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Static Structural Analysis of Corn Fiber Reinforeced Composite

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Abstract: The investigation compares the normal stress, normal strain, and natural fiber reinforcement used in the composite construction with GP resin (general purpose).Between the composite and the plywood, there is strain and total deformation. The practice of cutting down trees for their wood to produce furniture is becoming less common as a result of environmental consciousness. As a result, the manufacturers are forced to look for effective materials to take the place of timbers. I choose the maize wrapper fiber above other natural because it contains a significant amount of cellulose (40%) in comparison. In practically all fields, timbers can be replaced with maize fiber composite if it is more effective than those materials (especially in furniture industries). Corn is widely available on international markets, although its commercial worth is quite low. The primary goal of this research is to use Ansys software to analyse and compare the behavior of plywood that is already on the market with that of a corn fiber composite. If the corn fiber composite outperforms plywood, it might take the place of wood in the manufacture of furniture while also being less expensive. The comparative study was used to confirm the expected outcomes and to get the best expected values with a tolerable error rate.
Keywords: Corn wrapper, GP resin, Matrix and Reinforcement, Cellulose.

I. INTRODUCTION

When two materials with various physical and chemical properties are combined, the result is a composite material. New material may be favoured for a variety of reasons. Materials that are more affordable, lighter, stronger, or more durable than ordinary materials are common examples. They combine to form a substance that is specifically designed to carry out a particular task. Additionally, they can increase stiffness and strength. They are preferred over conventional materials because they enhance the underlying material's qualities and can be used in a variety of contexts. Composites have been utilised by people for thousands of years.

The focus of practically every industry nowadays is on composite materials, which are obtained through diverse procedures. The composite material is used in many industries, including the automotive, aerospace, construction, marine, and sports industries. The principal market for composite materials, however, is modern aviation, which has a high need for materials that are both lighter and stronger. The majority of composites are created by encasing or pieces of stronger materials within a single substance (matrix) (the reinforcement). The first contemporary composite was created in the late 1940s and was made of fibre glass. It still dominates the market, accounting for about 65% of all composites made today. However, more materials are now being employed for reinforcing in order to achieve various qualities.

II. NATURAL

Due to their beneficial qualities, natural -reinforced composites have recently gained enormous popularity for a variety of applications. The usage of natural fibre in polymer composites is growing as a result of governmental policies and environmental consciousness. Natural have a low density, a high specific strength, and effectively insulate both sound and heat. Either plants or animals provide the natural fibre. Due to their similar mechanical qualities to glass fibre, these offer an advantage over synthetic in a variety of industries, including the automotive, building, and sports industries. To achieve certain qualities, more materials are utilised for reinforcement. The use of natural fibre as reinforcement in polymer matrix brought environmental awareness to the forefront of global discussion.

A hybrid composite is made up of two or more different fibre types, where one type of fibre makes up for the lack of another. In many situations, natural fibre reinforced polymer composites have proven to be an effective substitute for synthetic fibre reinforced polymer composites. Car parcel shelves, door panels, instrument panels, armrests, headrests, and seat shells are all made of natural fibre composites.

III. POLYMER MATRIX COMPOSITE

s embedded in an organic polymer matrix make up polymer matrix composites, which are materials. These are added to the material to improve a few specific qualities. Based on their degree of stiffness and strength, polymer matrix composites are divided into two categories: (1) Reinforced plastics – provide plastics more tensile strength by including embedded fibre material. (2) Advanced Composites: these materials combine fibre and matrix for increased strength and greater stiffness. Graphite, aramid, or other organic, as well as high-stiffness glass (S-glass), are the main high-performance continuous found in them.
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IV. EXTRACTION

Corn wrappers are gathered and dried in the dark to help them shed as much moisture as possible. The dried corn wrapper is then broken up into little pieces and cooked.with the percentage of soda ash 1 cup (50g) of soda ash dissolved for 2 hours in 19 litres of water. Both soda ash and baking soda are used to elevate the pH of swimming pools, although in this instance soda ash (Sodium carbonate / Na_2CO_3) is preferred over baking soda since it aids in pH elevation while just slightly increasing alkalinity. The cooked maize wrapper is cleaned of any contaminants after boiling by being washed under cold running water. Now that the maize wrapper has been washed, the water has been drained in order to extract the fibre. Currently, the fibre has been dried for a few days. By applying a weight of 100kg for 72 hours, the dried fibre is transformed into thin paper-like sheets that range in thickness from 1mm to 2mm.

Fig.1: Obtained fiber Fig.2: Fiber sheet

V. MATRIX PREPARATION

The GP (General purpose) resin is utilised in this composite. It is an unsaturated polyester resin that cures quickly and is based on orthophthalic raw material for laminating. It is un-accelerated. Both hand layup and gun spray up are acceptable. The resin has superior mechanical, impact, and water resistant qualities. From COVAI SEENU & COMPANY in Coimbatore, it is bought. The catalyst is methyl ethyl ketone peroxide (MEKP), while the actuator is cobalt octoate (6%).For every kilogramme of GP resin, 10 millilitres of the actuator (cobalt octoate) and 15 millilitres of the catalyst (methyl ethyl ketone peroxide) are combined. The conventional mould release agent PVA (which is not the same as PVA glue!) It provides a very compatible and reliable release barrier for polyester, vinyl ester, and epoxy composites. It can be wiped on or sprayed onto a variety of pattern and mould surfaces.

VI. FABRICATION

The PVA is applied to all sides of the mould to prepare it for the composite manufacturing process. The mould has between 7 and 10 minutes to dry. The GP resin is then injected into the mould after being combined with the actuator (cobalt octoate) and catalyst (methyl ethyl ketone peroxide) in the appropriate ratio. The resin mixture is poured in the opposite direction once the fibre sheet has been placed inside the mould. The air in the mould is removed with the pointed needle. The 100kg load is applied to the resin and -filled mould after it has been filled with fibre and resin. The release agent PVA, which is used at the beginning of this procedure, during the mould preparation phase, allows the composite to be removed without any harm once the composite has been allowed to cure for 24 to 48 hours at room temperature. Before pouring the resin, a plain, thin layer of plastic sheet may be placed on the mould to aid in obtaining a proper surface finish. If a thin, plain plastic sheet is not used, machining is required to achieve the desired surface finish. Therefore, in making, the provision must be made for machining.

VII. SPECIMEN

The composite material is machined to achieve the correct surface polish after being removed from the mould. From the composite material, which is moulded in accordance with ASTM standards, the specimen is cut out. The most typical specimen for ASTM D3039 for a natural fibre polymer composite is a constant rectangular cross section that is 25 mm wide and 250 mm long with a gauge length of 150 mm utilising a cutting machine and vice. To avoid gripping damage, optional tabs can be attached to the specimen's ends.

VIII. EXPERIMENTAL ANALYSIS

The tensile strength is the highest tensile stress that a material can withstand before failing, though the precise definition of failure will typically depend on the type and design of the material. Reduced ductility and increased brittleness are linked to accelerated corrosion rates, which can cause the material to fail in a way that is much more dangerous than ductile failure. A tensile test is a physical experiment that evaluates the suitability of materials for certain engineering or building applications in order to guarantee quality. To measure the strain, stress, yield deformation, and other specific features of the specimen, tensile testing entails applying force to the specimen's opposite ends and drawing outward until the metal snaps. The specimen is sliced from the composite in accordance with ASTM D3039 dimensions. The specimen is 250mm long, 25mm wide, and 5mm thick. The specimen's gauge length is 150mm, and 100mm is utilised to secure it in the fixture/gripper. The stress-strain curve for the tensile test is obtained, the data points are removed, and the young's modulus is computed. The yield strength is computed using Microsoft Excel using the 0.2% offset approach. Young's modulus (E) = 21.664Mpa, yield strength (y) = 11.88Mpa, and the poisson's ratio (v) = 0.34 are the estimated values. Tensile testing was conducted in UTM MT-100 (100KN).

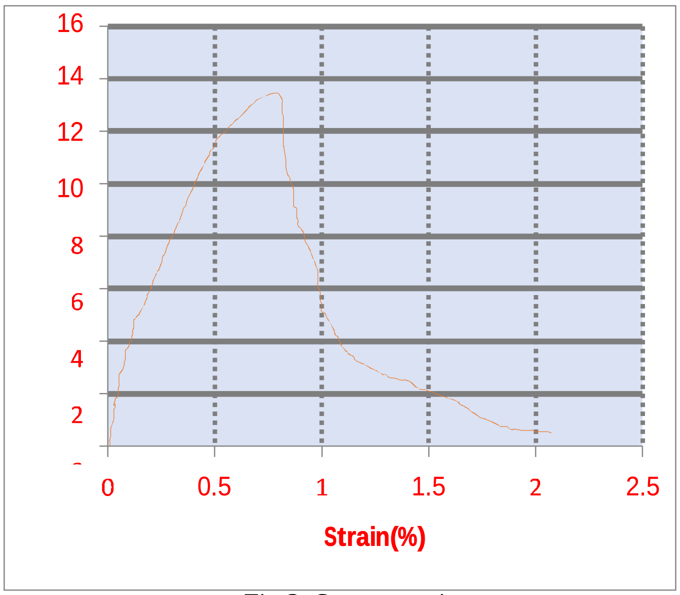

Fig.3: Stress - strain curve

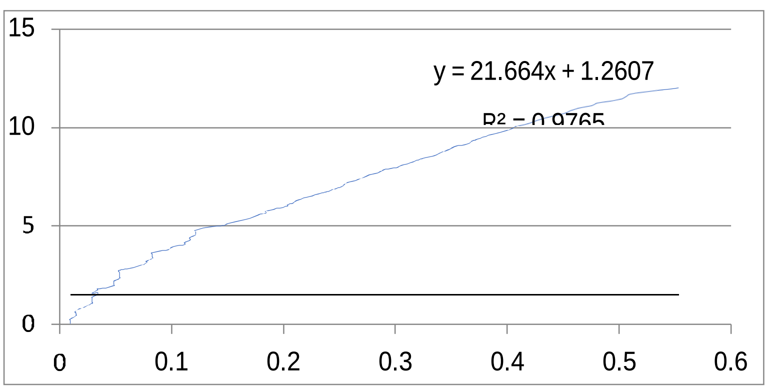

Fig.4 : Graph to find Young’s modulus

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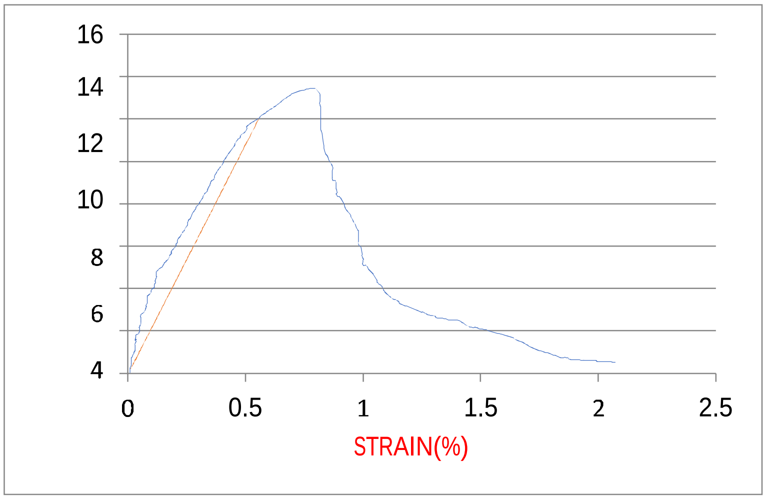

Fig. 5: Off-set graph to find yield strength

IX. NUMERICAL ANALYSIS

The software is used to create and analyse two different furniture models. Ansys is used to analyse the mechanical properties of the designed models after they have been designed using Solidworks. Plywood and a composite material reinforced with corn wrappers are the two material attributes for which the chair and the table are developed and analysed. Utilizing the data points gathered from the stress-strain curve and displaying them in Excel, the tensile characteristics are determined. Poisson's ratio is computed using the acquired stress-strain curve yield strength. The total deformation, maximum shear elastic strain, maximum main stress, maximum shear stress, normal stress (x-axis), and normal strain may all be calculated using the Ansys software (x – axis). Ansys provides structural analysis software tools that help engineers of various experience levels and educational backgrounds tackle challenging structural engineering issues more quickly and effectively. Engineers may do finite element analyses (FEA), tailor and automate solutions for structural mechanics problems, and analyse various design scenarios using our set of tools. Businesses can save money, shorten the length of design cycles, and launch products to market more quickly by utilising our software early in the design cycle.

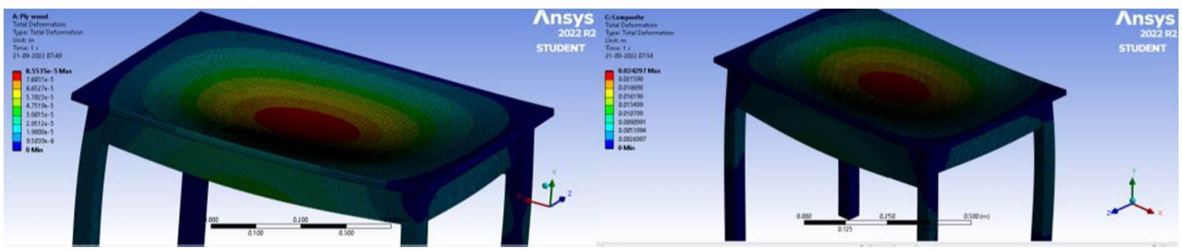

Fig. 6: Total deformation of plywood and corn composite.

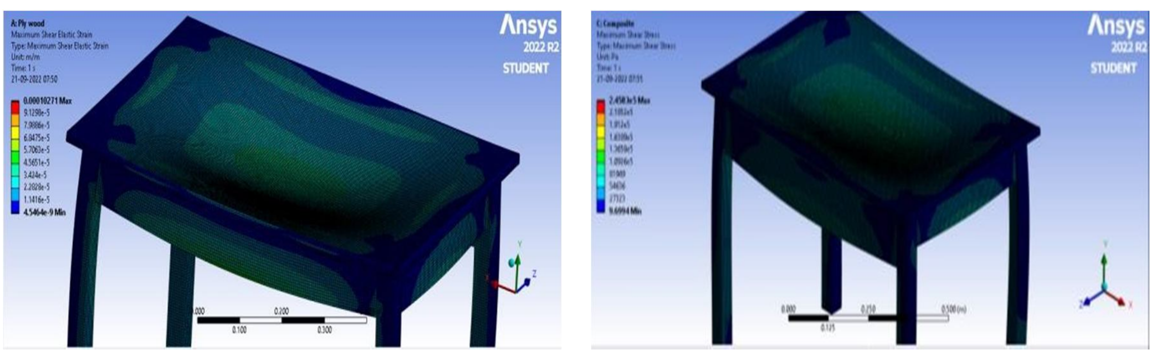

Fig. 7: Maximum shear elastic strain of plywood and corn composite.

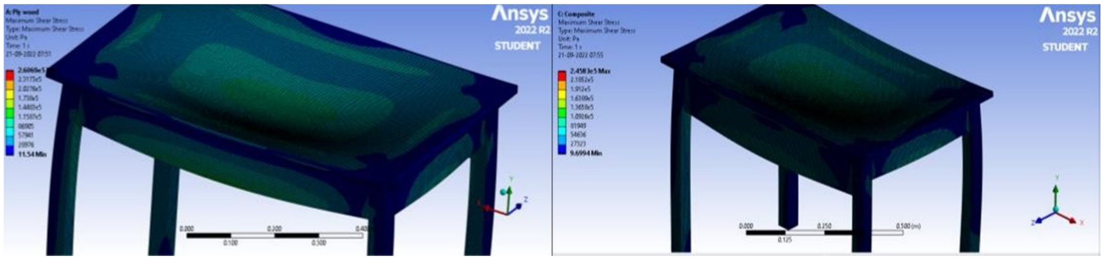

Fig. 8: Maximum shear stress of plywood and corn composite.

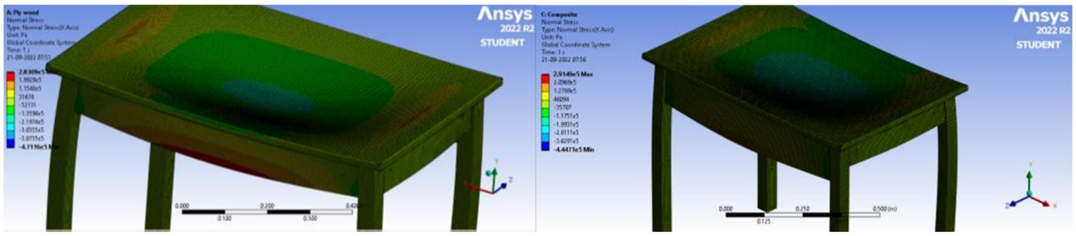

Fig. 9: Normal stress of (X – axis) of plywood and corn composite.

X. RESULT

Utilizing the estimated value from the stress-strain curve and the data points collected from that curve, the corn fibre reinforced composite is examined in the Ansys software. Ansys software is used to analyse the plywood and the corn fibre reinforced composite. The composite made of reinforced maize in Ansys analysis is compared to the outcome of plywood. For both corn fibre composite and plywood, the total deflection, maximum shear stress, maximum shear strain, normal stress, and normal strain are analysed. When comparing the results of the two materials' analyses, it can be seen that plywood exhibits less deformation than corn fibre composite, while corn fibre composite exhibits a higher maximum shear elastic strain while plywood exhibits a higher maximum shear stress and slightly lower normal stress and normal strain. Therefore, plywood is more durable than composite made with corn fibre. The applied load (50 kg) is supported by plywood. However, the corn fibre reinforced composite is unable to support such a heavy load.

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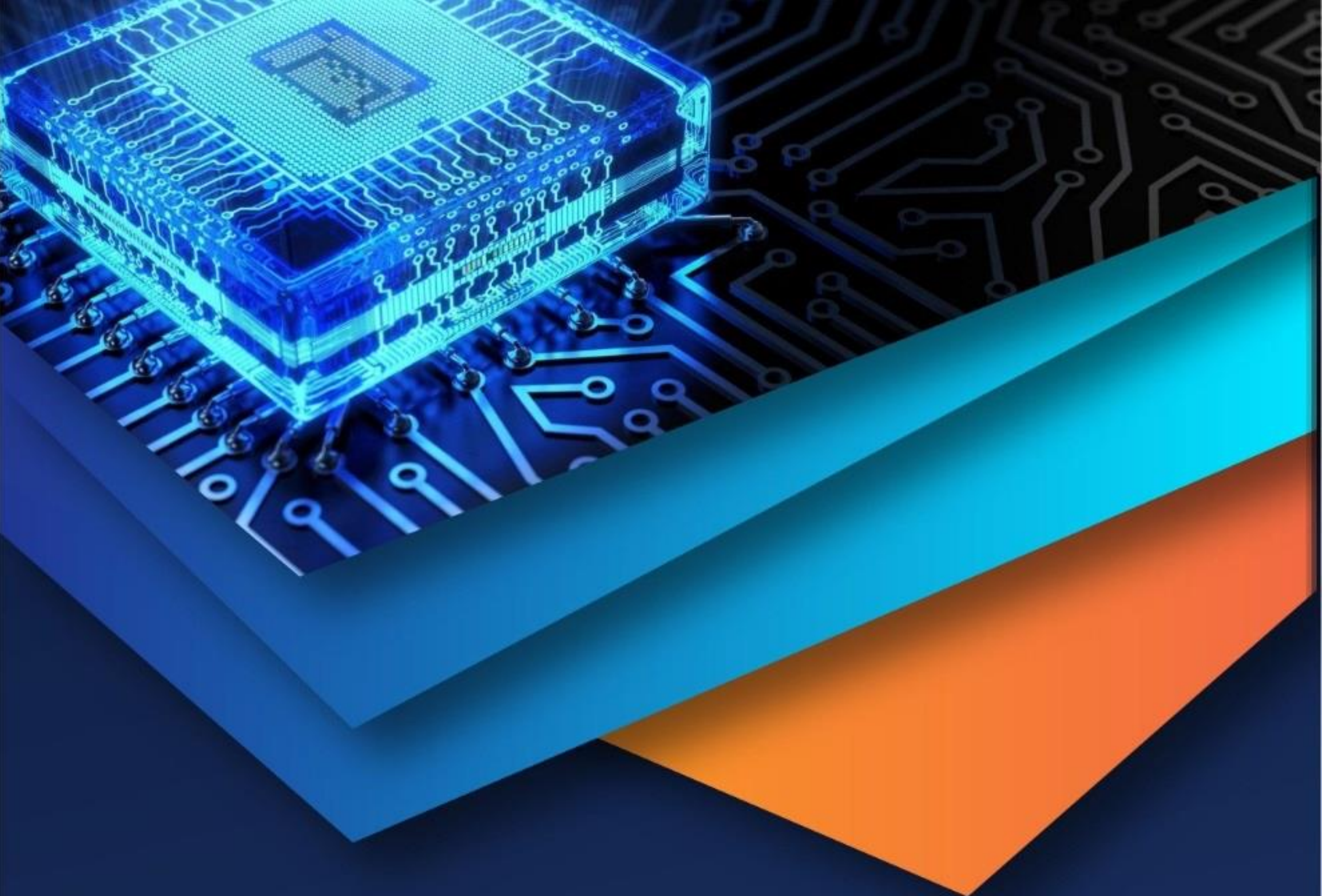

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