As per UGC guidelines an electronic bar code is provided to seure your paper

International Journal for Modern Trends in Science and Technology, 8(03): 73-80, 2022

ISSN: 2455-3778 online
DOI: https://doi.org/10.46501/IJMTST0803013
Available online at: http://www.ijmtst.com/vol8issue03.html

Effects of Silicon Carbide, Aluminum and Graphite on Flax /S Glass E Glass Combo Mat Composites

Y V S Jaideep[1] | Dr.K.Govindarajulu[2]

[1]PG Scholar, Department of Mechanical Engineering, Product Design(specialization), JNTUA College of Engineering Ananthapuramu, A.P India.
[2]Professor, Department of Mechanical Engineering, JNTUA College of Engineering Ananthapuramu, A.P India.

To Cite this Article
Y V S Jaideep and Dr.K.Govindarajulu. Effects of Silicon Carbide, Aluminum and Graphite on Flax /S Glass E Glass Combo Mat Composites. International Journal for Modern Trends in Science and Technology 2022, 8(03), pp. 73-80. https://doi.org/10.46501/IJMTST0803013

Article Info
Received: 05 February 2022; Accepted: 05 March 2022; Published: 11 March 2022.

ABSTRACT

Fiber-reinforced composites serve a critical function in a wide range of engineering applications. Polymer composites with natural fibers are being developed. Natural fiber-reinforced composites are gaining popularity because of their inexpensiveness, biodegradability, eco-friendliness, and reasonably good mechanical qualities. Structural failure of natural fibers takes place when natural fibers are exposed to high relative humidity. Longer exposures time could change both physical and mechanical properties so instead of natural fibers much research has been done with chopped strand mat and plain weaved E glass and flax jute. In this project it is proposed to carry out the experimental study on SE glass Combo mat (which is known as chopped strand mat/planed weaved E glass combo mat) and flax composites as reinforcements with epoxy (LY556) as resin and HY951 as a hardener and sic, Al, Gr are taken as additives. The experimental study is carried out by fabricating six types of specimens with the help of hand lay-up method such as (i) flax +LY556, (ii)chopped hybrid E-glass+LY556,(iii) flax + SEglass + LY556,(iv) flax +SEglass + Sic+LY556, (v)flax + SEglass + Al+LY556,(vi) flax +SEglass+ Gr +LY556. All specimens are subjected to without water without fungi, only water, and water with fungus(yeast). Mechanical properties such as tensile test, flexural test, impact test, and hardness are tested according to ASTM standards.

KEYWORDS: Composites, Hand layup Method, Mechanical Test Methods, Glass fiber, Polymers.

1. INTRODUCTION

The growing realization that nonrenewable resources are becoming scarce and that a predictable dependency on renewable energy is required has prompted a surge in advances in the study of sustainable and environmentally friendly composite materials in recent years. Silva Rv[1] Environmental legislation, in conjunction with industrial and consumer imperatives around the world, is increasing pressure on organizations and scientists to develop new environmentally and socially responsible alternative materials to existing synthetic fibers and reduce reliance on petroleum-based products.[2-3] In this context, excessive use of nonrenewable resources depletes natural resources and limits landfill capacity. There has been an increasing tendency to create and use bio-composite materials in a wide range of engineering applications, particularly those that use natural fibers as fillers or reinforcers. [6-7]Flax composites have gained interest as next-generation materials for structural applications in infrastructure, aircraft, and the automotive industries. The strength of natural fiber-reinforced composites is determined by several factors, including fiber-matrix bonding, fiber orientation, fiber volume percentage, and fiber aspect ratio. The majority of natural fibre composites research focuses on mechanical qualities as a function of fibre content, SEmical treatment effects on fibres, and the use of external coupling agents. The tensile, flexural, and impact strength of hybrid composites reinforced with flax and bamboo fibres varies linearly with the flax fibre volume percentage. [3-5]The lowest void content was found in particulate-filled bamboo-epoxy composites with silicon carbide filling, and lowest void fraction was found in particulate-filled bamboo-epoxy composites with glass fibre reinforcement. The effect of filler content on the attributes of coconut shell-filled polyester composites was studied.[11-12] A high filler content harms the composites' processability, ductility, and strength. The impact of coconut shell content on the mechanical characteristics, swelling behavior, and morphology of polyester composites were investigated. The results reveal that as the polyester percentage grew, the tensile strength, Young's modulus, and water absorption of polyester composites increased, but elongation at break dropped. The morphology analysis revealed that the propensity of filler-matrix interaction increased as the filler content in the polyester matrix increased.

2. OBJECTIVE OF THE STUDY:

1. Axial particles in a matrix material make up fiber-reinforced composites with high specific strength and specific modulus.
2. In this project it is proposed to fabricate six specimens as per ASTM

Only Flax Jute
Only SEglass
SEGlass/Flax Jute
SEGlass/Flax Jute Including SIC as an additive
SEGlass/Flax Jute Including Al as an additive
SEGlass/Flax Jute Including G as an additive

After fabrication every specimen was subjected to (i) without water without fungi (ii) only water (1litre) iii) water(liter) with fungus(10 gms yeast) for thirty days. the mechanical tests such as Tensile, Flexural, Impact, and Hardness were conducted as per ASTM standards for every specimen in this project.

3. MATERIALS AND METHODS:

1. Flax Jute:

Most jute fibers are made up of the plant components cellulose and lignin. The bast fibre group includes jute, kenaf, industrial hemp, flax (linen), ramie, and other bast fibers (fibers obtained from the plant's phloem, generally referred to as "skin"). Flax is a plant in the genus Linum that has a single, slender stalk about a foot and a half tall with blue blooms, and is sometimes referred to as linseed, especially when referring to the seeds, whereas jute is the coarse, strong fiber of the East Indian plant used to make mats, paper, and gunny fabric. Flax is a type of plant fibre derived from the flax plant. It's a bast fibre, which means it comes from the stem of a plant. Flax is used to making linen, but the phrase is also used to describe clothes made from other fibres that have a similar look and feel.

2. S E- Glass:

S E-glass is the combo mat prepared by stitching of chopped strand mat(S glass) and plain weaved hybrid E glass (E glass) which is manufactured by the company Go green products located at Chennai and Arotextiels located at Mumbai. It is also called a Chopped strand plain weaved e glass combo mat. S glass fibers are shorter in length (3-5mm) and according to specifications these fibers are in random directions with better structural strength and E glass fiber is unidirectional which gives better electrical properties. In this project, the proposed S E glass combo mat is good in both structural strength and electrical properties.

Fig:1. Tested sample of both Flax and Chopped glass

3. Additives:

Silicon carbide elements are now used in the melting of glass and nonferrous metals, metal heat treatment, the manufacture of float glass, ceramics and electronics component fabrication, and gas heater pilot lighting igniters. Silicon carbide is made up of the light elements silicon (Si) and carbon (C) (C). Its basic structural element is a tetrahedron, which is made up of four carbon atoms covalently bonded to a single silicon atom in the middle. Polymorphism can be found in SiC in a variety of phases and crystalline forms. Adding Aluminum as an Additive High power is required to completely melt highly reflective materials; otherwise, partial melting will result in incomplete filling of the melt pool space during solidification, creating flaws. Aluminum powder is aluminum that has been ground into a fine powder. This was initially made by mechanical means, with flakes created by a stamp mill. Graphite powder is a type of graphite that can be used to make chemical stability, high cycle life counts, greater capacity, and enhanced adhesion are all benefits of graphite powder in most batteries. Fuel cells, improved lead-carbon batteries, alkaline batteries, and Li-ion batteries can all benefit from this formula. It can also be employed in circumstances involving thermal management.

Table: 1.Properties of all additives

PROPERTIES	Sic	Al	Gr
Density	3.1 g/cm^3	2.7 g/cm^3	2.26 g/cm^3
Flexural strength	550MPa	446MPa	50 to 60% of compressive strength
Elastic modulus	410GPa	70GPa	4.1*10^6 psi
Hardness	280	78 HB	
Compressive Strength	3900		

4. SELECTION OF RESIN AND HARDENER

Epoxy, also known as poly-epoxide, is a thermosetting polymer made when an epoxide "resin" reacts with a polyamine "hardener." Fiber-reinforced plastic composites and general-purpose adhesives are only a few of the possibilities for epoxy. The epoxide groups in epoxy resin react with a curing agent (hardener) to generate a strongly crosslinked, three-dimensional network during the curing process. It is important to cure epoxy resins with a hardener to transform them into a hard, infusible, and rigid material. It depends on the curing agent that is used to make the epoxy resin harden. It can harden at temperatures between 5 and 150 degrees Celsius.

4.1. Epoxy and hardener:

Depending on the method and quality required, a range of curing agents for epoxy resins are available. Amines, polyamides, phenolic resins, anhydrides, isocyanates, and polymercaptans are all common epoxies-curing agents. The cure kinetics and Tg of cured systems are influenced by the molecular structure of the hardeners, which varies depending on the application, procedure, and desired attributes. The characteristics of the cured material are also affected by the stoichiometry of the epoxy-hardener system. Different types and amounts of hardener, which influence cross-link density, are used to change the structure.

5. EXPERIMENTAL PROCEDURE

5.1. Preparation of specimen:

The hand-lay method is used to create composite materials in this investigation. The specimen was cut into dimensions of 220*200*4 of length, breadth, and height using flax and SEglass with an additive of SIC, Al, and Graphite. The composite specimen is made up of several different parts. In this project, the thickness of the specimen is 4mm as per ASTM. In flax, the reinforcement (%) is compromised to 23% to meet the ASTM standard thickness.

Specimen	Layers	Reinforcement (%)	Additives (%)in reinforcement
Flax	F/F/F/F/F	23	-
SE glass	SE/SE/SE	35	-
F+SE	F/SE/F/SE/F/SE	35	-
F+SE+ Sic	F/SE/F/SE/SIC	35	4
F+SE+ Al	F/SE/F/SE/Al	35	4
F+SE+Gr	F/SE/F/SE/Gr	35	4

For the preparation of a variety of samples, the use of a tip ultrasonicate to introduce additives to composites the fiber layer was created by using the appropriate amount of epoxy glue. The epoxy resin is applied to the glass fibre after it has been installed on the table. The second layer of natural fibre is put over the glass fibre before the glue dries. The method was repeated for all six specimens, with the air gaps between the layers gently pushed out during the preparation. The wet composite was then pressed hard to remove any excess resin and maintained for several hours to obtain excellent samples. The composite material was removed from the hydraulic press after it had dried fully, and the rough edges were cleanly trimmed and removed following ASTM requirements.

5.2. Stages in Hand Lay-Up method:

1. First, cut the fiber mats to a size of 220*200*4.
2. Mix epoxy LY556 (Jute Flax -1:3, SEglass -1:1.5) and harder in a 1:10 ratio with (HY951) hardener to make the matrix.
3. After that, we placed two OHB sheets on the floor and applied the wax on the sheets.
4. After that, mix the matrix on the OHB sheets, keep the fiber mat as the initial layer, and roll the mat properly.
5. Roll the first layer of fibre appropriately after applying the mixed matrix.
6. Apply mixed matrix to the second layer of fibre mats, which is kept above the first layer, and roll properly again.
7. After that, the laminates are left to cure for two days in the open air.

6. MECHANICAL TEST METHODS:

a)Tensile Test b)Flexural Test c)Impact Test

Results and Discussions:

6.1. Tensile Test :

Fig: 2. Tested samples of all specimens of Tensile Strength

Table: 3.Tensile strength of all specimens:

	Max Load(N)	UTS(Mpa)	Modulus(Mpa)
Flax	2620.43	43.67	5110.609
Flax(only water)	2340.14	39	3733.5351
Flax(Fungi)	2220.25	37	4001.277
SE Glass	11890.4	198.17	9674.65
SE Glass(only water)	11686.61	194.17	9967.77
SE Glass(Fungi)	11680.48	194.78	9966.12
Flax+ SE glass	8938.08	148.97	7985.192
Flax+ SE(only water)	7602.83	126.71	7269.57
Flax+ SE glass(Fungi)	6571.33	109.52	7498.21
Flax+ SE glass+ Sic	8493.24	141.55	8889.655
Flax+SE glass+SIC (only water)	8331.01	138.85	8105.27
Flax+SE glass+SIC (fungi)	7902.7	131.71	7964.84
F+SE+Al	6951.62	115.86	8819.47
F+SE+Al(only water)	6899.75	115	7855.28
F+SE+Al(fungi)	6868.25	114.47	8218.966
F+SE+Gr	9358	155.98	8445.911
F+SE+Gr(only water)	8654.39	144.24	7465.393
F+SE+Gr(Fungi)	8620.88	143.68	9653.81

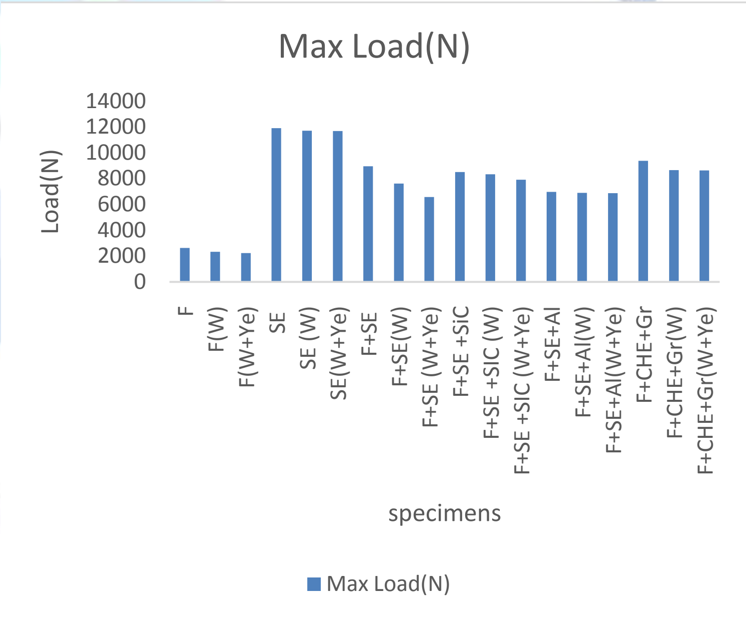

Fig: 3. Tensile Stress of all specimens at Maximum load

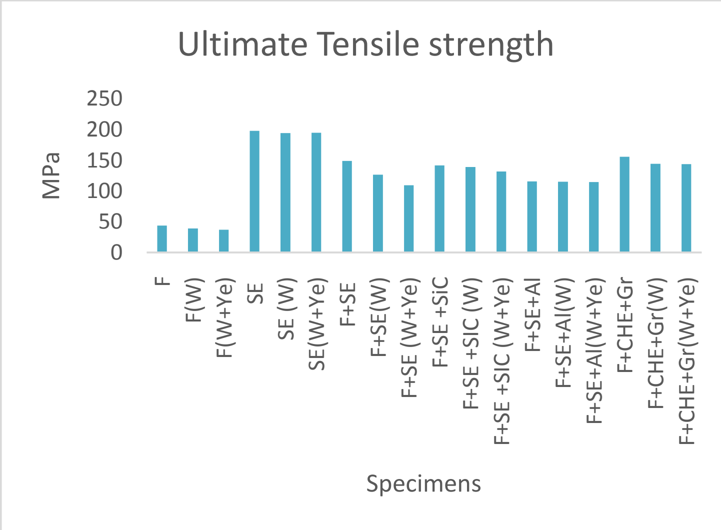

Fig:4. Ultimate tensile strength of all specimens

Table: 4. Flexural strength of all specimens

	Max flex load	Max Flex Stress	Flexural Modulus(Mpa)
Flax	108.91436	66.37	5014.62
Flax(only water)	107.81353	65.7	5807.96
Flax(Fungi)	100.822	61.44	4238.31
SE Glass	461.266	281.08	11918.80141
SE Glass(only water)	452.603	275.81	11926.967
SE Glass(Fungi)	385.13	234.69	11405.011
Flax+SE glass	383.109	233.46	10482.28
Flax+SE(only water)	352.154	214.59	11660.57
Flax+SE glass(Fungi)	315.912	192.51	8631.45
Flax+SE glass+SiC	453.45	276.32	14885.802
Flax+SE glass+SIC (only water)	396.092	241.37	13328.65
Flax+SE glass+SIC (fungi)	368.99	224.85	12538.34
F+SE+Al	460.76	280.78	13072.45
F+SE+Al(only water)	427.03	260	15281.515
F+SE+Al(fungi)	369.74	225.31	10253.138
F+SE+Gr	413.26	251.8	11962.848
F+SE+Gr(only water)	395.56	241.05	10682.792
F+SE+Gr(Fungi)	388.72	236.88	10486.77

The maximum tensile load that a body can sustain before failing is divided by the cross-sectional area of the body. When a material is strained or stretched to its maximum tensile strength, it will not break. High tensile strength allows for weight and cost savings without compromising performance. By observing the above graph, we can say SE glass(without water without fungi) is the highest tensile strength of 198.17 Mpa at maximum load 11890.40 N among the specimens which are included with additives F+SE+Gr (without water without fungi) gives the highest tensile strength of 115.98 Mpa at maximum load of 9358 N at varied tensile strengths. At SE glass, the only water in the material is in a comparison of three mediums, the specimen without water without fungi is nearly 6% higher than using water and fungi as a medium.

6.2.Flexural Test :

Fig:5. Tested samples of flexural strength of all specimens

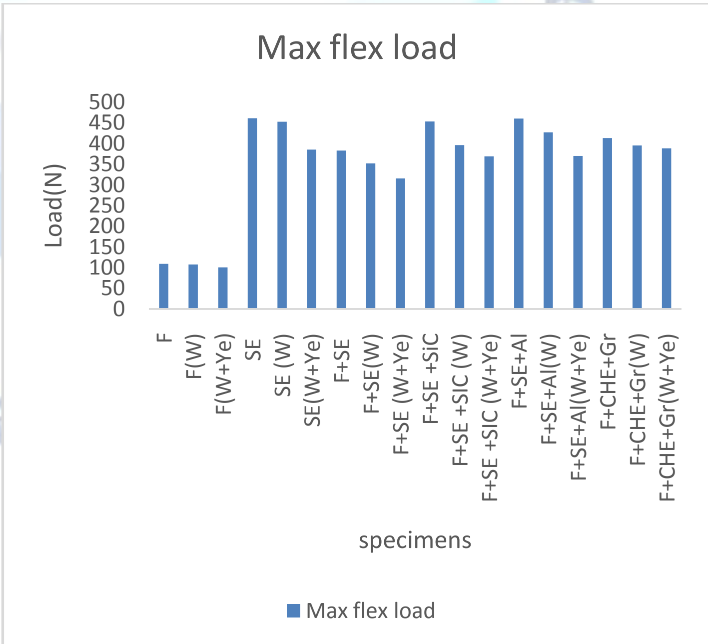

Fig:6. Flexural strength of all specimens at maximum load

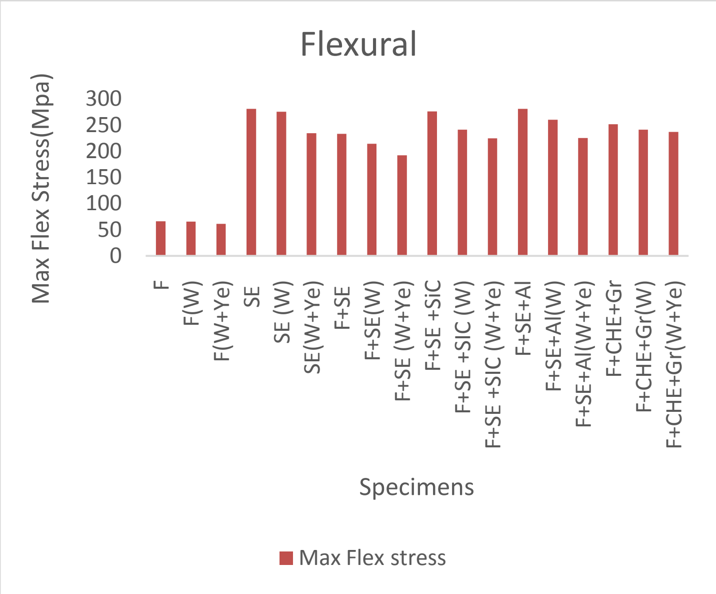

Fig:7. Flexural Modulus of all specimens

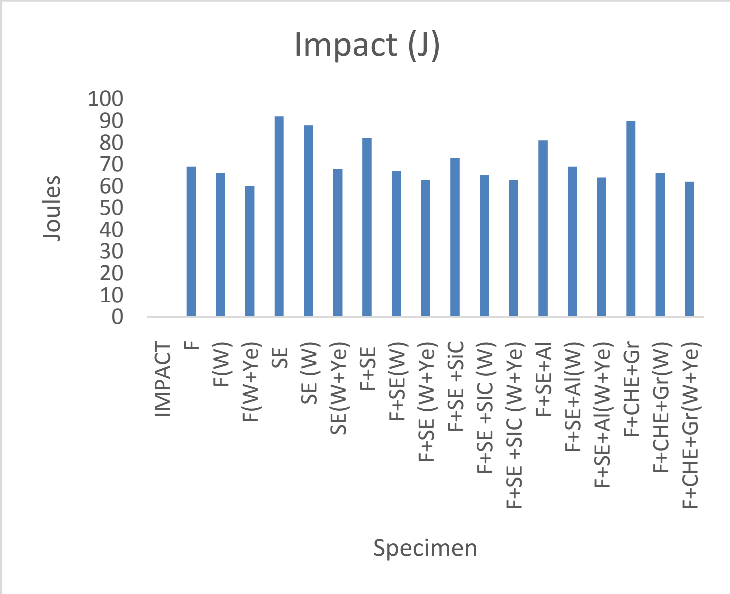

Fig: 9. Impact strength of all specimens

Flexural modulus refers to a material's ability to bend, which is measured in terms of flexural deformation. The behavior of a structure's indirect bonding is referred to as flexural strength. The harder it is to bend a material with a higher flexural modulus gives high flexural stresses the easier it is to bend a material with a lower flexural modulus lower flexural stress. The flexural strength of composites is one of the most important properties for quantifying structural applications along. It was discovered that the highest flexural strength is obtained for samples made of chopped Hybrid E-glass material in every medium. The flexural strength among specimens with additives F+SE+Al (without water without fungi) gives both flexural modulus and flexural strength is high.

6.3 Impact Test :

Fig: 8.Tested samples of Impact strength

Impact strength, also known as impact toughness, is the amount of energy that a material can endure when a load is suddenly applied to it. The energy absorbed in the break is assessed by allowing a pendulum to strike a grooved machined test piece. Toughness is the capacity to prevent deformation-induced damage from becoming a failure point. High impact strength is required, and pressure must be evenly dispersed throughout the object. For pure medium, it must also have a large volume, a low modulus of elasticity, and a high material yield strength. The SE glass is high, followed by F+SE+Gr (without water without fungi).

6.4. Rockwell Hardness :

Fig: 10.Tested samples of Rockwell hardness test

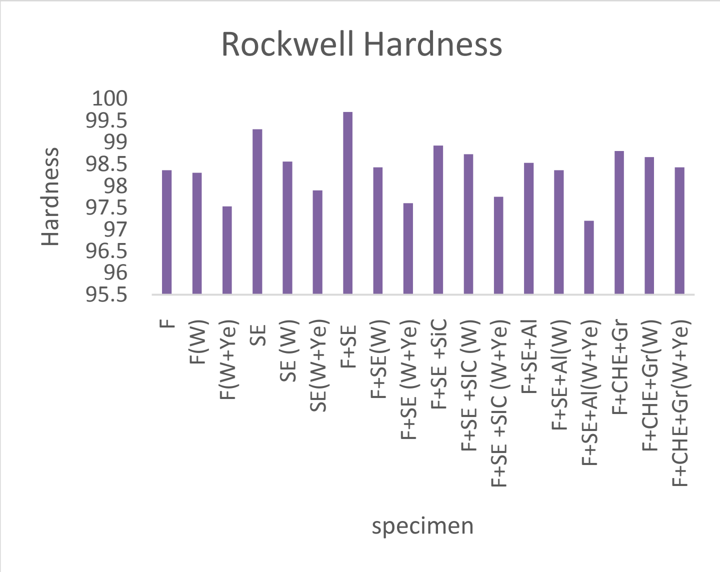

Fig: 11.Rockwell hardness of all specimens

A high Rockwell rating indicates that the steel under test is of high strength; any score on the Rockwell scale between mid—50 and above is considered hard. The more force is necessary to modify the shape of the material, the more expensive it is. The Rockwell hardness of SE(without water without fungi) is 99.3. Among specimens with additives, Flax+SE+Gr is 98.8 (without water without fungi).

7. CONCLUSION:

From the study, we conclude three mediums such as without water without fungi, only water, and water with fungi, and each specimen is tested on mechanical test methods such as tensile, flexural, impact, and hardness.

From the experimental results, we observed that

1.Tensile test :

1. In without water without fungi medium: SE>F+SE>F+SE+GR>F+SE+SIC>F+SE+ Al>F
2. In only water: SE>F+SE+GR>F+SE+SIC>F+SE>F+SE+ Al>F
3. water with fungi: SE>F+SE+GR>F+SE+SIC>F+SE+AL>F+SE>F

From above, all mediums, the tensile strength is high at SE glass (without water without fungi). But among the specimens' additives, SE+F+GR (without water, without fungi) gives better high UTS properties. The trend is followed among all specimens, that is, without water without fungi, only water, and water with fungi. F+SE has shown a higher reduction from no water to no fungi to only water. High UTS of the specimens is used for the application of adhesives, mastics, and sealants.

2.Flexural test :

1. Without water without fungi: SE>F+SE+Al>F+SE+SIC>F+SE+GR>F+SE>Flax.
2. only water: SE>F+SE+Al>F+SE+SIC>F+SE+GR>F+SE>Flax.
3. water with fungi: F+SE+GR>SE>F+SE+AL>F+SE+SIC>F+SE>Flax.

The form above all mediums the flexural strength is high at SE glass(without water without fungi). But among specimens with additives F+SE+AL (without water without fungi) is showing higher flexural strength. The trend is followed by every specimen and their properties were decreased such as (without water without fungi>only water >water with fungi).F+SE+SIC as shown a higher reduction of flexural strength from without water without fungi to only water. High flexural specimens are used for the application of beams, cantilevers, shafts, etc.

3.Impact test :

1. Without water without fungi: SE>F+SE+Gr>F+SE>F+SE+Al>F+SE+SIC>F
2. only water: SE>F+SE+AL>F+SE>F+SE+GR>F+SE>F+SE+SIC.
3. water with fungi: SE>F+SE+AL>F+SE=F+SE+SIC>F+SE+GR>Flax.

The form is above all mediums. The flexural strength is high at SE glass (without water without fungi). But among specimens with additives, F+SE+Gr is shown to have a higher impact strength. The trend is followed by every specimen and their properties are decreased, such as (without water without fungi) or (only water, with fungi). The greater the reduction in F+SE+Gr, the greater the reduction in F+SE (without water without fungi) to F+SE (only water).High Impact specimens used for application for industrial polymers and plastics.

4. Rockwell Hardness:

CH e Without water without fungi are showing a higher hardness value in the Rockwell hardness test and the trend is followed by each specimen, and their properties are decreased, such as (without water without fungi) > (only water) > (water with fungi). The better reduction is shown in F+S.

Conflict of interest statement

Authors declare that they do not have any conflict of interest.

REFERENCES

[1] Silva RV. Silva Composite of polyurethane resin derived from mamona oil and plant fibres. Universidad de S. Paulo, Sao Carlos, 2003, p. 139. These (Doutorado) - Escola de Engen aria de S. Carlos, Universidad de S. Paulo, Sao Carlos, 2003, p. 139.

[2] Goulart S.A.S., Oliveira T.A., Teixeira A., Mileo P.C., Mulinari D.R., Goulart S.A.S., Oliveira T.A., Teixeira A., Mileo P.C., Mulinari D.R., Goulart S.A.S., Mechanical behavior of palm fibre reinforced polypropylene composites, Procedia Engineering, vol. 10, no. 10, pp. 2034-2039, 2011.

[3] Geethamma VG, Thomas Mathew K, Lakshminarayanan R, Sabu Thomas, Geethamma VG, Thomas Mathew K, Lakshminarayanan R, Sabu Thomas, Geethamma VG, Thomas Mathew Polymer 1998;6:1483–90. Composite of short coir fibres and natural rubber: Effect of SEmical alteration, loading, and fibre orientation.

[4] SV Joshi, LT Drzal, AK Mohanty, S Arora. Are natural fibre composites better for the environment than glass fibre composites? Compos Part A, vol. 35, no. 3, pp. 371–76, 2004.

[5] N. Venkateshwara, A. ElayaPerumal, A. Alavudeen M. Thiruchitrambalam, N. Venkateshwara, A. ElayaPerumal, A. Alavudeen M. Thiruchitrambalam, A. Alavudeen M. Thiruchitrambala Banana/sisal reinforced hybrid composites: mechanical and water absorption behavior 32 (2011) 4017-4021

[6] H.J. Kwon, J. Sunthornvarabhas, J.W. Park, and others. The role of aspect ratio of natural fibres in the tensile characteristics of kenaf fibre and corn husk flour reinforced poly(lactic acid) hybrid bio-composites. 232–237 in Compos Part B Eng, 2014.

[7] Ho M, Wang H, Lee J, et al. Critical parameters on natural fibre composite manufacturing processes. [8] 3549–3562 in Compos Part B, 2012. 3. O. Faruk, A. K. Bedzin, H. P. Fink, et al. 2000-2010: Bio composites reinforced with natural fibres. 1552–1596 in Prog Polym Sci, 2012.

[8] Thomas S. and John MJ. Biofibers and bio composites are two types of biomaterials. 343–364 in Carbohydras Polym 2008; 71: 343–364 in Carbohydras Polym 2008; 71: 343–364 5. J. Holbery and D. Houston in automobile applications, natural-fibre-reinforced polymer composites. 58: 80–86 in J Miner Met Mater Soc (2006). 6.

[9] Yousif BF, Ku H, and Alsaeed T. An overview of natural fibre reinforced composites' mechanical characteristics and machinability. Int J Precis Technol, vol. 3, no. 3, 2013, pp. 152–182.

[10] CC Tsao and YC Chiu Drilling parameters and thrust force in drilling carbon fibre reinforced plastic (CFRP) composite laminates with compound core-special drills were investigated. 740–744 in International Journal of Machining Tools and Manufactures, 2011.

[11] HoSEng H and Tsao CC, HoSEng H and Tsao CC, HoSEng H and Tsao CC, HoSEng The road to delamination-free composite material drilling. 167: 251–264 in J Mater Process Technol, 2005.

[12] H. Ku, H. Wang, N. Pattarachaiyakoop, and others. The tensile characteristics of natural fibre reinforced polymer composites are reviewed. Compos Part B Eng 42: 856–873 (2011). D. Liu, Y. Tang, and W.L. Cong. Mechanical drilling for composite laminates is discussed. 94: 1265–1279. Compos Struct 2012; 94: 1265–1279.

[13] M. George, M. Chae, and D. C. Bressler. Structural, technological, and environmental aspects of composite materials containing bast fibres. 83: 1–23 in Prog Mater Sci.