International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** VI **Month of publication:** June 2021

DOI: https://doi.org/10.22214/ijraset.2021.35980

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

Design and Analysis of Natural Fiber Reinforced Epoxy Composites for Automobile Applications

Mr. Saurav Sariyal[1], Mr. Jayal Choksi[2], Mr. Darshan Shisodia[3], Mr. Shubham Dubey[4], Mr. Sudarshan D. Martande[5]
[1, 2, 3, 4]Student, Department of Mechanical, Dr. D. Y. Patil School of Engineering and Technology, Lohegaon, Pune
[5] Assistant Professor, Department of Mechanical, Dr. D. Y. Patil School of Engineering and Technology, Lohegaon, Pune

Abstract: The need for eco-friendly materials is increasing in the automobile and aerospace sectors. Material selection for automobile components is influenced by various factors such as cost, weight and strength. Natural fibers offer various advantages over conventional materials such as environment friendly, easily available, recyclable and higher specific strength. Among the natural fibers Sisal and Kenaf fibers are selected for present study due to their good mechanical properties and availability. Kenaf fibers have great potential to be used as construction and automotive materials due to their long fibers which are derived from the bast. Sisal fibers do not absorb moisture and possess good impact, sound absorbing properties and high fire resistance properties. Epoxy LY556 is selected as matrix material to bind the combination of these two natural fibers due to its high temperature resistance and adherence to reinforcements. This project aim is to development of a new hybrid natural composite made of Sisal and Kenaf for automobile application. Static analysis of specimen will be perform utilizing in ANSYS 19 software to determine force reaction for specified displacement with both composite materials along with stress concentration effect with deformation. Results and end will be drawn by looking at systematic and experimental esteems.

Keywords: Sisal Fiber, Kenaf Fiber, Tensile Testing, Cad model, Ansys

I. INTRODUCTION

A. Overview

Automation production rate will increase and estimated to reach 100 million cars annually by 2022. For that reason, utilization of bio-composite will be major leads to decrease in weight of vehicles and emissions. It is estimated that there will be a 25% reduction in car weight. Sisal fiber is an extensively available material which grows as a stiff fiber and used in making different products such a paper, cloths, footwear, covers, bags, dartboards, carpets, etc. This fiber contains 71% cellulose, 12% hemicellulose, 10% pectin and 9% lignin. Natura fibers reinforced composites have application as automotive interior linings and have gained interest as a glass fiber substitute in automobile industries. Natural fiber is classified in three types i.e. animal, plant and mineral sources. Among these types, natural plant fiber has more potential and according to it, the fibers are extracted as bast, leaf, straw, fruits, seed and wood. The bast fibers have low density and higher mechanical properties and because of this there is possibility to make light weight composite for automotive parts. In taking consideration of environment friendly material, natural fiber reinforced polymer composites have raised a great attention for their mechanical properties. They are renewable, cheap, recyclable and biodegradable. The Kenaf leaves were the bast fiber used for packs, bags, covers, etc. Also yarn is processed out of Kenaf in making cloths, carpets, bags, sacks and different covering materials. Also in some nations it is used as Fabric or cloth and packs for grains and sugar.

B. Definition of Composite

According to Van Suchetclan, Composite materials are heterogeneous materials consisting of two or more solid phases, which arein contact with each other on a microscopic scale.

C. Manufacturing Processes of Composite Material

Manufacturing of a composite material is to combine the polymeric resin system with the reinforcement. The manufacturing process is important to align the fibers in desired direction which will produce a higher and uniform fiber volume fraction.

The manufacturing techniques can be classified into two categories:

1) *Open Mould Process*
a) Hand lay-up process
b) Spray up process
c) Vacuum bag auto clave process
d) Filament winding process
2) *Closed Mould Process*
a) Compression moulding
b) Injection moulding
c) Sheet moulding compound process
d) Continuous pultrusion process

II. PROBLEM STATEMENT

Material selection for automobile components is influenced by various factors such as cost, weight and strength. Natural fiber offer various advantages like it is environment friendly, easily available, recyclable and high tensile strength. Among the different natural fibers kenaf and sisal are used due to their mechanical properties. Kenaf have great potential due to their long fibers which are derived from the bast and used in automobile and construction industry. While Sisal fibers do not absorb moisture and possess good impact, sound absorbing properties and high fire resistance properties.

A. *Objective*

1) Understanding the tensile strength of Sisal, Kenaf and hybrid natural composite made of Sisal and Kenaf for automobile application.
2) To prepare specimen using hand lay-up technique
3) Static analysis of Sisal, Kenaf and hybrid natural composite made of Sisal and Kenaf using ANSYS 19 software.

B. *Tensile Testing in Automotive Industry*

In the automotive industry, different types of tests are performed to reduce the cost of production without compromising the quality. Tensile testing is used to guarantee the quality of components, materials and finished products within a wide range industries.

Application of tensile testing in various industries are as follows:

1) Aerospace industry.
2) Automobile industry.
3) Construction industry.
4) Pharmaceutical industry.
5) Textile industry.

III. DESIGN AND ANALYSIS

A. *Design of the System*

Computer-aided design(CAD) is the use of computer to aid in the creation, modification, analysis of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communication through documentation and to create a database for manufacturing.

CAD is used as follows:

1) To produce detailed engineering designs through 3-D and 2-D drawings of the physical components of manufactured products.
2) To create conceptual design, product layout, strength and dynamic analysis of assembly and the manufacturing processes themselves.
3) To prepare environmental impact reports.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

B. CAD Model

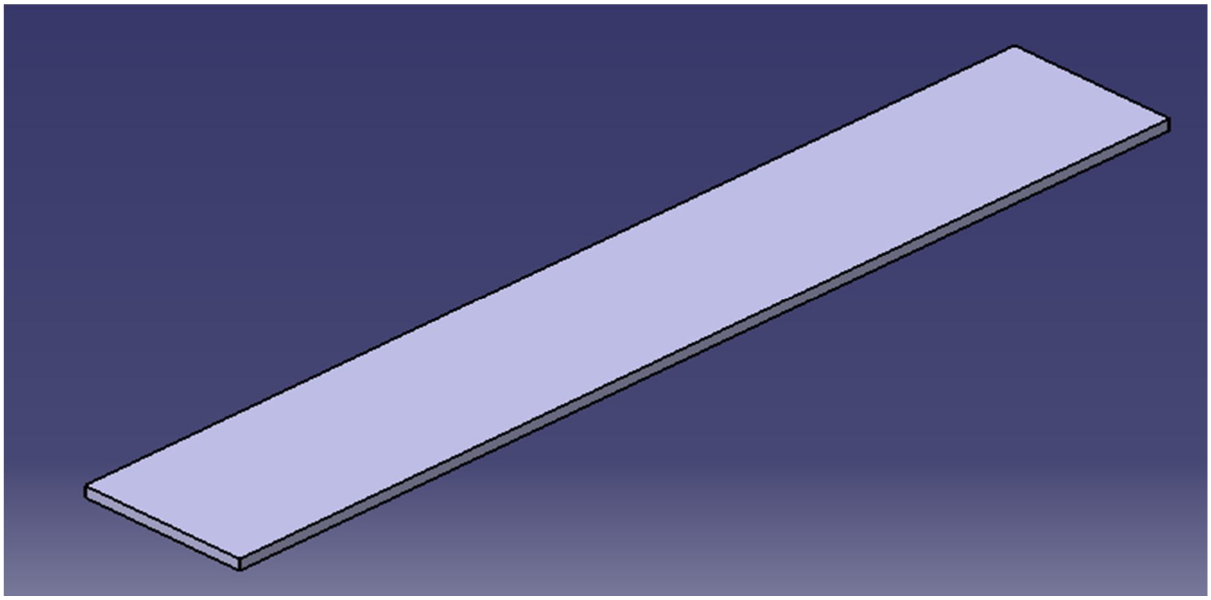


Figure 1: Cad model of specimen

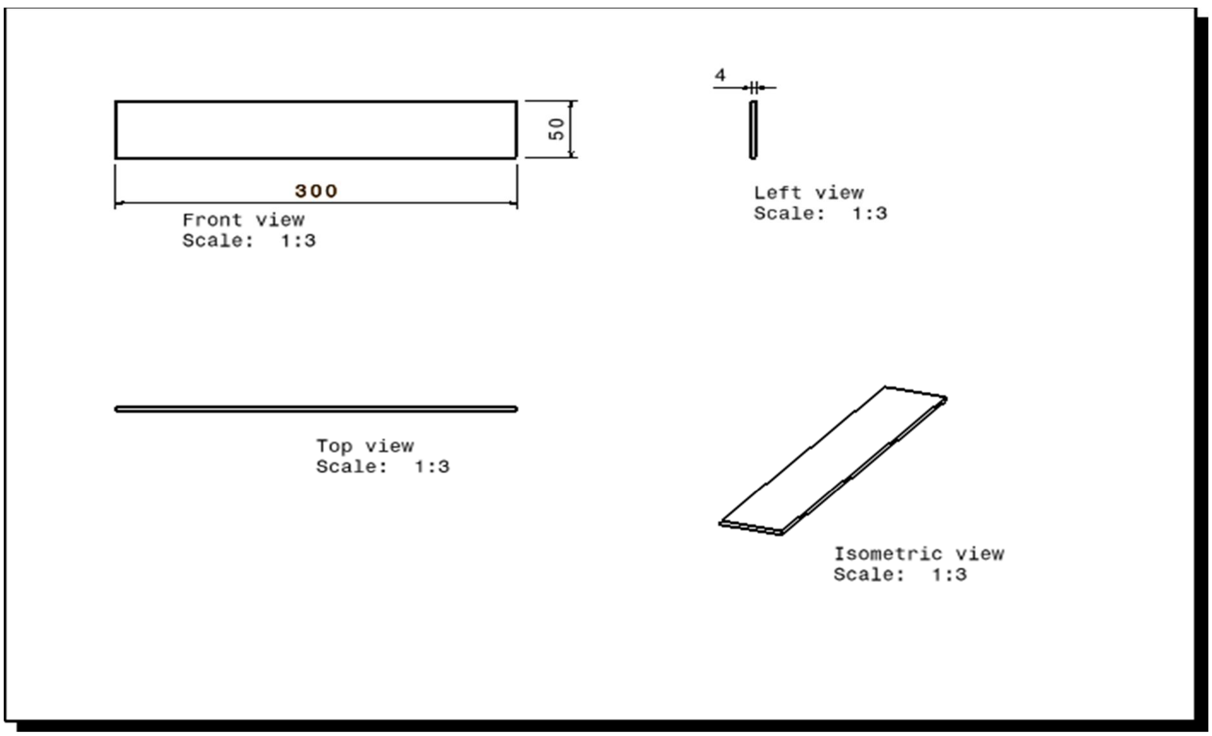


Figure 2: Drafting of specimen

C. FEA (Finite Element Analysis)

Finite Element Analysis (FEA) is the process of simulating the behavior of a part or assembly under given conditions so that it can be assessed using the Finite Element Method (FEM). Typical problem areas of interest include structural analysis, heat transfer, fluid flow, mass transport and electromagnetic potential. To solve the problem, it subdivides a large problem into smaller, simpler parts that are called finite elements. Algebraic problem are solved by using numerical linear algebra method. While ordinary differential equation that occur are solved by technique using Euler's method. In present research for analysis ANSYS (Analysis System) software is used. Basically, its present FEM method to solve any problem.

D. Material Properties

Properties of Outline Row 4: sisal

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	1.22	g cm^-3
4	Isotropic Elasticity		
5	Derive from	Young's Modulus and...	
6	Young's Modulus	2E+05	MPa
7	Poisson's Ratio	0.23	
8	Bulk Modulus	1.2346E+11	Pa
9	Shear Modulus	8.1301E+10	Pa

Figure 3: Material properties for Sisal

Properties of Outline Row 3: kenaf

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	1.2	g cm^-3
4	Isotropic Elasticity		
5	Derive from	Young's Modulus and...	
6	Young's Modulus	53000	MPa
7	Poisson's Ratio	0.42	
8	Bulk Modulus	1.1042E+11	Pa
9	Shear Modulus	1.8662E+10	Pa

Figure 4: Material properties for Kenaf

E. Analysis for Kenaf Material

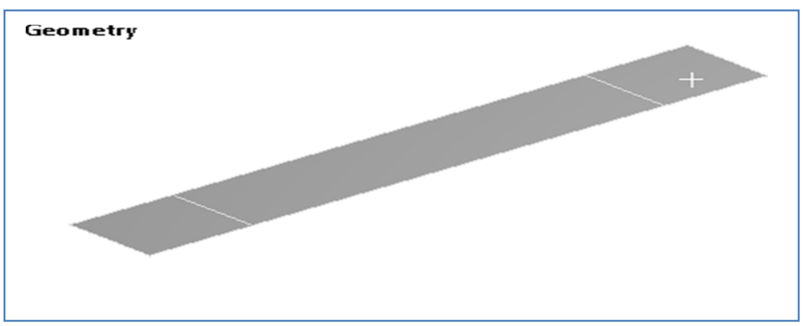


Figure 5: Geometry

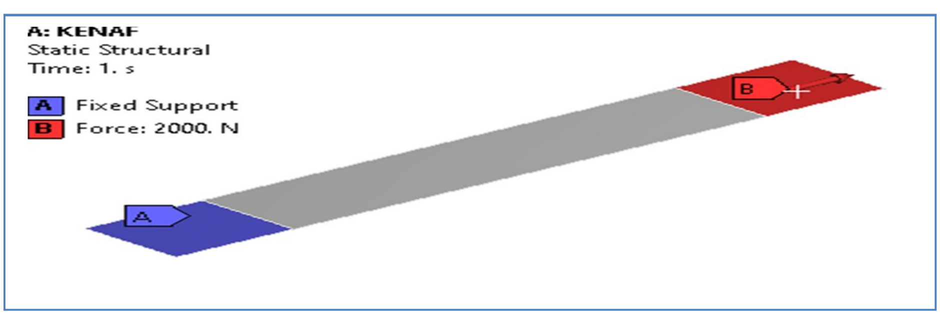


Figure 6: Boundary condition

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

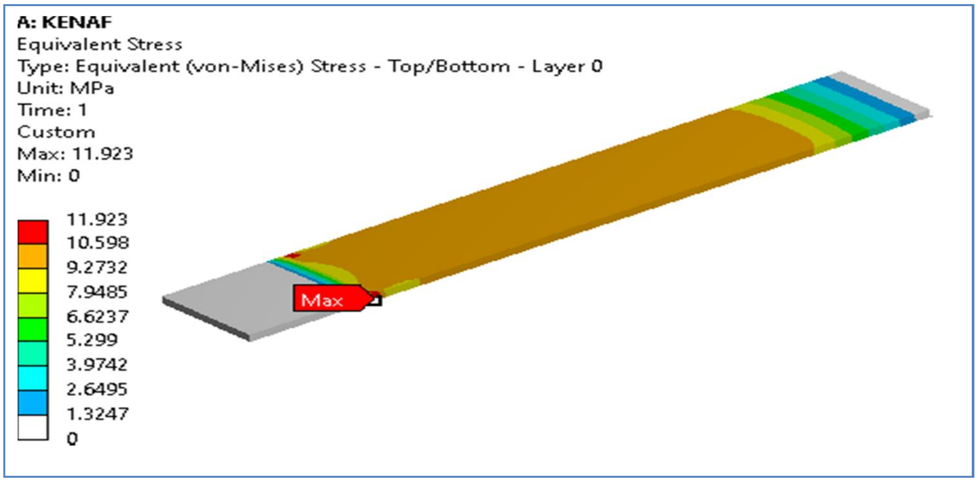


Figure 7: Equivalent stress

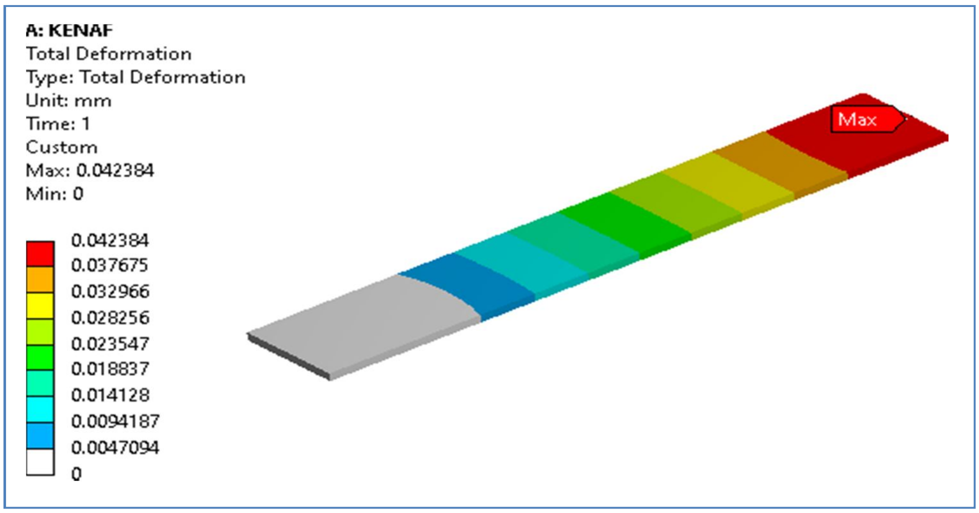


Figure 8: Total deformation

F. Analysis for Sisal Material

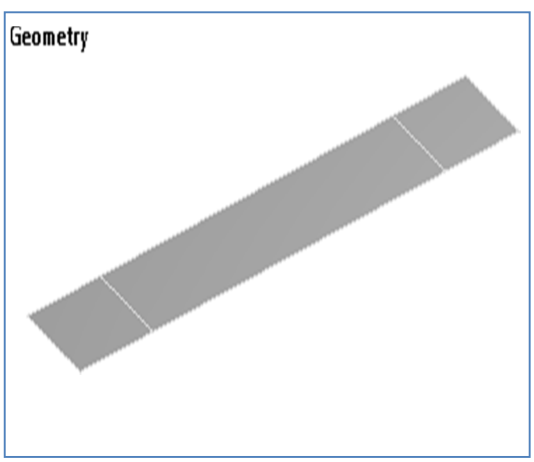


Figure 9: Geometry

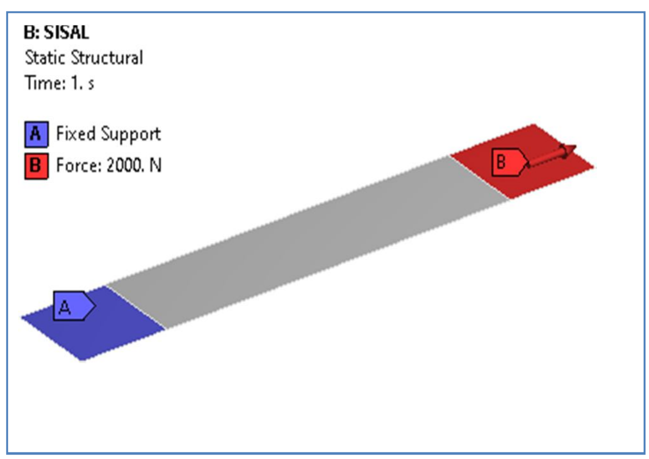


Figure 10: Boundary condition

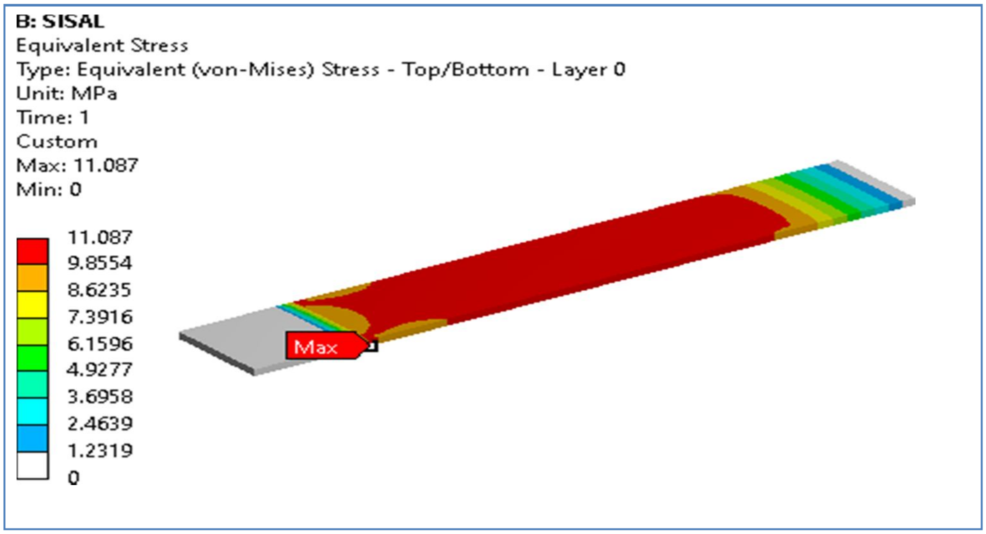


Figure 11: Equivalent stress

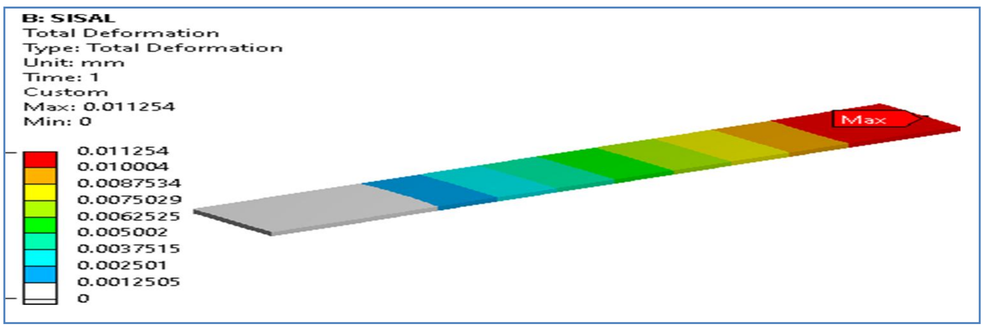


Figure 12: Total deformation

G. Analysis with combination of Sisal and Kenaf Material

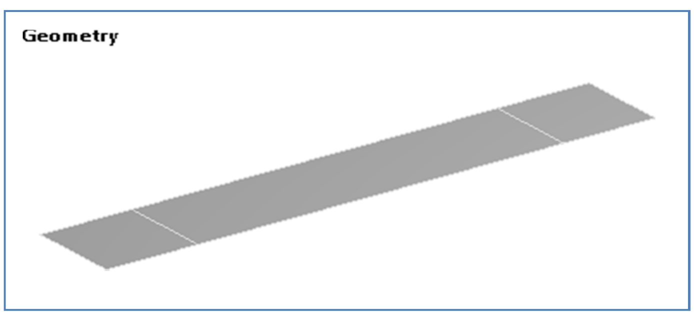


Figure 13: Geometry

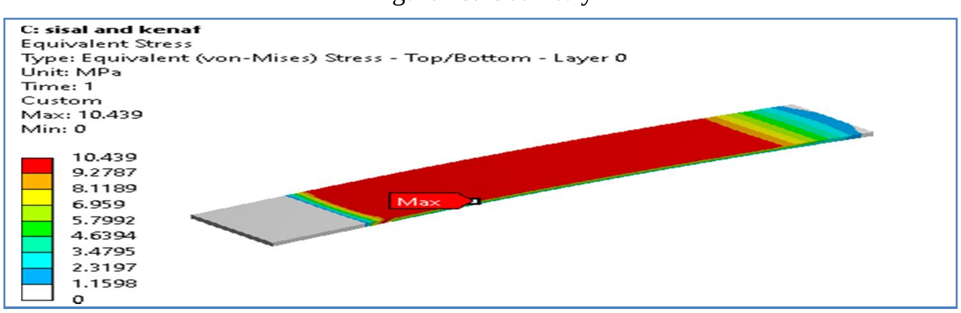


Figure 14: Equivalent stress

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue VI Jun 2021- Available at www.ijraset.com

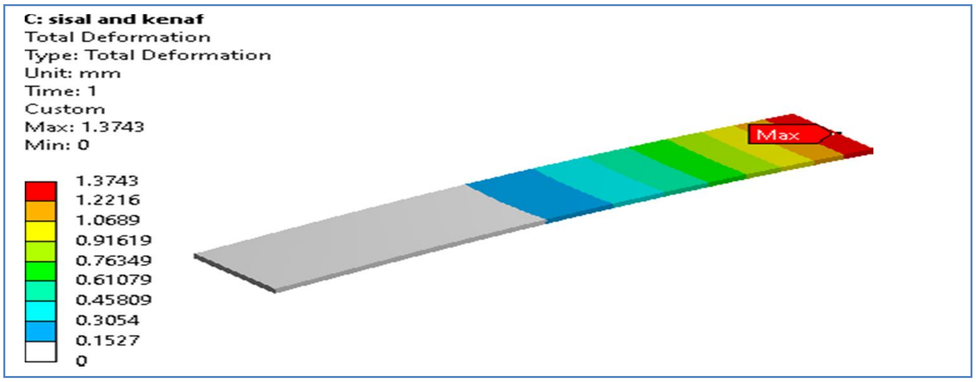


Figure 15: Total deformation

IV. MATERIALS AND METHOD

A. Material Used

1) Epoxy Resin (LY-556): It is light weight material which is easily fabricated and can resists stiffness, stress cracking and flexibility. It is used in structural and industrial applications.
2) Hardener (HY-951): Hardener is a curing agent for epoxy or fiber glass.
3) Natural Fibers (Sisal and Kenaf): By natural fiber composites we mean a composite material that is reinforced with fibers, particles or platelets from natural or renewable resources in contrast to for example carbon or aramid fibers that have to be synthesized. Natural fibers have many advantages like it is easy to handle, it is non-toxic, it is environmental friendly, low cost and fully biodegradable.

Properties of Natural Fibers

Plant Fibers	Density (Kg/m^3)	Tensile strength (MPa)	Young's Modulus (GPa)
Sisal Fiber	1300-1500	80-840	9-22
Kenaf Fiber	1300-1500	450-800	21-45

4) NaOH Solution: The NaOH solution i.e. Sodium Hydroxide is alkaline solution used for surface morphology of natural fibers.

B. Methodology

1) *Step 1: Selection of matrix material*
2) *Step 2: Selection of reinforcement and Natural Fibres*
3) *Step 3: Extraction of Fibres*
4) *Step 4: Surface Treatment of Fibres*
5) *Step* 5: Manufacturing of composite materials
a) *Hand Lay-Up Method:* It is open moulding method for making variety of composites in various sizes.
b) *Spray-up:* It is open mould method similar to hand lay-up in its suitability for making boats, tanks, transportation components, and tub/shower units in a large variety of shapes and sizes.

V. ADVANTAGES

A. It is bio-degradable, user friendly material.
B. It has slow cost and has light weight.
C. It is one of source of income for rural community.
D. It has very good thermal properties and excellent toughness.

VI. CONCLUSION

1) Here we have completed static analysis on specimen using natural composite material.
2) Here we have added a layered section to apply layer of different composite material with different orientation.
3) After applying boundary conditions in static analysis we got that total deformation and stress is generated in specimen.

A. Conclusion Table

Sr. No.	Composite material	Equivalent stress	Total deformation
1.	SISAL FIBER	11.92	0.042
2.	KENAF FIBER	11.08	0.011
3.	SISAL+KENAF FIBER	10.43	1.374

VII. ACKNOWLEDGEMENTS

First of all, we would like to thank Head of Mechanical Engineering Department, to give us the opportunity to work on this project. We wish to express our sincere gratitude to our guide for his kind guidance and valuable suggestions without which this proposed work would not have been taken up. We sincerely acknowledge the encouragement, timely help and guidance given to us by our beloved guide to carry out this proposed work within the stipulated time successfully.

REFERENCES

[1] "Mechanical Properties of Kenaf/Polyester Composites" by Mohd Yuhazri, Y., Phongsakorn, P.T., (Haeryip Sihombing, Jeefferie A.R., Puvanasvaran Perumal, Kamarul, A.M., and Kannan Rassiah. International Journal of Engineering & Technology IJET-IJENS Vol: 11 No: 01

[2] "Mechanical Properties of Kenaf/Fiberglass Polyester Hybrid Composite" by M.A. A Ghani, Z. Salleh, Koay Mei Hyie, M.N.Berhan, Y.M.D. Taib, M.A.I. Bakri, International Symposium on Robotics and Intelligent Sensors 2012 (IRIS 2012), 1877-7058 © 2012 Published by Elsevier Ltd.

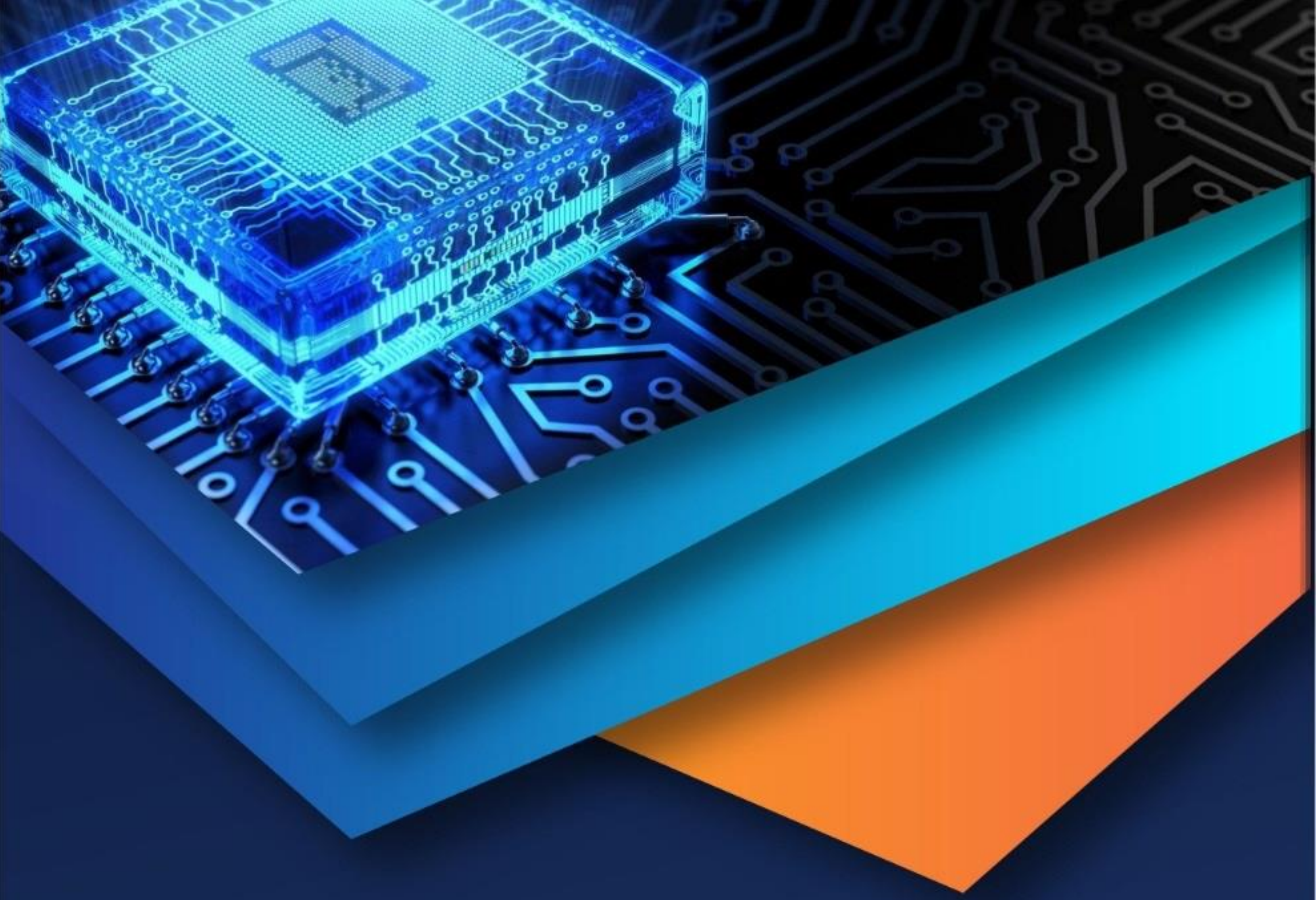
[3] "Effect of layering sequence and chemical treatment on the mechanical properties of woven kenaf–aramid hybrid laminated composites" by R. Yahaya, S.M. Sapuan, M. Jawaid, Z. Leman, E.S. Zainudin. Materials and Design 2014 Elsevier Ltd.

[4] "Effects of fibre treatment on mechanical properties of kenaf fibre reinforced composites: a review" by Muhammad H. Hamidona, Mohamed T.H. Sultana,b, Ahmad H. Ariffina, Ain U.M. Shaha. Published by Elsevier B.V

[5] "Tensile and Compressive Properties of Woven Kenaf/Glass Sandwich Hybrid Composites" by Mohaiman J. Sharba,Z. Leman, M. T. H. Sultan,M. R. Ishak,and M. A. Azmah Hanim. International Journal of Polymer Science Volume 2016, Article ID 1235048

[6] "a review on sisal fiber reinforced polymer composites" by Kuruvilla Joseph, Romildo Dias Tolêdo Filho, Beena James, Sabu Thomas & Laura Hecker de Carvalho.

[7] "Effects of enzymatic treatment of sisal fibres on tensile strength and morphology" by Pinkie E. Zwane, Thabile Ndlovu, Thulisile T. Mkhonta, Mike T. Masarirambi, Justice M. Thwala.



10.22214/IJRASET

45.98

IMPACT FACTOR:
7.129

IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY