



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 12, Issue 6, June 2023

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

ijirset@gmail.com

www.ijirset.com

Analysis of Natural Fiber Composite Material for Tensile Strength

Patadiya Mitesh, Gosai Ridham, Kachadiya Darshan, Achary Anish, Mr.Sandep.S.Patil,
Mr. Gopal.P.Patel

Department of Mechanical Tapi Diploma Engineering College, Kapodra, Varachha Road, Surat, India

ABSTRACT: Analysis of Natural fibres Composite for Tensile strength , the composition of different natural fibres are done in order to produces and make a strong and increase the mechanical property of the system. By performing the analysis of natural fibres for tensile strength we get the accurate data of how much the composite material is strong and is it useful in various works. Tensile strength is measured in mega pascal (MPa). In this project we have taken four types of natural fibres such as Jute fibre, coir fibre (coconut), banana fibre, bamboo fibre, making a composition of each material by adding epoxy and hardener. During this process, the ratio of hardener is slightly different in each composition of natural fibres, therefore, while the testing process for tensile strength is being conducted, we can achieve vivid results and figure out the amount of material required to make the product strong.

KEYWORDS: Natural fiber composite ,polymer ,tensile strength, epoxy ,testing process

1.1 INTRODUCTION

A composite material is composed of at least two materials, which combine to give properties superior to those of the individual constituents. For our website we refer to fibre reinforced polymer (FRP) composites, usually with carbon, glass, aramid, polymer or natural fibres embedded in a polymer matrix. Other matrix materials can be used and composites may also contain fillers or nano-materials such as graphen .The many component materials and different processes that can be used make composites extremely versatile and efficient. They typically result in lighter, stronger, more durable solutions compared to traditional materials.

1.2 WHY USE COMPOSITES?

The primary reason composite materials are chosen for components is because of weight saving for its relative stiffness and strength. For example, carbon-fibre reinforced composite can be five times stronger than 1020 grade steel while having only one fifth of the weight. Aluminium (6061 grade) is much nearer in weight to carbon-fibre composite, though still somewhat heavier, but the composite can have twice the modulus and up to seven times the strength.

1.3 ADVANTAGE OF COMPOSITE MATERIALS

Design flexibility

Low cost per cubic inch

Lower material cost

II. NATURAL FIBER

Fibres are thread-like structures that are long, thin and flexible. These may be spun into yarns and then made into fabrics. There can be different types of fibres. Natural fibres are the fibres that are obtained from plants, animals or mineral sources. Some examples are cotton, silk, wool etc. Natural fibres can again be divided into two types based on their source i.e. plants and animals.

2.1. CHARACTERISTIC OF NATURAL FIBER

Perhaps the best definition of a composite is a material consisting of two or more distinct phases bonded together (see Comprehensive Composite Materials, Anthony Kelly and Carl Zweben, Editors-in-Chief, Pergamon Press, Elsevier Science, Oxford, 2000). This distinguishes composites from metal alloys in which constituents are dissolved in one another. Solid materials can be divided into four categories—polymers, metals, ceramics, and carbon, which we consider as a separate class because of its unique characteristics. We find both reinforcements and matrix materials in all four categories. This gives us the ability to create a limitless number of new material systems which have unique properties that cannot be obtained with any single monolithic material. Shows the types of material combinations which are now in use. Composites are usually classified by the type of material used for the matrix. The four primary categories of composites are polymer matrix composites (PMCs), metal matrix composites (MMCs), ceramic matrix composites (CMCs), and carbon matrix composites (CAMCs). Carbon-carbon composites (CCCs) are the most important subclass of CAMCs. At this time, PMCs are by far the most widely used type of composites. However, there are important applications of the other types which are indicative of their great potential in mechanical engineering applications

2.2 .APPLICATION OF NATURAL FIBER COMPOSITE

Natural fibers reinforced composites are emerging very rapidly as the potential substitute to the metal or ceramic based materials in applications that also include automotive, aerospace, marine, sporting goods and electronic industries. Natural fiber composites exhibit good specific properties, but there is high variability in their properties. Their weakness can and will be overcome with the development of more advanced processing of natural fiber and their composites. Their individual properties should be a solid base to generate new applications and opportunities for biocomposites or natural fiber composites in the 21st century “green” materials environment. The exploitation of natural fiber composites in various applications has opened up new avenues for both academicians as well as industries to manufacture a sustainable module for future application of natural fiber composite

III. MATRIX

Matrix surrounds the fibers and thus protects those fibers against chemical and environmental attack. For fibers to carry maximum load, the matrix must have a lower modulus and greater elongation than their reinforcement. Matrix selection is performed based on chemical, thermal, electrical, flammability, environmental, cost, performance, and manufacturing requirement

The matrix determines the service operating temperature of a composite as well as processing parameters for part manufacturing.

For the matrix, many modern composites use thermosetting or thermo softening plastics (also called resins). (The use of plastics in the matrix explains the name 'reinforced plastics' commonly given to composites). The plastics are polymers that hold the reinforcement together and help to determine the physical properties of the end product.

IV. FIBER

Fibers are the principal constituents in a fiber-reinforced composite material. They occupy the largest volume fraction in a composite laminate and share the major portion of the load acting on a composite structure. Proper selection of the fiber type, fiber volume fraction, fiber length, and fiber orientation is very important.

Following characteristics of a fibers are of interest for composite laminates:

- Density
- Tensile strength and modulus
- Compressive strength and modulus
- Fatigue strength as well as fatigue failure mechanisms
- Electrical and thermal conductivities
- Cost

4.1 WHY WE NEED NATURAL FIBERS?

- Environmental reasons
- Renewable resources

- Thermally recyclable ,biodegradable ,CO2neutral
- Low energy consumption (which means low CO2 and low “carbon footprint”)
- Cost :potentially low cost
- Health and safety: less abrasive and safe to handle
- Good specific mechanical and biological properties
- Natural image ,design aspects
- Light weight structures with high modulus values
- Low coefficient of thermal expansion
- Good acoustic and vibration damping capacity
- Increased recycling possibilities ⊥ better energy recovery
- Less environmental impact due to material production

V. BAMBOO FIBER.

Bamboo fibre is a regenerated cellulosic fibre produced from bamboo. Starchy pulp is produced from bamboo stems and leaves through a process of alkaline hydrolysis and multi-phase bleaching. Further chemical processes produce bamboo fibre. It is softer than cotton, with a texture similar to a blend of cashmere and silk (8). Because the cross-section of the fibre is filled with various micro-gaps and micro-holes, it has much better moisture absorption and ventilation. Moisture absorbency is twice than that of cotton with extraordinary soil release. A characteristic of bamboo fibre is such that it absorbs moisture due to micro-gaps and static electricity is hard to be generated. Bamboo fibre does not contain free electron and thus it is antistatic, so it fits very well next to the human skin but not clinging it. It flows lightly over the body. Product of bamboo fibre is eco-friendly and bio-degradable (9). Due to its anti-bacterial property, the bamboo fibre has wide prospects in the field of hygiene home textile items such as mattresses, sanitary towel and table napkins. It is also most preferred fibre for decorating products like curtain, television cover, sofa slipcover and also for bathroom products like towels and bathrobes used in spas and hotels, as well as among the household consumers.



FIG BAMBO FIBER REINFORCED COMPOSITE SHEET

5.1 BAMBOO FIBER (MECHANICAL PROPERTY)

Fiber	Density (g/cm ³)	Elongation (%)	Tensile strength (MPa)	Young's modulus (GPa)
BAMBOO	0.6-1.1	-	540-630	12.0

5.2 APPLICATION OF BAMBOO FIBER

- Production of mattress
- Mats
- Mattress
- Geo Textile

VI. COTTON FIBER

Cotton fibers are natural hollow fibers; they are soft, cool, known as breathable fibers and absorbent. Cotton fibers can hold water 24–27 times their own weight. They are strong, dye absorbent and can stand up against abrasion wear and high temperature. In one word, cotton is comfortable. Since cotton wrinkles, mixing it with polyester or applying some permanent finish gives the proper properties to cotton garments. Cotton fibers are often blended with other fibers such as nylon, linen, wool, and polyester, to achieve the best properties of each fiber. Cotton fibers are anisotropic and have a complex morphological structure. They are single cell seed hair that grows around the seeds of the cotton plant.



FIG COTTON FIBER REINFORCED COMPOSITE SHEET

6.1 COTTON FIBER (MECHANICAL PROPERTY)

Fiber	Density (g/cm ³)	Elongation (%)	Tensile strength (MPa)	Young's modulus (GPa)
Cotton	1.5-1.6	7.8-8.0	287-597	12.0

6.2 APPLICATIONS OF COTTON FIBER

Fishnets,
Coffee filters,

VII. POLYMER SUGGESTED (CRYSTAL CLEAR EPOXY RESIN)

The term epoxy has been widely adopted for many uses beyond fiber reinforced polymer composites. Today, epoxy adhesives are sold in local hardware stores, and epoxy resin is used as the binder in countertops or coatings for floors. The myriad of uses for epoxy continues to expand, and variants of epoxies are constantly being developed to fit the industries and products they are used in.



FIG CRYSTAL CLEAR EPOXY RESIN

7.1 APPLICATION OF (CRYSTAL CLEAR EPOXY RESIN)

- used for laminating and filling wood
- for casting jewelry, decorative items, table tops, bar tops, marble coating, wood casting and coating applications
- epoxy can be used for all of your casting and coating applications

VIII. MOULD SELECTION (WOODEN DIE)



FIG FEMALE PART



FIG MALE PART

IX. DIFFERENT METHODS OF MANUFACTURING COMPOSITE MATERIAL SHEET

- Hand lay-up (the selected method)
- Wet lay-up
- Compression moulding different
- Injection moulding
- Resin transfer moulding
- Vacuum infusion

9.1 HAND LAY-UP TECHNIQUE

Hand lay-up is an open molding method suitable for making a wide variety of composites products from very small to very large. It is the simplest composites molding method, offering low-cost tooling, simple processing, and a wide range of part sizes. Design changes are readily made. There is a minimum investment in equipment. With skilled operators, good production rates and consistent quality are obtainable.

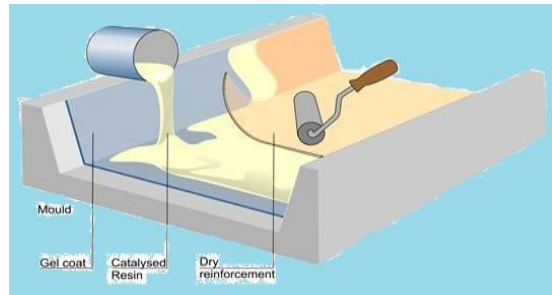


FIG HAND LAY-UP TECHNIQUE

X. STANDARD TEST METHOD FOR TENSILE PROPERTIES OF PLASTIC

This test method covers the determination of the tensile properties of unreinforced and reinforced plastics in the form of standard dumbbell-shaped test specimens when tested under defined conditions of pretreatment, temperature, humidity, and testing machine speed. This test method is applicable for testing materials of any thickness up to 14 mm (0.55 in.). However, for testing specimens in the form of thin sheeting, including film less than 1.0 mm (0.04 in.) in thickness, ASTM standard D882 is the preferred test method. Materials with a thickness greater than 14 mm (0.55 in.) shall be reduced by machining



FIG ASTM D638 BAMBOO FIBRE SAMPLE



FIG ASTM D638 COTTON FIBRE SAMPLE

XI. TENSILE STRENGTH & ELONGATION (SINGLE DIRECTION)

Ultimate tensile strength (or just tensile strength for short) is an important property of materials to determine their mechanical performance. **It is the ability of a material to resist tearing due to tension.** This parameter applies to all types of materials such as wires, ropes, metal beams, etc.

11.1. ULTIMATE TENSILE STRENGTH STRESS STRAIN CURVE

There are 4 major regions that a stress-strain curve can be divided into:

11.1.1. PROPORTIONAL LIMIT

In the proportional limit, the specimen material acts like a spring and any strain caused is completely reversible. On the stress-strain curve, this area is called the Hooke's region. The reason lies with the applicability of Hooke's Law for forces that fall into the area.

1.1.2. YIELD LIMIT

As soon as the specimen passes the proportional limit, it enters the yield limit region. At this point, permanent deformation sets in. From this point on, it doesn't matter if you release the tensile force or apply a force in the opposite direction, the specimen will not return to its original dimensions.

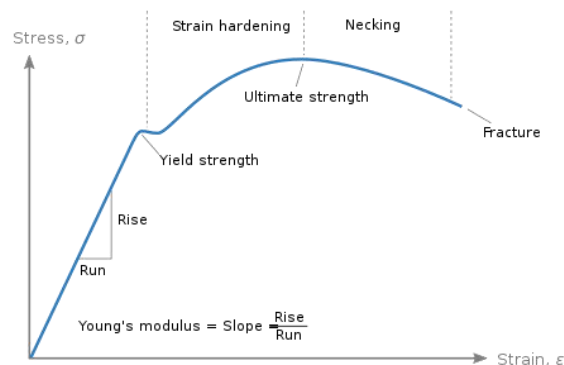
11.1.3. STRAIN HARDENING REGION

On further increasing the tensile stress, the specimen enters the strain hardening region. This is a very unique section because you are changing the crystal structure of the material. The material is under enough stress that its very microstructure is modified. As the name suggests, the material becomes harder and tougher. This hardening can be very useful and so it is not necessarily a bad thing (cold hardening, cold forming processes actually use this region to impart strength to the workpiece).

11.1.4. NECKING REGION

Right before entering the necking phase, the material is the strongest it will ever be. We have strain hardened it to its maximum limit. When we enter the necking phase, the material starts to get weaker. It is characterized by a local reduction in cross-section. Beyond this point, the material is only moving towards failure. It can handle less stress with increasing strain. We can sort of go back to the original equation that says stress is equal to force per unit area and infer that the smaller the area, the higher the stress. The material moves beyond this point until rupturing.

11.2. ULTIMATE TENSILE STRENGTH ON THE CURVE



The point that separates the strain hardening region and the necking region is the ultimate strength for that material. At this point, the maximum amount of strain hardening has taken place. The material is handling the highest amount of load it can handle safely.



11.3. WHY IS TENSILE STRENGTH IMPORTANT?

It is imperative to know the tensile strength of a particular metal or any material to ensure it is the right choice for an application. This ensures an incident-free service life. The results of choosing materials with lower tensile strength than what the application demands can be disastrous. Engineers turn to **yield strength in the design phase** to make sure the stress never reaches any higher than that. Otherwise, the structure suffers permanent deformations. But **ultimate tensile strength** tells us the value that is necessary for complete failure and breaking. Thus, a roof construction that comes under more stress because of a higher than normal snow load may bend the structure. At the same time, surpassing the tensile strength value means that the roof may fall in.

11.4 UNIVERSAL TESTING MACHINE

A **universal testing machine (UTM)**, also known as a **universal tester**,^[1] **materials testing machine** or **materials test frame**, is used to test the tensile strength and compressive strength of materials. An earlier name for a tensile testing machine is a **tensometer**. The "universal" part of the name reflects that it can perform many standard tensile and compression tests on materials, components, and structures (in other words, that it is versatile).

TENSILE STRENGTH & ELONGATION (SINGLE DIRECTION)

12. TEST RESULT

12.1. COTTON FIBER

SR NO	SAMPLE NAME	STRENGTH	ELONGATION
1	Cotton 01	1709.6 N	4.40%
2	Cotton 02	1536.9 N	3.15%
3	Cotton 03	1762.9 N	3.99%
4	Cotton 04	1724.1N	4.13%
5	Cotton 05	1613.2 N	3.43%
6	Cotton 06	1785.9 N	4.97%
7	Cotton 07	1839.7 N	5.44%
8	Cotton 08	1511.1 N	4.03%
9	Cotton 09	1591.6N	4.92%
10	Cotton 10	1665.1 N	4.55%

12.2. BAMBOO FIBER

SR NO	SAMPLE NAME	STRENGTH	ELONGATION
1	Bmboo 01	608.9 N	1.85%
2	Bmboo 02	974.8 N	4.35%
3	Bmboo 03	1023.5N	3.29%
4	Bmboo 04	1189.6 N	3.13%
5	Bmboo 05	1169.5 N	3.02%
6	Bmboo 06	1006.6 N	3.21%
7	Bmboo 07	1068.9 N	2.62%
8	Bmboo 08	601.3 N	2.01%
9	Bmboo 09	1087.6 N	4.01%
10	Bmboo 10	1119.4 N	4.33%

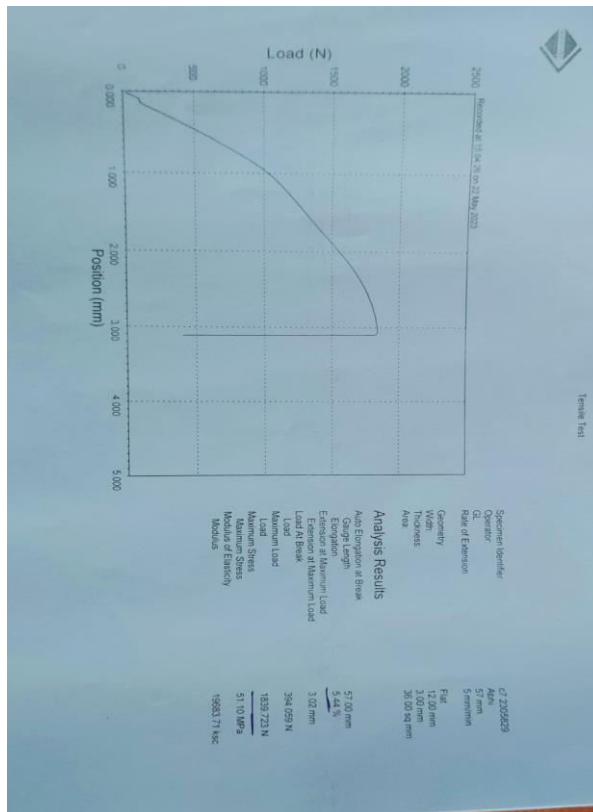


FIG COTTON FIBER LOAD VS POSITION GRAPH

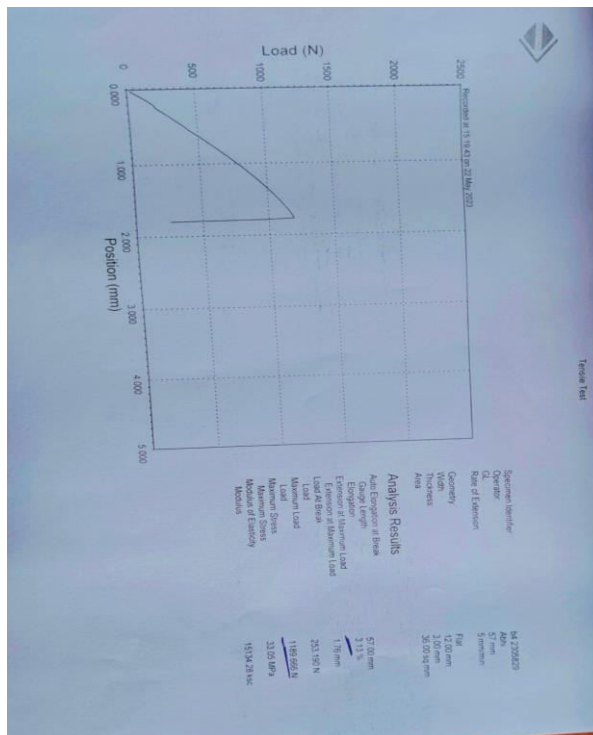


FIG BAMBOO FIBER LOAD VS POSITION GRAPH

XIII. CONCLUSION

The investigation done on the tensile strength of bamboo fiber and cotton fiber reinforced composites gives us the following conclusions:

- └ It is possible to make composite plate for a wide variety of loading conditions with variation in fiber length
- └ The main parameters that determine a plate's properties are the fibers length and resin and fiber wt %
- └ The fiber percentage in cotton is inversely proportional to the tensile strength up to a degree. Taking into consideration the wide variety in properties available in natural fiber composites truly will be the material of the future and since there is limited study done on natural fiber composites we have till now established the tensile strength values for bamboo and cotton fiber reinforced composite now subsequently we will work on the carryover of properties of individual when put in a composite to establish optimal value of tensile strength when the following two natural fibers are mixed thus analyzing the trend of change of tensile strength in a natural fiber composite plate with the variation in the fiber percentage for a given epoxy resin percentage and looking for a trend in carryover of property in case of bamboo and cotton

REFERENCES

1. <https://www.skyfilabs.com/project-ideas/fabrication-of-glass-hybrid-fiber-epoxy-composite-material-using-hand-layup-method>
2. <https://www.scribd.com/document/500624320/>
3. <https://www.studocu.com/in/document/chandigarh-university/aerospace/original-report-of-cu/39730394>
4. https://www.google.com/search?q=tensile+strength+elongation+single+direction&rlz=1C1YTUH_enIN1027IN1027&oq=&gs_lcrp=EgZjaHJvbWUqCQgBECMYJxjqAjIJCAAQIxgnGOoCMgkIARAJGccY6gIyCQgCECMYJxjqAjIJCAMQIxgnGOoCMgkIBBAJGccY6gIyCQgFECMYJxjqAjIJCAYQIxgnGOoCMgkIBxAJGccY6gLSAQxOTk1ODMyMWowajE1qAIIsAIB&sourceid=chrome&ie=UTF-8
5. <https://www.instron.com/en-in/testing-solutions/astm-standards/astm-d638#:~:text=ASTM%20D638%20is%20the%20most,mechanical%20strength%20of%20their%20materials.>



INNO SPACE
SJIF Scientific Journal Impact Factor
Impact Factor: 8.423



ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

9940 572 462 6381 907 438 ijirset@gmail.com



www.ijirset.com

Scan to save the contact details