epoxy resin .In the above graph the load and displacement can be deformed at the origin. If load will be increase the elongation length of the specimen will be increase . The ultimate compression load of the specimen is 0.705 KN



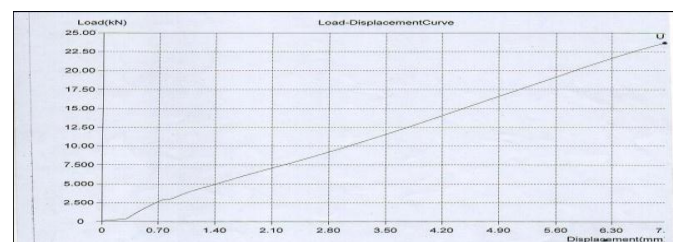
GRAPH 5.4 STRESS VS STRAIN (COMPRESSION)

The above graph can shows that the stress-strain relation of the Glass fiber along with the Epoxy resin .In the stress-strain curve, if the stress increases the strain is also increases. In the above graph, the origin point of stress and strain is zero. If the stress is increases to 0.6 Mpa the strain will also increases to 1.2%.Then the final ultimate compression strength of that specimen is 5 Mpa.

5.1.3 Impact Test on GFRP Laminate

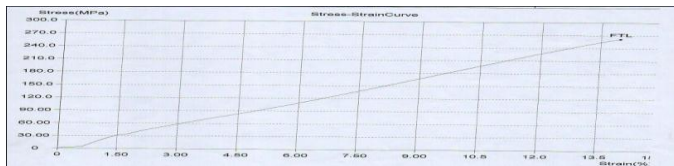
Test parameter	Sample1	Sample 2	Average
AbsorbedEnergy(Joules)	8	8	8

5.2.1 Tensile Test on GFRP With Coconut Coir Laminate



**GRAPH 5.5 LOAD VS DISPLACEMENT SPECIMEN
(TENSILE)**

In the above graph displacement taken on x-axis and load can be take on Y-axis. In this sample Glass fiber is taken along with the Epoxy resin And Coconut coir .In the above graph the load and displacement can be deformed at the origin. If load will be increase the elongation length of the specimen will be increase . The ultimate tensile load of the specimen is 23.690 KN



**GRAPH 5.6 STRESS VS STRAIN SPECIMEN
(TENSILE)**

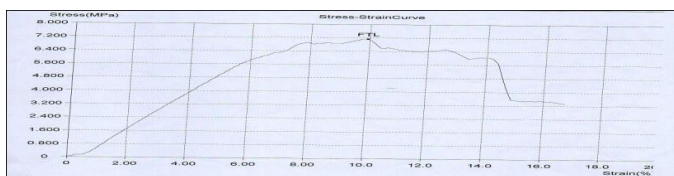
The above graph can shows that the stress-strain relation of the Glass fiber along with the Epoxy resin And Coconut coir .In the stress-strain curve, if the stress increases the strain is also increases. In the above graph, the origin point of stress and strain is zero. If the stress is increases to 30 Mpa the strain will also increases to 1.5%.Then the final ultimate tensile strength of that specimen is 261 Mpa.

6.2.2 Compression Test on GFRP With Coconut Coir Laminate



**GRAPH 5.7 LOAD VS DISPLACEMENT
(COMPRESSION)**

In the above graph displacement taken on x-axis and load can be take on Y-axis. In this sample Glass fiber is taken along with the Epoxy resin And Coconut coir .In the above graph the load and displacement can be deformed at the origin. If load will be increase the elongation length of the specimen will be increase . The ultimate compression load of the specimen is 0.77 KN



GRAPH 5.8 STRESS VS STRAIN (COMPRESSION)

The above graph can shows that the stress-strain relation of the Glass fiber along with the Epoxy resin And Coconut coir

.In the stress-strain curve, if the stress increases the strain is also increases. In the above graph, the origin point of stress and strain is zero. If the stress is increases to 0.8 Mpa the strain will also increases to 1.2%.Then the final ultimate compression strength stress of that specimen is 7 Mpa.

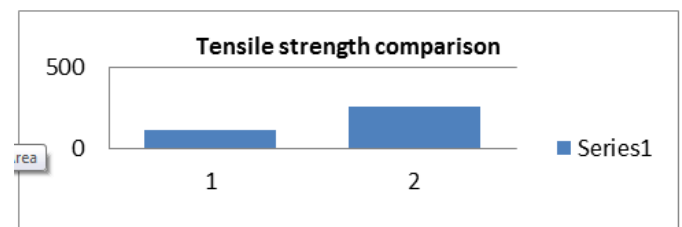
5.2.3 Impact Test on GFRP With Coconut Coir Laminate

Test parameter	Sample1	Sample2	Average
AbsorbedEnergy-(Joules)	14	12	13.33

Table 5.2.3 Impact test on GFRP With Coconut Coir Laminate

5.3 Comparison Between GFRP And GFRP With Coconut Coir

5.3.1 Tensile Test



1 – GFRP Laminated plate tensile strength

2 – GFRP with coconut coir laminated plate tensile strength

Fig 5.3.1 Tensile Strength Comparison

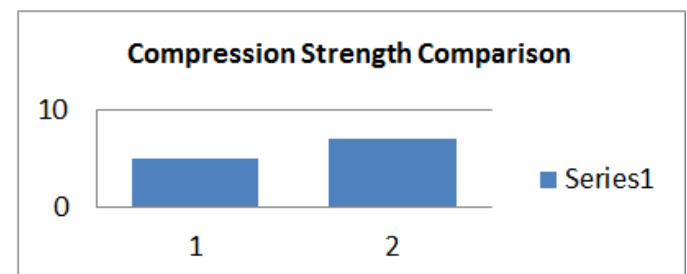
Table 5.3.1 Tensile strength comparison

Test Parameters	GFRP	GFRP-Coconut Coir
Tensile load (KN)	14.33	23.69
Tensile strength (Mpa)	116	261

➤ *Incremented Tensile Load when compared to GFRP-coconut coir with GFRP is 65%*

➤ *Incremented Tensile strength when compared to GFRP-coconut coir with GFRP is 125%*

5.3.2 Compression Test

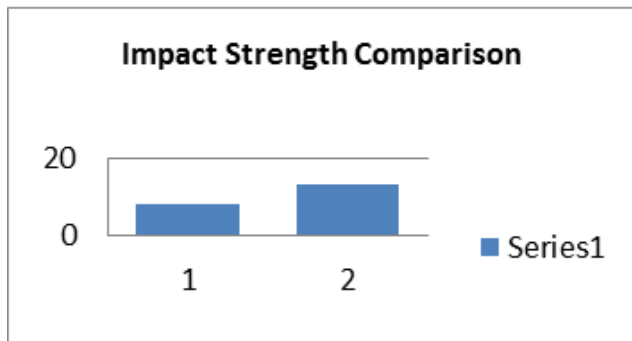


1 – GFRP Laminated plate compression strength**2 – GFRP with coconut coir laminated plate compression strength****Fig 5.3.2 Compression Strength Comparison**

Test Parameters	GFRP	GFRP-Coconut Coir
Compressive load (KN)	0.71	0.77
Compressive strength (Mpa)	5	7

Table 5.3.2 Compression Strength Comparison

- *Incremented Compressive Load when compared to GFRP-coconut coir with GFRP is 9%*
- *Incremented Compressive strength when compared to GFRP-coconut coir with GFRP is 40%*

5.3.3 CHARPY IMPACT TEST**1 – GFRP Laminated plate impact streng****2 – GFRP with coconut coir laminated plate impact strength****Fig 5.3.3 Impact Strength Comparison****Table 5.3.3 Impact Strength Comparison**

Test parameters	GFRP			GFRP-COCONUT COIR		
	Sam1	Sam2	Avg	Sam1	Sam2	avg
Absorb Energy (Joules)	8	8	8	14	12	13.33

- *Incremented Absorbed Energy when compared to GFRP-coconut*
- *coir with GFRP is 62%*

CONCLUSION

From the experimental investigation, the following conclusions can be made. Coconut coir which reinforced with glass fiber epoxy composite gives the best results in comparison to neat glass fiber with epoxy respectively. In tensile and compression test, coconut coir fiber which was provided the good strength. Also when coconut coir added with glass fiber the weight and strength also was increased. These may suitable for automobile and aeronautical structural applications.

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