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Experimental Investigation of Natural and Artificial Fiber Composites

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Abstract:
Composite materials are intriguing with numerous applications in all industrial sectors. In this project, investigation is done on the effect of the single oriented stacking sequence optimization of the laminated structure. The stacking sequence is done by arranging the fibers at standard orientation based on their mechanical strength of different fibers. Two different types of fibers are taken, like Glass fiber and Jute fiber to form a laminate of identical orientation 90 degrees. These fibers are arranged in the order of standard dimensions 30*30cm to form a laminate. The composites are fabricated using a hand layup process under compression type with infusion of the epoxy resin. The results of the ordinary optimized laminate are compared Also the investigation of the flexural strength of the fiber is done and the tensile strength of two different types of fibers are also studied. Three-point bending test was performed and the mechanical properties are calculated in these two different fibers. Tensile and compressive test are also done on the laminate to find their enhanced mechanical properties. Cohesive behavior is also investigated (Surface to surface interaction).The experimental results are compared with each other for validation and to yield the optimized results.

Keywords: Flexural test, Glass fiber, Impact test, Jute fiber, Mechanical properties, Tensile test,

I. INTRODUCTION

Mankind has been aware of composite materials since several hundred years before Christ and applied innovation to improve the quality of life. Although it is not clear as to how man understood the fact that mud bricks made sturdier houses if lined with straw, he used them to make buildings that lasted. Ancient Pharaohs made their slaves use bricks with straw to enhance the structural integrity of their buildings, some of which testify to wisdom of the dead civilization even today materials, like tissue surrounding the skeletal system, soil aggregates, minerals and rock. Contemporary composites results from research and innovation from past few decades have progressed from glass fiber for automobile bodies to particulate composites for aerospace and a range other applications. Ironically, despite the growing familiarity with composite materials and ever-increasing range of applications, the term defines a clear definition. Loose terms like "materials composed of two or more distinctly identifiable constituents" are used to describe natural composites like timber, organic materials, like tissue surrounding the skeletal system, soil aggregates, minerals and rock Composites that forms heterogeneous structures which meet the requirements of specific design and function, imbued with desired properties which limit the scope for classification. However, this lapse is made up for, by the fact new types of composites are being innovated all the time, each with their own specific purpose like the filled, flake, particulate and laminar compositesFibers or particles embedded in matrix of another material would be the best example of modern-day composite materials, which are mostly structural. Composite materials are used more and more for primary structures in commercial, industrial, aerospace, marine, and recreational structures. Composite parts used for aircraft applications are defined by Material, process, manufacturing specifications and Material allowable (engineering definition). All of these have a basis in regulatory requirements Most efficient use of advanced composites in aircraft structure is in applications with highly loaded parts with thick gages, high fatigue loads (fuselage and wing structure, etc), areas susceptible to corrosion (fuselage, etc), critical weight reduction (empennage, wings, fuselage, etc.).Composite material is a material composed of two or more distinct phases (matrix phase and dispersed phase) and having bulk properties significantly different from those of any of the constituents The second phase (or phases) is embedded in the matrix in a discontinuous form. This secondary phase is called dispersed phase. Dispersed phase is usually stronger than the matrix, therefore it is sometimes called reinforcing phase. Many of the common materials (metal alloys, doped Ceramics and Polymers mixed with additives) also have a small amount of dispersed phases in their structures, however they are not considered as composite materials since their properties are similar to those of their base constituents (physical properties of steel are similar to those of pure iron Polymer Matrix Composites(PMC)are composed of a matrix from thermos set(Unsaturated Polyester (UP), Epoxy (EP) or thermoplastic (Polycarbonate (PC),Polyvinylchloride, Nylon, Polystyrene) and embedded glass, carbon, steel or fibres (dispersed phase)

II. AIM AND SCOPE

Laminates are going to be prepared using hand layer process.The laminates are fabricated in two different types of fiber Jute and Glass fiber are also using a resin are using to laminates Epoxy Resin.. Set of specimens fortensile, bending and impact tests are selected as per ASTM(American Society for Testing and Materials) standards Specimens are cut using water jet cutting as per the ASTM standards. Material properties like tensilestrength, bending strength, compression strength for various different fiber strength. In this present work, comparison of different orientation fibers and resin behavior of mechanical properties with respect to moisture absorption must be shown

III. EXPERIMENTAL METHODS AND MATERIALS

In general, the reinforcing and matrix materials are combined, compacted and processed to undergo a melding event. After the melding event, the part shape is essentially set, although it can deform under certain process conditions. For a thermoses polymeric matrix material, the melding event is a curing reaction that is initiated by the application of additional heat or chemical reactivity such as organic peroxide. For a thermoplastic polymeric matrix material, the melding event is a solidification from the melted state. For a metal matrix material such as titanium foil, the melding event is a fusing atFor many molding methods, it is convenient to refer to one mould piece as a "lower" mould and another mould piece as an "upper" mould. Lower and upper refer to the different faces of the molded panel, not the moulds con Fig: uration in space. The molded product is often referred to as a panel. For certain geometries and material combinations, it can be referred to as a casting. For certain continuous processes, it can be referred to as a profile. Applied with a pressure roller, a spray device or manually. This process is generally done at ambient temperature and atmospheric pressure.

IV. RESULTS

Table.1. Comparison of Flexural Properties

S No	Fiber Orientation	Ultimate Breaking Load (KN)	Ultimate Stress (MPa)	% of Elongation
1	Glass Fiber sample 1	0.270	10	4.2
2	Glass Fiber sample 2	0.305	11	3.7
3	Jute Fiber sample 1	0.185	7.2	11
4	Jute Fiber sample 2	0.190	7.3	12

Table.2. Comparison of Tensile Properties

S No	Fiber Orientation	Ultimate Load(KN)	Ultimate Tensile Strength (MPa)	% of Elongation
1	Glass Fiber sample 1	9.07	219.1	11.67
2	Glass Fiber sample 2	8.26	247.2	10
3	Jute Fiber sample 3	4.77	195.6	6.66
4	Jute Fiber sample 4	4.46	182.9	5

Table.3. Comparison of Impact Properties

S No	Fiber Orientation	Glass Fiber (Joule}	Jute Fiber (Joule)
1	Specimen 1	54.9	53.8
2	Specimen 2	55.1	53.6
3	Specimen 3	54.5	53
4	Specimen 4	55	53.5

V. DISCUSSION

Tensile testing, also known as tension testing, is a fundamental materials science test in which a sample is subjected to a controlled tension until failure The results from the test are commonly used to select a material for an application, for quality control, and to predict how a material will react under other types of forces. Properties that are directly measured via a tensile test are ultimate tensile strength, maximum elongation and reduction in area. From these measurements the following properties can also be determined Young's modulus, Poisson's ratio, yield strength, and strain-hardening characteristics Uniaxial tensile testing is the most commonly used for obtaining the mechanical characteristics of isotropic materials. For anisotropic materials, such as composite materials and textiles, biaxial tensile testing is required The most common testing machine used in tensile testing is the universal testing machine This type of machine has two crossheads; one is adjusted for the length of the specimen and the other is driven to apply tension to the test specimen. There are two types hydraulic powered and electromagnetically powered machines. The machine must have the proper capabilities for the test specimen being tested. There are four main parameters force capacity, speed, and precision and accuracy Force capacity refers to the fact that the machine must be able to generate enough force to fracture the specimen. The machine must be able to apply the force quickly or slowly enough to properly mimic the actual application. Finally, the machine must be able to accurately and precisely measure the gauge length and forces applied; for instance, a large machine that is designed to measure long elongations may not work with a brittle material that experiences short elongations prior to fracturing Alignment of the test specimen in the testing machine is critical, because if the specimen is misaligned, either at an angle or offset to one side, the machine will exert a bending force on the specimen. This is especially bad for brittle materials, because it will dramatically skew the results. This situation can be minimized by using spherical seats or U-joints between the grips and the test machine. If the initial portion of the stress–strain curve is curved and not linear, it indicates the specimen is misaligned in the testing machine. The strain measurements are most commonly measured with an extensometer, but strain gauges are also frequently used on small test specimen or when Poisson's ratio is being measured. Newer test machines have digital time, force, and elongation measurement systems consisting of electronic sensors connected to a data collection device (often a computer) and software to manipulate and output the data. However, analog machines continue to meet and exceed ASTM, NIST, and ASM metal tensile testing accuracy requirements, continuing to be used todayThe specimens were cut for bending test according to the ASTM standards(D790). The specimen was kept under 2 point setup at the edge and a compressive load was made to act at the middle from the top. The three point bending flexural test provides values for the modulus of elasticity in bending E_f, flexural stress σ_f, flexural strain $\epsilon_f$and the flexural stress-strain response of the material. The main advantage of a three point flexural test is the ease of the specimen preparation and testing. However, this method has also some disadvantages the results of the testing method are sensitive to specimen and loading geometry and strain rateThe test method for conducting the test usually involves a specified test fixture on a universal testing machine. Details of the test preparation, conditioning, and conduct affect the test results. The sample is placed on two supporting pins a set distance apart and a third loading pin is lowered from above at a constant rate until sample failure The values were transferred to the system through the serial ports and they were taken down with the help of WIN UTM software. All the graph and results were printed outI-ZOD Impact machine is preferable for aluminum and other metal and fiber composites because its values are lower and is a tedious process to measure in a charpy impact test which has dead weight of more than20Kg and minimum values will start from 6J. An impact test was used to determine the amount of energy that was required to break the specimen. An un-notched Izod Impact test was conducted to study the impact energy according to ASTM D256.The un-notched specimens were kept imam cantilever position, and a pendulum has swung around to break the specimen. The impact energy (J) was calculated using a dial gauge that was fitted on the machine. Five samples were taken for each test, and the results were averaged The specimens were cut for impact test according to the ASTM standards (D790).The specimen was fixed in the machine and the handle is pulled down and the readings from the dials are noted

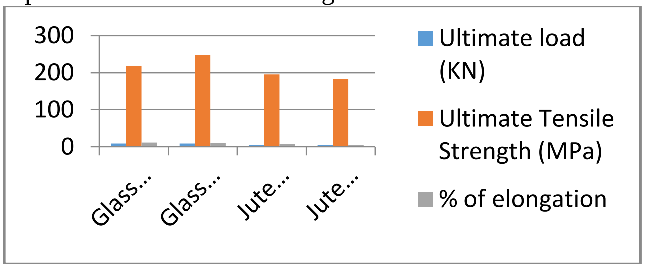

Figure.1. Comparison of Tensile Properties

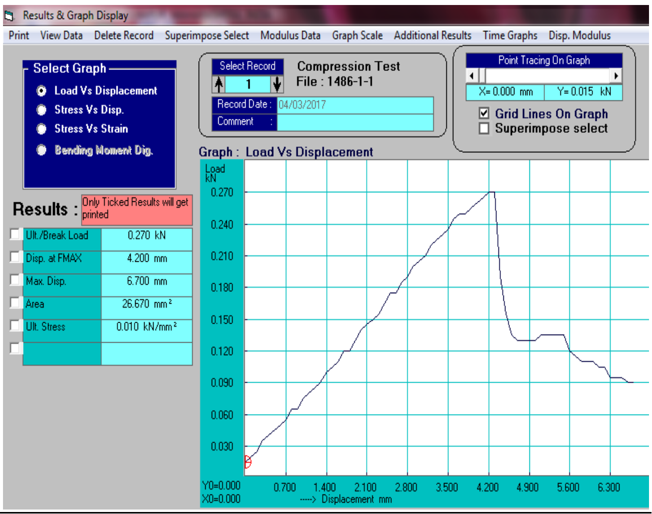

Figure .2. Load vs Displacement Graph for Glass fiber

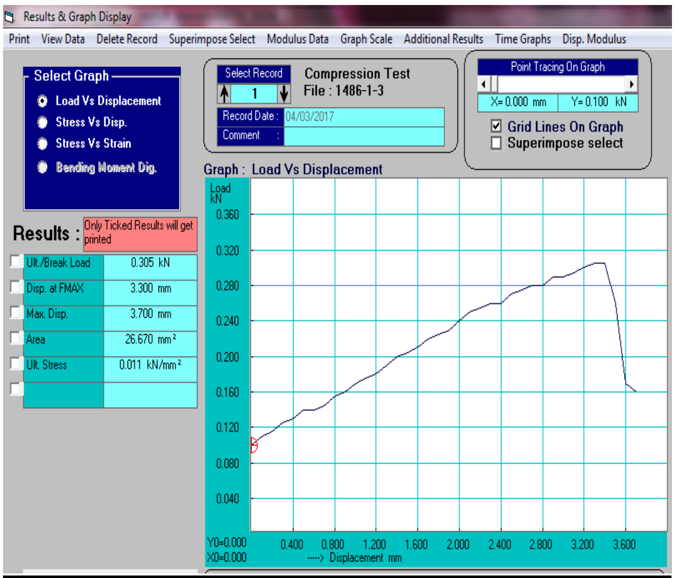

Figure. 3. Load vs Displacement Graph for Jute fiber

VI.CONCLUSION

Project gives a profound knowledge of composite materials and its properties including of different f fiber. Based on the testing we carried out in this project for composite materials it has been evaluate that which materials has excellent mechanical properties which can be used in various structural application. Tensile strength, bending strength and impact strength of the composites increased with increasing of fiber weight fraction in the Glass/Jute/Epoxy composite compared with pure resin. Comparing the both the laminate with the mechanical properties based on this glass fiber has more strength when compare to the Jute fiber. All the mechanical properties are carried out Tensile; Bending and Impact tests are done. In this tests are proven that Glass has High mechanical strength compared to the Jute fiber.

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