



# AN INVESTIGATION ON MECHANICAL CHARACTERIZATION OF SANDWICH COMPOSITES

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## ABSTRACT

In the current work, an experimental inquiry has been conducted to examine the impact of adding bamboo fibers to recycled High Density polyethylene at varying weight percentages (2.5%, 5%, 7.5%, 10%, and 12.5%). This work focuses on mechanical properties of recycled high density polyethylene by modifying it with bamboo fibers. We prepare sandwich composites of different weight percentages of bamboo fiber with high density polyethylene and their impacts on mechanical properties are examined. The findings of mechanical tests indicate that the best mechanical qualities are obtained with 7.5 % weight percentage of mixed recycled high density polyethylene that contains bamboo fiber. The tensile, flexural, and impact properties of recycled high density polyethylene have been enhanced by the inclusion of bamboo fibers. The recycled high density polyethylene modified with 7.5 % bamboo fiber is shown to be superior to other combinations based on the overall study.

**Keywords:** Bamboo fiber, rHDPE, Tensile Strength, Flexural Strength, Impact Strength, Compressive Strength, RHBF.

## I- INTRODUCTION

India has concentrated on creating natural fiber composites to investigate value-added uses because of its abundant natural fiber resources, which include jute, pineapple, bamboo, and bananas. These natural fiber composites are perfect for replacing wood in the construction and housing sectors. To prevent forest resource depletion and ensure profitable returns for natural fiber farming, India has adopted a two-pronged strategy for developing these composites. Initially, advancements in composite materials catered to the aerospace industry's demands. Over time, these advancements have extended to household and industrial applications. Composites have emerged as a superior material, surpassing traditional materials like metals and wood due to their lightweight, high strength-to-weight ratio, and stiffness. Worldwide, material scientists have concentrated on natural composites reinforced with jute, pineapple, and other fibers to primarily reduce raw material costs. Sandwich composites have garnered significant attention in various industries, including aerospace, owing to their superior strength-to-weight ratio, formability, and thermal insulation properties. These structures typically consist of two thin, stiff face sheets bonded to a thick, lightweight core, resulting in a structure that exhibits exceptional bending stiffness and low weight. The design of sandwich composites involves the careful selection of materials for both the face sheets and the core, as the combination of these components significantly influences the overall mechanical behavior of the structure.

### A-Definition of composite

The definition that is most commonly applied is as follows, as described by Dicker et.al. "Composites are multipurpose material systems that offer properties that no separate material can match. These are harmonious constructions created through the physical fusion of two or more suitable elements that vary in composition, properties, and occasionally form. This definition's flaw was that it allowed any mixture of materials to be categorized as a composite without specifying its specificity or the laws that should apply to it to set it apart from other extremely commonplace, meaningless mixtures. [1] makes it very evident that composites are more than just two materials combined. Within a wider context, the amalgamation possesses unique characteristics of its own. It is either significantly different from each of the parts alone or superior to both of them together in terms of strength, heat resistance, or another desired attribute. [2] Bhong describes as "The composites are compound materials which differ from alloys by the fact that the individual components retain their characteristics but are so incorporated into the composite as to take advantage only of their attributes and not of their short comings" in order to create better materials. [3] characterizes composite substances as heterogeneous materials made up of two or more solid phases which are closely interacting on a microscopic level. On a microscopic level, they can also be thought of as homogeneous materials since every part of them will have the same physical characteristics. [4]

## B- Features of the composites

Composites consist of a continuous phase mixed with one or more discontinuous phases. The continuous phase is called the "matrix," while the discontinuous phase—which is frequently stronger and tougher than the continuous phase—is referred to as the "reinforcement" or "reinforcing material." The properties of composites are greatly influenced by the qualities of the composite components, their distribution, and their interactions with each other. The composite attributes could be the volume fraction total of the separate properties of the parts, or the elements could combine to produce better or superior features.

The form, size, and distribution of the reinforcement's geometry have a significant impact on the composite's qualities in addition to the makeup of the component parts. The characteristics are also influenced by the reinforcement's orientation and concentration distribution. The interfacial area is determined by the discontinuous phase's shape, which can be spherical, cylindrical, or rectangular cross-sectioned prisms or platelets. The volume fraction, size, and size distribution of the discontinuous phase also play a significant role in determining the degree of interaction between the reinforcement and the matrix. Concentration, which is typically expressed as a volume or weight fraction, indicates how much of an individual component goes into the overall characteristics of the composites. It is not just the single most significant factor affecting the composites' characteristics, but it is also a readily adjustable production variable that can be utilized to change those characteristics.

## C- The constituents of a composite material

A composite material, in its most basic form, is one that is made up of two or more elements that combine to provide material properties that differ from the individual attributes of those constituents. The majority of composites that are used in practice are composed of a bulk material called the "matrix" and some sort of reinforcement that is added mainly to give the matrix more strength and stiffness.

**Matrix** - When in a fibrous form, many materials show excellent strength properties; but, in order to obtain these qualities, the fibers need to be linked together by an appropriate matrix. In order to stop abrasion and the development of new surface imperfections, the matrix separates the fibers from one another and serves as a bridge to keep them in place. An optimal matrix should have the capacity to yield to applied load with ease, transmit the load to the fibers, and distribute stress uniformly.

**Reinforcement**- Increasing the mechanical characteristics of the plain resin system is the primary function of reinforcement in composite materials. The many fibers that are used to make composites each have unique qualities that have an impact on the composite's characteristics. In the majority of applications, handling is made possible by the fibers being arranged into a sheet, or fabric. Variations in the methods used to put together fibers into sheets and the range of orientations that can be used to achieve various properties.

**Interface**- It possesses qualities that none of the components alone can capture. An interface, thus, is a boundary or zone that experiences a discontinuity of any kind, be it chemical, mechanical, physical, etc. The fibers need to be "wet" by the matrix material. The area of the interaction surfaces is increased by well "wetted" fibers. The applied load must be efficiently transferred from the matrix to the fibers via the interface for a composite to have the desired characteristics. This indicates that a large interface with robust fiber-to-matrix adhesion is required. Debonding, or failure at the interface, may or may not be desired.

## II- LITERATURE REVIEW

Over the past 20 years, composites have attracted a lot of attention and many researchers are researching in this topic. It becomes crucial to talk about the well-known studies on polymer composites and their characteristics.

The literature review's two main goals are to highlight the importance of the current study and to give background knowledge on the topics this paper will be discussing. A number of polymer composite-related factors have been taken into consideration in relation to their creation and characterization. A review of the body of research on the physical and chemical characteristics of composites has been conducted, with a focus on the mechanical characteristics. The need and goals of the current effort have been outlined by presenting the knowledge gaps from the previous investigations.

### A- Bamboo fiber reinforced polymer composites

In recent years, scientists and engineers have become increasingly interested in natural fiber reinforced polymer composites as a means of creating environmentally beneficial materials.

[Keya et. al. 2019][5] These materials have a high specific strength and modulus, are inexpensive, easily obtainable, and recyclable. It is well known that natural fibers have non-uniform cross sections, which distinguishes their structures from those of man-made fibers like carbon, glass, etc.

[Oliveux et. al. 2012][6] Numerous researchers have examined natural fibers that contain polyester, epoxy resins, polyolefins, and polystyrene. These composites' unique selling factors include qualities like low cost, lightweight, high specific strength, and lack of health hazards. Although natural fibers' weak interfacial interaction with hydrophobic polymers is caused by the presence of hydroxyl and other polar groups, interfacial treatment can greatly enhance these characteristics.

[Nunez et. al. 1994][7]Bamboo fiber is a promising option among the different types of natural fibers for usage in composite materials. Tensile strength of bamboo-fiber reinforced plastic (BFRP) composite is comparatively equal to that of the mild steel, whereas their density is only 12% of that of the mild steel. Hence, the BFRP composites can be enormously useful in structural applications.

[Fei et. al. 2005][8] have investigated that a uniform strength can be achieved in all directions of the composites by using multidirectional compass reading of fibers. Considerable attention has been generated in the manufacturing of thermoplastic composites due to their good rupture toughness and thermal constancy .

[Naik et. al. [2008][9] With more tough demands for recycling standards, thermoplastic polymers are substituting thermosetting polymers as matrix materials for high volume consumer-driven composites . Materials made of thermoplastic matrix composites provide a wider range of uses in the building, automotive, and home/urban furnishings industries as well as in electrical appliances.

[Saba et. Al. 2014][10] In today's modern world, bio-degradable resins have drawn a lot of interest as environmentally friendly materials. Following perfect biodegradation by microorganisms, they can be resolved in both water and carbon dioxide, posing relatively minimal environmental burden. The majority of biodegradable resins, however, are not very strong, which makes them

unsuitable for structural applications requiring great strength. As a result, a lot of research is being done to improve biodegradable resins by mixing them with natural fibers like pineapple, hemp, bamboo, etc.

## B-Mechanical properties of composites

### Literature Review on the Mechanical Properties of Bamboo Fiber

Bamboo fiber has gained significant attention in various fields of engineering and material science due to its remarkable mechanical properties, environmental benefits, and potential as a sustainable alternative to synthetic fibers. This literature review focuses on the key mechanical properties of bamboo fiber, including tensile strength, flexural strength, modulus of elasticity, and other relevant characteristics.

#### 1. Tensile Strength

Tensile strength is a critical mechanical property, indicating the ability of a material to withstand pulling forces without breaking. Several studies have investigated the tensile strength of bamboo fiber:

Variation in Tensile Strength: Bamboo fiber exhibits a high tensile strength compared to many natural fibers.

Researchers such as [Chan et. al. 2007][11] found that the tensile strength of bamboo fiber ranges from 140 MPa to 800 MPa, depending on factors such as species, extraction method, and fiber treatment. This wide range highlights the inherent variability in bamboo fiber properties.

**Effect of Treatment:** Various chemical and physical treatments, such as alkali treatment, have been shown to enhance the tensile strength of bamboo fibers by improving fiber-matrix adhesion and reducing the fiber's lignin content. Studies by Correal et.al. 2022][12] suggest that alkali-treated bamboo fibers demonstrate superior tensile strength compared to untreated fibers.

#### 2. Flexural Strength

Flexural strength, which measures a material's ability to resist deformation under load, is another key mechanical property relevant for structural applications.

- **Bamboo Fiber Reinforced Composites:** Research by [Mousavi et. al. 2022][13] examined the flexural strength of bamboo fiber-reinforced polymer composites, finding that the addition of bamboo fibers significantly enhances the flexural properties. The strength depends on factors such as fiber orientation, length, and the resin matrix used in the composite.
- **Effect of Fiber Alignment:** The alignment of bamboo fibers in the matrix plays a crucial role in determining flexural strength. Aligned bamboo fibers show better flexural performance compared to randomly oriented fibers due to the uniform distribution of stress along the fiber length.

#### 3. Modulus of Elasticity

The modulus of elasticity (MOE) describes a material's stiffness and ability to return to its original shape after deformation. Bamboo fiber's high modulus makes it suitable for load-bearing applications.

- **Comparative Stiffness:** Studies by [Liu et.al. 2012][14] demonstrated that bamboo fiber exhibits a higher modulus of elasticity than many other natural fibers like jute or sisal, with values ranging from 20 GPa to 40 GPa. This stiffness makes bamboo fiber-reinforced composites suitable for structural elements that require both strength and stiffness.
- **Influence of Fiber Orientation:** As with flexural strength, the orientation of bamboo fibers within a composite affects the modulus of elasticity. Longitudinally aligned fibers provide higher stiffness compared to randomly oriented fibers.

#### 4. Impact Resistance and Fracture Toughness

Bamboo fiber has also been studied for its impact resistance and fracture toughness, which are important for applications involving dynamic loading.

- **Energy Absorption:** Bamboo fibers have been found to absorb more energy before failure than synthetic fibers like glass, making them ideal for impact-resistant applications. This characteristic is particularly evident in bamboo fiber-reinforced polymer composites, which have been shown to outperform some traditional materials in terms of energy dissipation during impact loading. [Mohd. Bakhori et.al. 2022][15]
- **Fracture Mechanisms:** Studies suggest that the fracture behavior of bamboo fibers is governed by a combination of fiber pull-out, matrix cracking, and fiber-matrix debonding. These mechanisms contribute to the toughness of bamboo fiber composites, making them suitable for applications where crack resistance is crucial.

#### 5. Moisture Absorption and Environmental Factors

While bamboo fiber has many mechanical advantages, it is susceptible to environmental factors such as moisture absorption, which can negatively impact its mechanical properties.

- **Effect of Moisture:** Research has shown that bamboo fiber tends to absorb moisture, which can reduce its tensile and flexural strength over time [Mohammed et.al.2022][16]. However, the use of surface treatments such as silane coupling agents and resin impregnation can mitigate these effects, enhancing the durability of bamboo fiber-reinforced composites in humid conditions.
- **Thermal Degradation:** Bamboo fibers are also sensitive to high temperatures, which can cause thermal degradation, leading to a loss of mechanical properties. However, thermal stability can be improved through chemical treatments or by using bamboo fibers in hybrid composites with more thermally stable fibers like carbon or glass.

## 6. Applications and Future Research

Bamboo fibers are increasingly being used in various sectors, such as construction, automotive, and packaging, due to their excellent mechanical properties and eco-friendly nature. For example, bamboo fiber-reinforced composites are used in lightweight structural components, automotive interiors, and sustainable packaging solutions.

Future studies on bamboo fiber ought to concentrate on:

- **Hybrid Composites:** Combining bamboo fibers with synthetic fibers (e.g., glass or carbon) or other natural fibers could further enhance the mechanical performance while retaining sustainability benefits.
- **Durability Studies:** Long-term studies on the durability of bamboo fiber-reinforced composites, especially in extreme environments, are necessary to expand their application scope.
- **Nano-enhancements:** The incorporation of nanomaterials, such as graphene or carbon nanotubes, could significantly improve the mechanical properties of bamboo fiber composites, particularly in terms of strength, toughness, and thermal stability.

Bamboo fiber exhibits excellent mechanical properties, including high tensile strength, flexural strength, and stiffness, making it a promising material for various engineering applications. However, challenges such as moisture absorption and thermal degradation must be addressed to fully harness its potential. Further research into treatment methods, hybrid composites, and durability studies will be essential for expanding the application of bamboo fiber in sustainable materials.

## III-MATERIAL PREPARATIONS

The development of new materials begins with raw materials, and the quality of the new material itself depends on the raw resources. The role of characterization techniques to guarantee the quality of the novel materials and processing techniques to create them follows. The materials and processing techniques employed for each of the composites under examination are described in this section. In terms of the mechanical characteristics of the composite samples being studied, it provides the specifics of the characterization methods. This section explains the mechanical characteristics of the materials used in sandwich composite casting. The technique utilized to ascertain the mechanical property covered in this section

### A. Material

The next section discusses the ingredients used to create the biocomposite, including the matrix, reinforcing material, that are utilized to recycled high density polyethylene.

#### 1. Matrix material

The substance that retains the reinforcing material's relative position is called matrix material. It dominates the composites' overall durability, form, surface appearance, and environmental tolerance.

#### 2. Recycled High Density Polyethylene

The strong strength and mechanical adhesiveness of recycled high density polyethylene make it suitable for a variety of industrial uses. Recycled high density polyethylene is good polymer matrix and it has good chemical resistance over a wide range of temperature. In the present investigation recycled high density polyethylene of the compression moulding grade P100 purchased from Maheshwary polymer vruksha composite Andhra Pradesh. According to the provider. Its density is 0.953 g/cm<sup>3</sup>, and its melt flow index (MFI) is 2.1 g/10min (190 °C/2.16 kg). The physical & chemical properties of recycled high density polyethylene are given in table-1.

**Table-I Physical and chemical properties of recycled high density polyethylene**

Recycled high density polyethylene	
Physical Properties	Green small drum, odourless, solid and completely nontoxic
Chemical Properties	Recycled HDPE has resistance to alcohols, bases, acids, and esters, both concentrated and diluted. Hydrocarbons that are aromatic and chlorinated cause it to lose resistance. Recycled HDPE generally has lower Environmental Stress Cracking Resistance (ESCR) .

### 3. Reinforcing Element

The high density polyethylene's qualities are enhanced by the inclusion of reinforcing agents. Bamboo fibers are utilized as reinforcing agents to enhance the composite material's various qualities.

### 4. Bamboo fibers

In every composite, bamboo fiber has been utilized as a reinforcing material. These were gathered from Andhra Pradesh's Vuksha Composite. Bamboo is a member of the Bambusoideae family of grasses. The lignin matrix contains cellulose fibers, making it a naturally occurring lignocellulosic composite. Due to improvements in processing technology and rising consumer demand, bamboo, a naturally occurring composite material that grows abundantly in most tropical regions, has found widespread use in both industrial and home applications. Bamboo has been utilized in Asian nations for a variety of household items, including chairs, fishing rods, cricket boxes, woven mats, chopsticks, containers, and handicrafts. It is used in many different types of buildings, including trusses, windows, doors, flooring, ceilings, and fences. Further, it is used as a structural component for building scaffolding, bridges, and water transportation infrastructure. In the first year, bamboo grows quite quickly, and after five years, it stops growing altogether.



Fig.1 Bamboo fiber

## B-Methodology

### Preparation of sandwich composite

First we prepared sandwich composite at different weight percentages of recycled high density polythene and bamboo fiber. For this, first we took a bamboo fiber into 14 mesh size and then applied grease to the mold. This fiber was then placed between the two equally weighed amounts of matrix material along with the particle reinforcement to create a sandwich like composite structure. The mold was then inserted into the mold cavity of compression molding machine and heated for about 220 °C for about 30 minutes, with inserting pressure of 130 Kg / cm<sup>2</sup>. After a curing period of 30 minutes, the mold was taken out, cooled to room temperature and the composite sheet prepared was carefully removed.

Table II. Optimization of rHigh-density polyethylene composite with Bamboo Fiber

Designation of Composition		Tensile Strength	Flexural Strength	Impact Strength	Compressive Strength	
	rHDPE Wt%	B.F. Wt %				
<b>RHBF0</b>	100	0	22.734	14.548	24.668	88.356
<b>RHBF1</b>	97.5	2.5	26.132	15.476	25.568	86.717
<b>RHBF2</b>	95	5	29.565	17.413	27.477	85.135
<b>RHBF3</b>	92.5	7.5	32.997	20.349	28.385	83.477
<b>RHBF4</b>	90	10	36.434	19.286	26.294	81.972
<b>RHBF5</b>	87.5	12.5	35.862	17.223	24.202	78.387

## IV. RESULTS AND DISCUSSIONS

### A. Mechanical Properties

#### 1. Tensile Test

The tensile properties of the bamboo fiber with recycled high density polythene composite were determined by Instron model 3382 Universal Testing machine and by following the ASTM D 638 standard (Standard Test Procedure for Evaluating Plastics' Tensile Properties). The results are presented in figures 2.

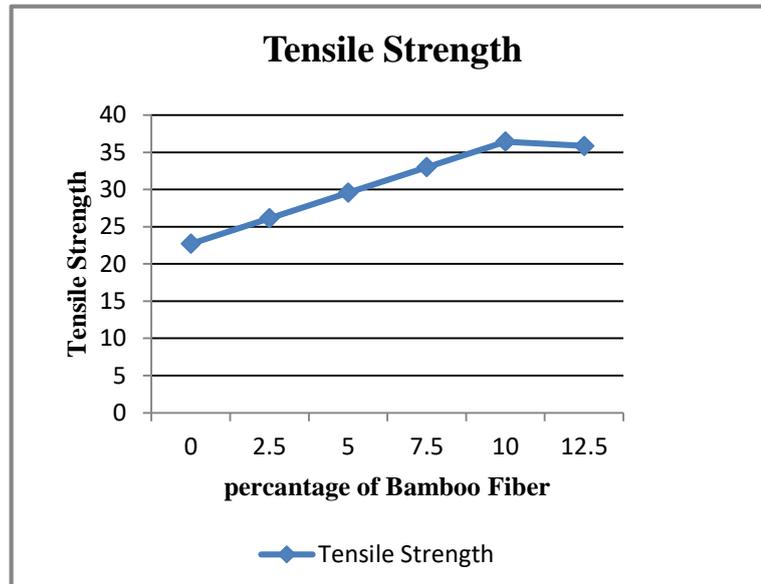


Fig.2 Stress-strain diagram for different wt% of bamboo fibers

The tensile stress-strain curve for unfilled recycled high density polythene with bamboo fiber composite material containing 2.5, 5, 7.5, 10 and 12.5 wt% bamboo fibers is shown in the figure 2.

The variations in tensile strengths of the composites are shown in Fig.2. The tensile strength of the bamboo- Recycled high density polythene composites decreases at 12.5 wt% fiber loading. This decrease in tensile strength is due to the maximum void contents and weak interfacial adhesion in case of composites i.e. when the material is stressed in tension test it tends to stretch and when the material elongates the bond between bamboo fibers and recycled high density polythene weakens and leads to the loosening of bamboo fibers and leads to fracture of material.

## 2. Flexural Test

The flexural properties have a very important role in structural applications. Flexural properties are a good measure of bending properties of brittle materials including composites. Flexural Test is considered to be more sensitive in sensing minute changes in the structure of a material [17]. It was measured in an Instron Machine Model 3382 following the ASTM D 790 (Test Method for Flexural Properties of Plastics) The flexural properties obtained at different weight percentage of bamboo fibers have been shown in figures, 3 . The effect of wt% of bamboo fibers on flexural strength is shown in figure 3.

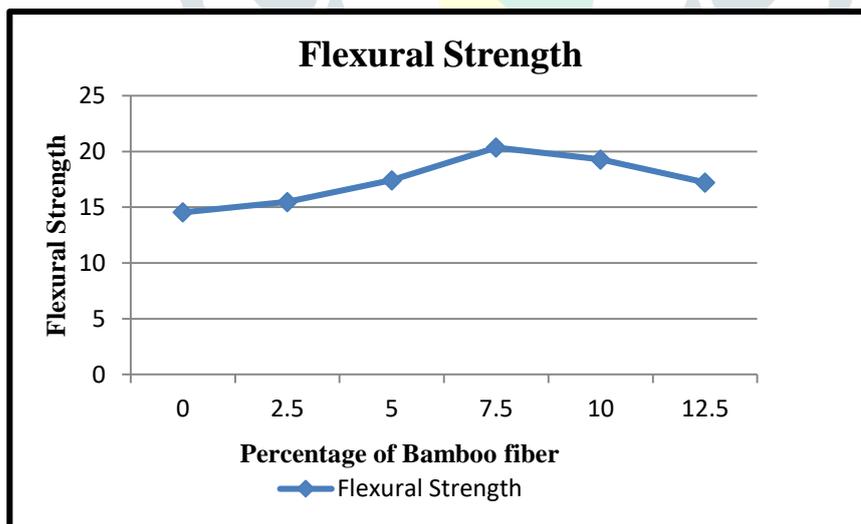


Fig.3 Effect of bamboo fiber (wt %) on flexural strength

It is observed that flexural strength decrease with an increase in bamboo fiber 10 wt% in recycled high density polythene. It is observed that flexural strain first increase with an increase in bamboo fiber 7.5 wt% in recycled high density polythene and then decreases with an increase in 10 wt% from fig.3.

## 3. Impact Test

Impact Strength or impact toughness is the amount of energy that a sample can up hold when unexpected load is placed on it. When the amount of energy a sample can hold exceed beyond its threshold point, material fractures or breaks and it can be said that the Impact Energy of the material is exceeded. Most commonly it is said that higher the toughness, higher is the Impact strength of the material under study. Table 2 displays the outcomes of the impact testing. Impact strength with varying weight percentages of bamboo fibers is displayed in Fig. 4.

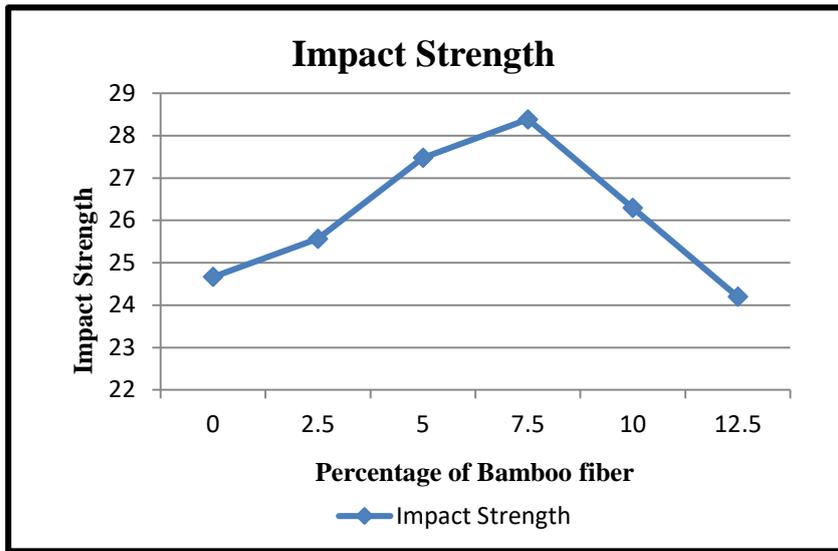


Fig.4. Effect of wt% of bamboo fibers on impact strength

It is observed that Impact strength decrease with an increase in bamboo fiber 10 wt% in recycled high density polythene. It is observed that impact strength increase with an increase in bamboo fiber 7.5 wt% in recycled high density polythene and then decreases with an increase in 10 wt% from fig.4.

#### 4. Compressive Test -

Compressive strength measures how a material behaves when it is compressed or crushed by applying pressure. A relatively low and uniform compressive load is applied to check the feasibility of specimen strength. Resulting effect may be either fracture or breakage or the sample may even deform permanently. Compressive strength is an important strength determining property in case of concrete materials which generally have higher compressive strength than composites.

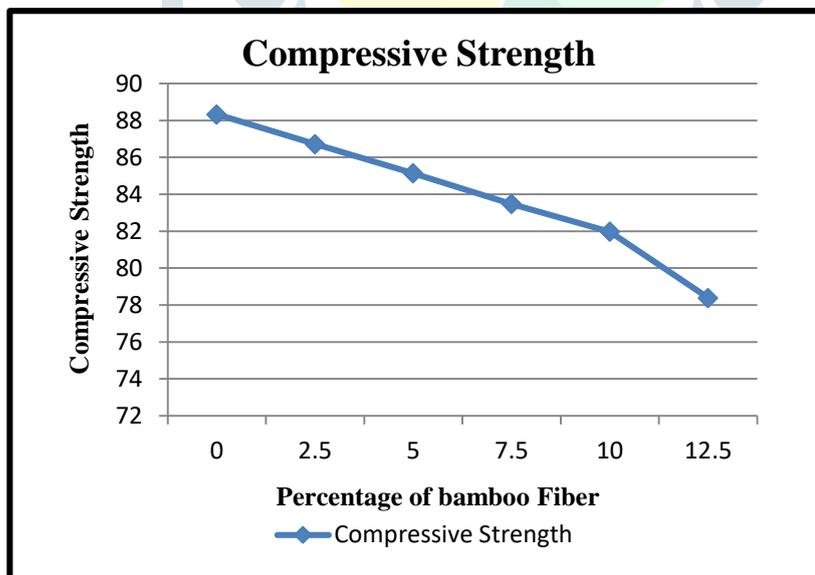


Fig.5. Effect of wt% of bamboo fibers on compressive strength

It is observed that Compressive strength decrease with an increase in bamboo fiber wt% in recycled high density polythene from fig.5.

#### V. CONCLUSIONS

Recycled high-density polythene composites bonded with bamboo fibers have been prepared with different fiber percentages (2.5%, 5%, 7.5%, 10%, and 12.5%). The compression molding technique, which is among the most straightforward ways to prepare composites under typical circumstances, was used to prepare the composites. The experimental analysis has shown that bamboo fiber

reinforcement in the recycled high density polythene matrix has improved the mechanical properties of composite structure. The fiber and matrix are properly bonded in the high-quality composites that are produced. The composites' tensile, flexural, and impact strength have all increased due to increased fiber loading, but their compressive strength has decreased, according to fiber variations. Inadequate interfacial bonding also creates partial gaps between the matrix material and the fiber, which makes the structure fragile. The impact strength of composites also rose until 7.5 % fiber loading, after which it fell at 10 % fiber loading. The micro-spaces between the fiber and matrix polymer caused a reduction in impact strength at 10 % fiber loading. This led to many micro-cracks when impact happened, making it easier for cracks to spread and reducing the impact strength of the composites.

The following findings are the result of the current work's analytical and experimental investigation:

- Recycled High density polythene based composite materials reinforced with bamboo fibres have been successfully fabricated by simple compression molding techniques.
- Research has shown that the NaOH-treated fibers utilized in the composites have a significant impact on their mechanical qualities, including their tensile, flexural, and impact strengths.
- The mechanical properties such as tensile strength, flexural strength, and impact strength of bamboo- rHDPE composites are found to be superior as compare to the neat rHDPE composites.
- Excess of fibres in composite materials deteriorate the mechanical properties of the composite because of lack of proper bonding between the matrix and fiber around their interface. This causes the disruption in transfer of load to the bonding fibres. Lower values of impact strength and flexural strength at higher composition of bamboo fibres may be because of this reason.

## VI. RECOMMENDATIONS

Engineers and manufacturers are constantly searching for new materials and enhanced production techniques to employ in the production of superior goods and so boost their profit margin. The created composites are a very sustainable resource and a good alternative to many petroleum-based items. Cheap density, cheap cost, recyclable, biodegradable, minimal abrasive wear, CO<sub>2</sub> neutral, and environmentally beneficial are just a few of its many benefits. There are several uses for natural fiber composites in the automotive, construction, marine, electronic, and aerospace industries. A novel class of bio-fiber reinforced composites known as bamboo rHDPE composites has potential uses in:

- Conveyor belt rollers
- Passenger seat frames (replacing wood/steel) in railway coaches / automobiles
- Household furniture and also as low cost housing materials.
- Trim parts in dashboards
- Door panels and Seat Cushions
- Backrests and Cabin linings

## VII. FUTURE SCOPE OF WORK

Given the current environmental concerns, there is a lot of research potential for bamboo-rHDPE composites. There are several ways in which the current thesis's work can be expanded. In light of the raw materials, the composites in this study were made using unidirectional short bamboo fibers. Bidirectional bamboo, on the other hand, can also be utilized in the composites as reinforcement. One of the variables in the composite production process is fiber length, and its impact on the mechanical, chemical, and erosive properties can be investigated. The bamboo-based polymer composites can also use other thermosetting polymers, such as polyester, polyurethane, and thermoplastics, such as polypropylene, as resins.

As far as the fabrication method is concerned, the compression molding method has been used for fabrication of composites in the present work. It is advised that injection molding be used to create composite test samples since it is more accurate and minimizes human error. Another interesting issue to research is how chemicals affect the mechanical characteristics of composites. It is possible to investigate the wear behavior of bamboo rHDPE composites as well as other chemical characteristics like moisture absorption and swelling behavior.

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