# NAGARJUNA COLLEGE OF ENGINEERING AND TECHNOLOGY

(An Autonomous College under VTU, Belagavi)

A Project Report

on

# "STUDIES ON MECHANICAL PROPERTIES OF OVEN JUTE WITH GRAPHENE RESIN COMPOSITION"

submitted in partial fulfillment for the award of the degree in

**BACHELOR OF ENGINEERING**

**IN**

**MECHANICAL ENGINEERING**


Submitted by

| | |
|---|---|
| Mr. BALRAJ T M | (1NC16ME012) |
| Mr. BHARATH R G | (1NC16ME014) |
| Mr. BHARATH A H | (1NC16ME013) |
| Mr. SUDARSHAN M N | (1NC16ME096) |

Under the guidance of

Ms. ANUPA R

Assistant Professor

**DEPARTMENT OF MECHANICAL ENGINEERING**

**NAGARJUNA COLLEGE OF ENGINEERING & TECHNOLOGY**

**(An Autonomous College under VTU, Accredited by NAAC with "A" Grade)**
**Devanahalli, Bengaluru-562164**


**2019-2020**

# NAGARJUNA COLLEGE OF ENGINEERING & TECHNOLOGY

**(An Autonomous College under VTU, Accredited by NAAC with "A" Grade)**
**Bengaluru-562164, Karnataka, India**

**DEPARTMENT OF MECHANICAL ENGINEERING**

# CERTIFICATE

This is Certified that the project work entitled **"STUDIES ON MECHANICAL PROPERTIES OF OVEN JUTE WITH GRAPHENE RESIN COMPOSITION"** carried out by **Mr. BALRAJ T M (1NC16ME012), Mr. BHARATH R G (1NC16ME014), Mr. BHARATH A H (1NC16ME013), Mr. SUDARSHAN M N (1NC16ME096),** bonafide students of Nagarjuna College of Engineering and Technology, an autonomous institution under Visvesvaraya Technological University, Belagavi in partial fulfillment for the award of Bachelor of Engineering in **Mechanical Engineering** during the academic year 2019-2020. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the phase I Project Report deposited in the departmental library. The project work has been approved, as it satisfies the academic requirement in respect of project work prescribed for the said degree.

| **Name & Signature of the Guide** | **Name & Signature of the Coordinator** | **Name & Signature of the HOD** |
|---|---|---|
| **Ms. ANUPA R** | **Mr. AMARESH GUNGE** | **Dr. N. KAPILAN** |

**<u>EXTERNAL Viva-Voce</u>**

| Name of the Examiner | Signature with date |
|---|---|
| 1. ..... | ..... |
| 2. ..... | ..... |

# ACKNOWLEDGEMENT

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people who made it possible, whose consistent guidance and encouragement crowned our effort with success. we consider it is our privilege and duty to express our gratitude and respect to all those who guide us in the completion of this project work.

First and foremost, it's our immense pleasure to thank our beloved guide **Ms.ANUPA R,** Assistant Professor, Department of Mechanical Engineering, Nagarjuna College of Engineering and Technology, for helping, guiding and strengthening us to complete this project work.

We would like to thank our project coordinator **Mr. AMARESH GUNGE,** Associate Professor, Department of Mechanical Engineering, Nagarjuna College of Engineering and Technology, Bengaluru for his constant support and assistance at every stage.

We would like to express our sincere thanks to **Dr. N. Kapilan, Head of the Department,** Department of Mechanical Engineering, Nagarjuna College of Engineering and Technology for his valuable suggestions and guidance throughout the period of this project work.

We take this privilege to express our deep gratitude to **Dr. Srikanta Murthy K**, **Principal,** Nagarjuna College of Engineering and Technology for his constant support and encouragement in preparation of this report and for providing library and laboratory facilities needed to prepare this project report.

Last but not least, we would like to thank our parents, friends, teaching and non-teaching staff of Department of Mechanical Engineering, NCET.

| | |
|---|---|
| Mr. BALRAJ T M | (1NC16ME012) |
| Mr. BHARATH R G | (1NC16ME014) |
| Mr. BHARATH A H | (1NC16ME013) |
| Mr. SUDARSHAN M N | (1NC16ME096) |

# ABSTRACT

An attempt has been made to develop novel polymer based nano composite material reinforced with natural fibre, synthetic fillers at both micro and nano- levels with increased performance in terms of mechanical properties. This work involves development of a new nano-composite material consisting of L-12 epoxy resin, graphene at nano, hemp fibres at micro levels. The percentage composition of hemp fibres is varied from 0.3%, 0.5% and 0.7% by weight of the holding matrix, A fixed dosage of graphene nano particle of 0.3wt% of holding matrix is taken. A suitable surface modification method is employed for natural fibre treatment in order to adhere the nano-particles, this paper shall be dealing with the surface adhesion by corona method. Surfactants like NaOH and KMnO4 were applied on the fibres. Fibers used as a reinforcement with epoxy to form composite material to enhance the adhesion between the fillers and holding matrix alkalisation. To determine interferential adhesion and homogeneous distribution of fibres in the holding matrix Spectroscopic analysis such as Fourier transform infrared (FTIR) and scanning electron microscope (SEM) were conducted. Mechanical testing like tensile and three-point bending tests were carried out. Among the varied 0.5% of NaOH and KMnO4 treated hemp containing graphene has given optimistic results as compared to other dosage levels

# CONTENTS


| | | |
|---|---|---|
| **Acknowledgement** | | **i** |
| **Abstract** | | **II** |
| **Table of contents** | | **III** |
| **List of figures** | | **IV** |
| **List of tables** | | **V** |
| **List of graphs** | | **V** |
| **Chapter** | | |
| **No.** | **Title** | **Page no** |
| **1** | **INTRODUCTION** | **01-08** |
| | 1.1 An overview of composite material | 03-04 |
| | 1.2 Types of composite material | 04 |
| | 1.3 Metal matrix composite | 04 |
| | 1.4 Ceramic matrix composite | 05 |
| | 1.5 Polymer matrix composite | 05 |
| | 1.6 Classification polymer composite | 06 |
| | 1.7 Fibre reinforced polymer | 06-07 |
| | 1.8 Particle reinforced polymer | 07 |
| | 1.9 Advantage of natural fibre | 08 |
| | 2.0 disadvantages of natural fibre | 08 |
| **2** | **Literature survey** | 9-11 |

| | | |
|---|---|---|
| 3 | **Objectives** | 12 |
| 4 | Materials and methodology | 13-21 |
| | 4.2 Methodology | 12 |
| | 4.3 Mould preparation | 13 |
| | 4.4 Fabrication of composite laminates | 13-14 |
| | 4.5 Mechanical testing | 14-20 |
| | 4.6.1 Tensile test | 14-17 |
| | 4.6.2 Flexural test | 17 |
| | 4.6.3 impact test | 17-20 |
| 5 | **Result** | 22-24 |
| 6 | **Conclusion** | 25 |
| 7 | **Reference** | 26 |
| 8 | **Internship details** | **27-30** |

# LIST OF FIGURES


| Figure no. | Title | Page no. |
|---|---|---|
| 1.1 | Types of composite materials | 04 |
| 1.2 | Classifications of polymer composites | 06 |
| 1.3 | Classification of composite in view of fortification sort | 07 |
| 1.4 | Composite types | 07 |
| 4.1 | Methodology of composite work | 13 |
| 4.2 | Mould for composite preparation | 14 |
| 4.3 | Prepared composite laminated with marking | 16 |
| 4.4 | Tensile test specimens | 16 |
| 4.5 | Test specimen with UTM | 17 |
| 4.6 | Flexural test specimen | 19 |
| 4.7 | Specimen under bending attachment | 20 |
| 4.8 | Impact test specimen | 20 |
| 4.9 | Test specimen with impact izode test attachment | 21 |

# LIST OF TABLES


| Figure no | Title | Page no |
|---|---|---|
| 5.2 | Mechanical properties of treated fibre | 23 |


# LIST OF GRAPHS


| Figure no | Title | Page no |
|---|---|---|
| 5.3 | unmixed v/s % of concentration | 24 |

# CHAPTER 1
# INTRODUCTION

Materials considered exclusively as assurance routinely comes as free fills supported with foil or paper. The conventional outlining materials are surely not skilled to get the need of such uncommon properties, for example, fantastic, bring down thickness and lower leading property. The energy on an exceptionally fundamental level continuing, financially shrewd and light-weight protection materials is thus developing very much requested. Composite materials are supplanting conventional materials, as a result of their unrivaled properties, for example, high quality to-weight proportion, high mechanical quality and least warm extension. Glass fiber and banana fiber are the two fillers utilized as a touch of present examination fortified just in epoxy gum to convey two methodologies of composites by carefully assembled structure. The proposed model is then bolstered through testing that drove in controlled research focus circumstances.

As far as possible for attestation is to debilitate the sparkle stream and manage temperature. It fills in as a warmth opposing material and subsequently it keeps the distinctive contraptions and reliable articles which ought to be kept up at determined temperature go A warm security execution of the composites which gets influenced by the three sections, i.e. strong conductivity, gas conductivity, and warmth radiations. Natural fiber strengthened polymer composites turned out to be more appealing because of their high particular quality, lightweight, biodegradability, and environment warmth. Normal fiber mixed with fabricated fiber-reinforced polymer composites are finding extended applications. The goals for the insignificant exertion, on to mind boggling degree fundamental level ambitious, true blue and light-weight certification materials is thusly opening up all around asked. Arranged and focal both the fibers have dumbfounding confirmation mechanical properties.

In setting of this, the ebb and flow investigate has been attempted to deliver a move at the aftereffects of including the isolative short fibers the mechanical property of polymer gum. The present work concentrates on the inconvenience composites of epoxy tars. For this the banana strands and glass filaments are used for enhancing the farthest traverse. There are numerous components that can affect the execution of normal fiber fortified composites. Beside the hydrophilic method for fiber, the properties of the customary fiber braced composites can similarly be influenced by fiber content/measure of filler. At the point when all is said in done, high fiber substance is required to achieve tip top of the composites. In this way, the effect of fiber substance on the properties of normal fiber braced composites is particularly importance. It is much of the time watched that the development in fiber stacking prompts to an addition in tractable properties.

Another essential component that on a very basic level effects the properties and interfacial qualities of the composites is the get ready parameters used. Accordingly, suitable get ready techniques and parameters must be meticulously picked remembering the true objective to yield the perfect composite things. This article hopes to review the reported wears down the effects of fiber stacking, engineered medications, delivering strategies and process parameters on malleable properties of consistent fiber sustained composites. Trademark fiber polymer composites (NFPC) are a composite material including a polymer framework inserted with surprising reliable strands, similar to jute, oil palm, sisal, kenaf, and flax. For the most part, polymers can be sorted out into two portrayals, thermoplastics and thermo sets. The structure of thermoplastic framework materials includes potentially a couple dimensional sub-atomic, so these polymers tend to make gentler at a raised warmth range and move back their properties all through cooling. Then again, thermo sets polymer can beportrayed as fundamentally cross-related polymers which cured utilizing just warmth, or utilizing warmth and weight, furthermore light lighting up.

Thusly, legitimate process methods and parameters should be altogether picked with a particular true objective to get the best qualities of making composite. The blend bit of normal fibers moreover bigly influences the characteristics of the composite addressed by the rate of cellulose, hemicelluloses, lignin, and waxes.

## 1.1 An Overview of Composite Materials

A composite material can be delineated as a mix of no under two materials that results in favored properties over those of the individual pieces used alone. Rather than metallic reinforces, each material holds its contrasting blend, physical and mechanical properties. The vivifying time of the composites gives the quality and dauntlessness, to make them harder, more grounded and stiffer than the system. The support is customarily as a fiber or a particulate. The length-to-width degree is known as the point of view degree and can differentiate on a very basic level for strands in light of the way that the length of the fiber is altogether more detectable than its estimation. Unending strands have high viewpoint degrees, while irregular filaments have low perspective degrees, and the presentation of unsurprising fiber composites typically is flawless, while sporadic strands for the most part have a subjective presentation. Ceaseless fiber composites are oftentimes made into spreads by stacking single sheets of filaments in various associates with getting the fancied quality and quality properties with fiber volume as high as 60 to 70%. In light of present circumstances, the more minor the partition transversely over of the fiber, the higher its quality, in any case, the cost increments when the broadness persuades the chance to be unmistakably littler. What's more, humble estimation strands have more basic adaptability and are more reasonable to make techniques, for example, weaving or encompassing, over the hardness.

The consistent stage is the structure, which is a polymer, metal or mud. Polymers have low quality and immovability, metals have facilitated quality and quality

however high flexibility, and stoneware creation have high bore and life yet are delicate. Broken fiber composites are typically sporadic in approach which in a general sense decreases their quality and modulus. Notwithstanding, these composites are all around essentially less exorbitant than persistent fiber composites. In this way, consistent fiber composites are used where higher quality and quality are required even at a higher cost, and fanciful fiber composites are used where cost is the central driver and quality and quality are less important.

## 1.2 Types of Composite Materials

On commence of system material composite materials can be asked for into three parties. They are:

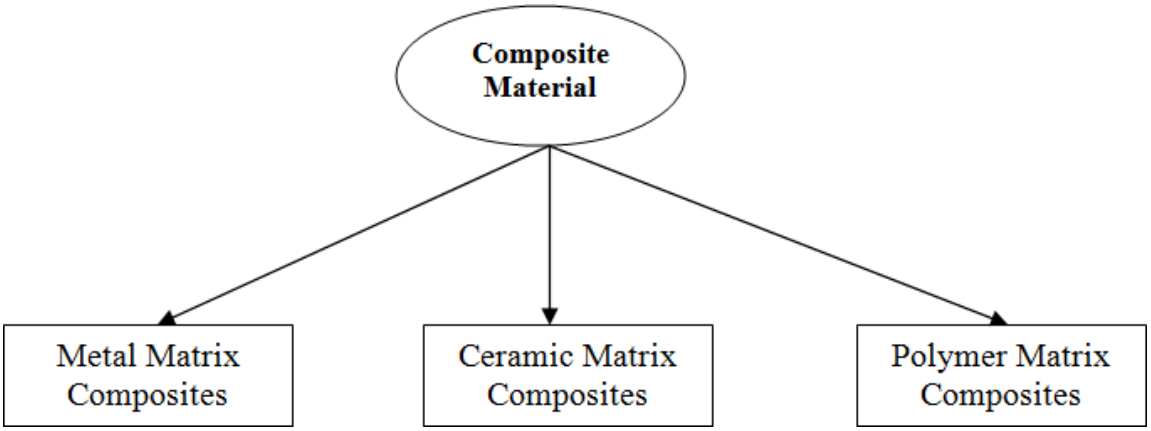



**Figure 1.1: -** Types of composite Materials.

### 1.2.1 Metal Matrix Composites (MMC)

Metal framework composites have many reasons for eagerness over strong metals, as higher specific modulus, higher specific quality, better properties at raised temperatures, and low coefficient of warm movement. Because of these qualities, metal structure composites are under thought for a broad gathering of usages. As gear bundling materials, the aluminum structure composites must be discovered for the consistent representation of use example which must be kept up by SiC molecule which is the warm upgrade of controlled coefficient. These are called the updated mechanical property which has distinctive potential flight advantages looking for

MMC. One more thing about this is that it is also having auto applications which are using these days widely in variety of fields and area to improve the matrix composite.

### 1.2.2 Ceramic Matrix Composites (CMC)

Pottery is depicted by touchy quality, hardness, separating and oxidation resistance and unrivaled lifted temperature properties. The blowing structure composites have a potential to use as a higher temperature as comparison of others polymer and we can say that metal framework composite and it has also not containing the distant diverse characteristics which is its natural property so far from the beginning. Focal mud structures are oxides, carbides, nitrides, borides, glasses, glass-soil creation and silicates. The supporting of material for improving mechanical properties are as strands, stubbles or particulates. These composites are facilitated by sintering, hot beating, hot isotactic crushing, catch, and reaction holding and start blend. One of the focal concentrations in passing on let go framework composites is to collect the robustness. Conventionally, it is trusted and purpose of actuality habitually found, that there is a modification in the quality and robustness of let go framework composites.

### 1.2.3 Polymer Matrix Composites (PMC)

There ought to be an event of the fortified plastics, the qualities of the looked for definite outcome, for instance, evaluate, shape, limit and fortify choose the system by which the essential materials are merged, framed, repaired and machined in each and every event. Faultless adornment handle for fortified plastics fuses handcrafted, sprinkle up trim, lay-up (vacuum pack and auto-clave molding), and crush framing (SMC, BMC and so on.), pitch implantation frivolity and fiber winding. The mechanical usages of fortified plastics have spread an extensive variety of client stock, improvements, compound plants, marine and road transportation and flight parts. Mechanical outlining things consolidate chambers, moves, shafts, coupling, axles; covering and so forth the

plane business used a broad assortment of things including floorboards, skin loads up, lifts, wings, folds, sharp edges.

## 1.3 Classifications of Polymer Composites

Comprehensively we can state that that it can be organized two segments in light of the quality and material and they are:

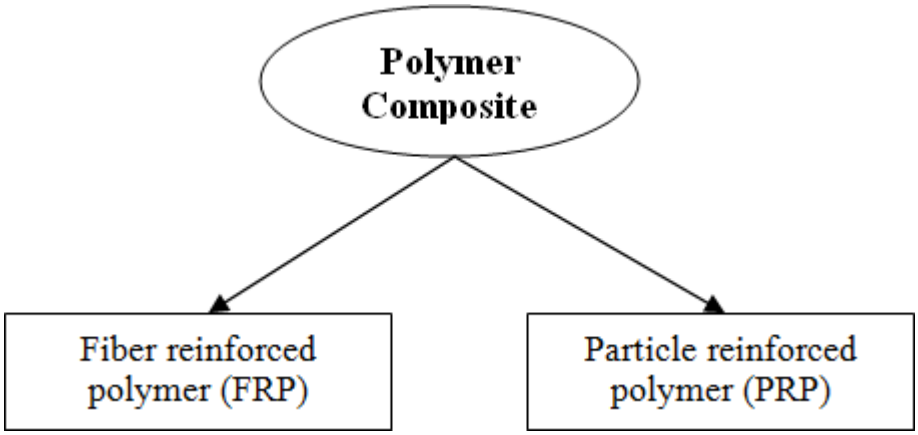



**Figure 1.2: -** Classifications of polymer composites

### 1.3.1 Fiber reinforced polymer

These composites are administered by sintering, hot beating, hot isotactic squeezing, assault, and response holding and begin mix. One of the essential objectives in making imaginative cross section composites is to fabricate the sturdiness. Really it is trusted and no ifs and or buts routinely found, that there is an adjustment in the quality and solidness of masterful cross section composites. Fiber Reinforced polymer (FRP) are composites used as a piece of basically every sort of bleeding edge building structure, with their usage running from flying machine, helicopters and transport through to vessels, boats and toward the ocean arrange and to autos, sports stock, mixture preparing apparatus and basic establishment.

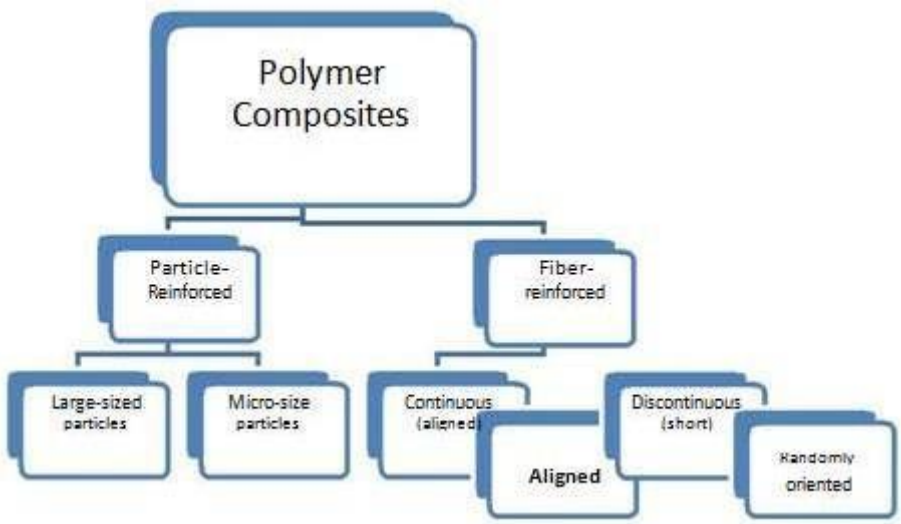



**Figure 1.3: -** Classification of composites in view of fortification sort.

## 1.3.2 Particle Reinforced Polymer

One type of composites is particulate strengthened composites with cement being a decent case. The total of coarse shake or rock is installed in a lattice of bond. The total gives solidness and quality while the concrete goes about as the folio to hold the structure together. There are a wide range of types of particulate composites. The particulates can be little particles (< 0.25 microns), hacked filaments, (for example, glass), platelets, empty circles, or new materials, for example, bucky balls or carbon nano-tubes. For every situation, the particulates give attractive material properties and the grid goes about as restricting medium important for basic applications.

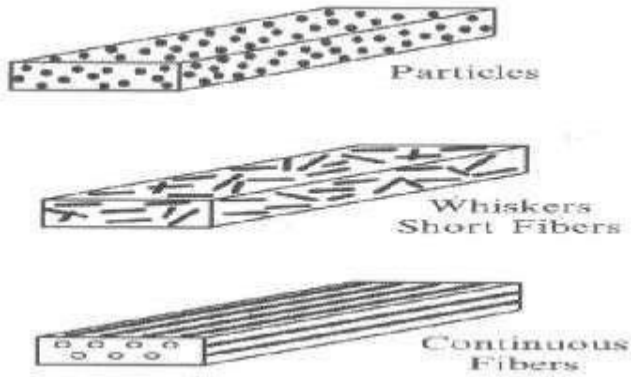



**Figure 1.4: -** Composites types.

## 1.4 Advantages of Natural Fibers

The advantages of natural fibers are as follows:

1. They are resistant to fire.
2. Natural fibers on burning do not produce poisonous gases.
3. Natural fibers are easily affordable.
4. These fibers absorb sweat and water and hence such clothes are comfortable for summer months.
5. Natural fibers are safe for human skin and are biodegradable.

## 1.5 Disadvantages of Natural Fibers

The disadvantages of natural fibers are as follows:

1. The strength of natural fibers is very less as compared to synthetic fibers.
2. Natural fibers are heavy in weight.
3. Natural fibers can be damaged by moths and other insects.
4. These fibers are not wrinkle-free.
5. These fibers are not long lasting and hence not durable.

# CHAPTER 2
# LITERATURE SURVEY

The natural fiber containing composites are more environmentally friendly, and are used in various applications, as results of increasing demand for environmentally friendly materials and desired to reduce the cost of traditional fibers. Nagamadhu M et al observed that 4% NaoH treatment gives hopefully good results as compare to the untreated and 6% treated samples [1]. Jiyas N et al worked on mechanical and interlaminar properties of woven banana-glass fiber reinforced epoxy composites [2]. Mohammad Asim et al worked on the effects of NaOH, silane and NaOH-silane treatments for natural fibers [3].Easwara Prasad G L et al concluded that impact strength of both untreated and 5 % NaOH treated sisal fiber embedded polyester matrix composites increases with increase in their thickness and fiber volume fraction [4]. Jai Inder Preet Singha etal worked on mechanical properties for treated and non-treated natural fiber reinforced [5]. Muhammad Khusairy Bin Bakria et al observed that treated fiber composites have superior properties as compared with untreated fiber composites [6].Nag Tien Lama et al investigated the Utilizing cellulose from sugarcane bagasse mixed with poly (vinyl alcohol) for tissue engineering scaffold fabrication .

[7]Milena Martelli Tosia et al observed changes in the chemical composition and structure of soybean straw treated with alkali 5% and 17.5% [8]. Mohammad Asim et al concluded that the scanning electron microscope indicates that silane treated fibers have less impurities, lignin and hemicelluloses removed than those by other chemical treatments [9]. M.J.M. Ridzuan et al observed that the effect of soaking time during the alkali treatment on the tensile strength of Napier grass fiber [10]. R.Yahaya et al concluded treated kenaf improves the mechanical properties of hybrid composites [11]. N. Venkateshwaran et al studied on alkali (NaOH) of various concentrations (0.5%, 1%, 2%, 5%, 10%, 15% and 20%) was used to treat the fiber surface and the effect of these concentrations on the mechanical and visco-elastic behavior of the composites were carried out [12]. E. O. Achukwu et al concluded that alkali treatment improved

the tensile strength and breaking elongation of the fabrics [13]. Bhanu Priya et al concluded that addition of GLU increases the tensile strength and degree of swelling of PVA blend films .

[14]Hemant Patel et al observed that the 50% sisal and 50% banana had less strength from composite having 80% Sisal and 20% banana fiber ratios [15].Dr. M.Venkata Ramana et al worked on natural fibers Treated with Chemicals and found that the composites strengthened with Sodium lauryl Sulfate treated strands displayed higher mechanical properties than the composites Fortified with NaOH treated filaments [16]. K. S. Ching et al focused on the effect of thermal ageing and mechanical properties of empty fruit bunch filled polyvinyl alcohol composites [17]. Alavudeen et al studied on the effect of weaving patterns and random orientatation on the mechanical properties of banana, Kenaf and banana/Kenaf fiber-reinforced hybrid polyester composites [18]. Atus Buku et al concluded that banana fibers are not soaking alcohol has a higher tensile strength than the through immersion alcohol [19]. G. Venkatachalam et al worked on tensile behavior of fabricated composites [20]. Tholkappiyan E et al worked on chemical and mechanical properties of the banana [21]. O.P. Balogun et al concluded that the SEM analysis revealed rough surfaces due to removal of impurities

[22]. J Ronald Asser et al observed that the. Scanning electron microscope revealed the changes in surface morphology after chemical treatment and also, the treated fibers showed reduced water uptake and improved thermal properties [23]. S. Dhanalakshmi et al the investigation of tensile strength of untreated and all chemically treated areca fiber reinforced natural rubber, observed that with increase in fiber loading up to 60%, the tensile strength of untreated and all chemically treated areca fiber reinforced natural rubber composites were increased [24]. Ramadevi Punyamurthy et al studied on the preparation of untreated and chemically treated abaca reinforced epoxy composites and the impact of these pre-treatments on tensile and flexural behavior of the composites.

[25]A. Alavudeen et al worked on the mechanical properties of banana, Kenaf and banana/Kenaf fiber-reinforced hybrid polyester composites [26].Layth Mohammed et al concluded that alkaline treatment, silane treatment and acetyl treatment of OPF improved the adhesion between the fibers and epoxy polymer [27]. Allan C. Manalo et al observed that the improvement in the mechanical properties of the composites was achieved with the treatment of the bamboo fibers with sodium hydroxide. This improvement is due to the enhancement in the adhesion between the bamboo fibers and the polyester resin [28].Mohammad Asima et al investigated with the aim to improve their compatibility with polymer matrices .

[29].Jun-Seok Yeo et al invested on the effect of chemical surface treatment on the fracture toughness of micro fibrillated cellulose [30].Sekhar Das et al observed that the effect of woven jute fabric and layering pattern effect on mechanical properties of newspaper/woven jute fabric hybrid composites [31].Raghuveer H. Desai et al made review paper is collective information about the research done until date on areca fiber chemical composition, characterization, and physical properties [32].T. Vinod Kumar et al worked on characterized and synthesized through the various mechanical tests and also the results were compared [33].R.Yahayaa et al studied on the effect of layering sequence and chemical treatment on mechanical properties of woven Kenaf and Kevlar composite [34].Michael George et al investigated on evaluation of the environmental impact of chemical methods .

# CHAPTER 3

# OBJECTIVES

The following objectives were made for the present work.

1. Identification and preparation of different natural fibers.
2. To study the effect bonding with respect to variation of graphene with natural fibers (5%, 10% and 15%).
3. Preparation of natural composite test laminates using hand lay-up method.
4. Testing of composite specimens for tensile, flexural and impact characteristics as per ASTM standards.

# CHAPTER 4
# MATERIALS AND METHODOLOGY

## 4.1 Materials Used

The materials used in fabricating the composite laminates were jute plain woven fabrics and polyvinyl alcohol (PVA), jute fabrics were collected from the jolly entrepreneur, kolkata and resin was purchased from M/s. pragathi industry, Bangalore.

## 4.2 Methodology

This chapter describes the methodology used for the processing of the composite specimens. It also presents the details of the various testing procedures to determine the mechanical properties of the composite specimens as shown in figure 4.1.

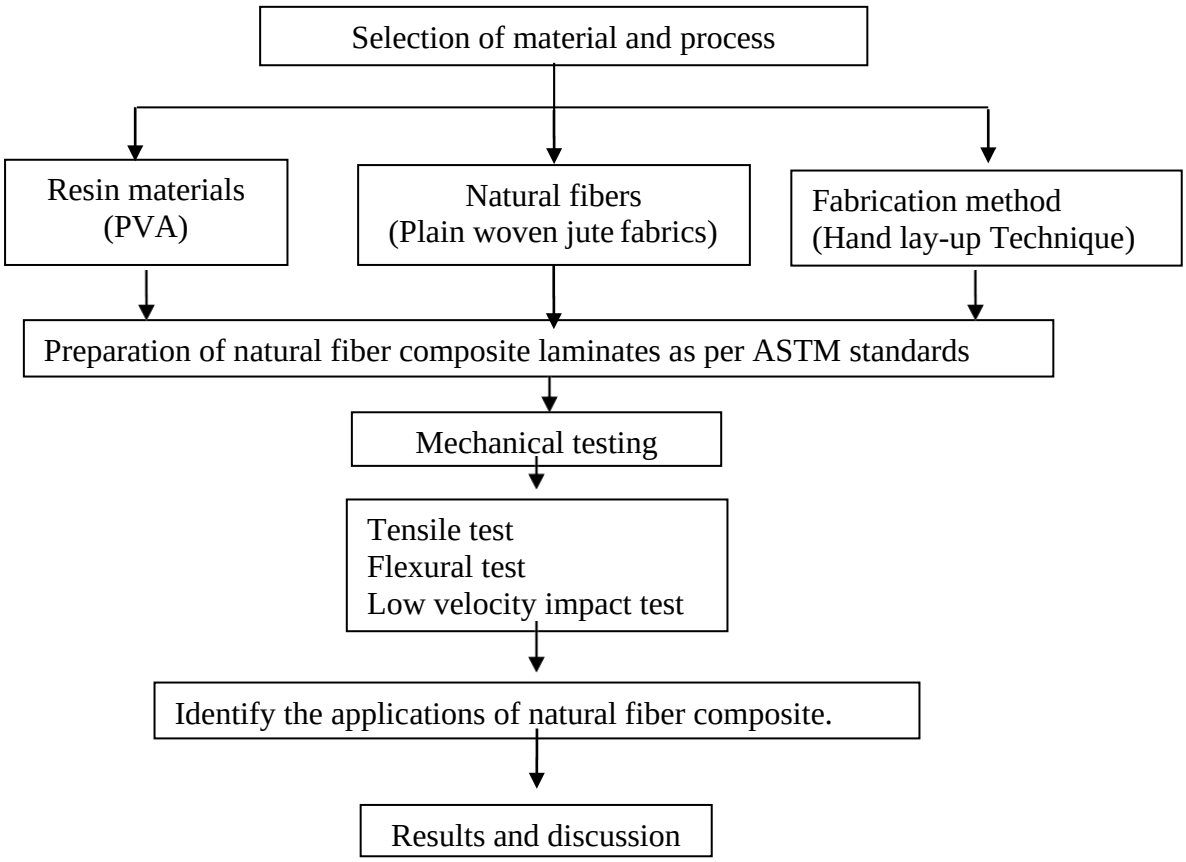



**Figure 4.1: -**Methodology of present work.

## 4.3 Mould Preparation

The present work initially deals in preparing mold a cleaned, smooth of a mild Steel plate of size 250 X 200 X 4 mm were used as shown in the figure 4.2. and figure 4.3. The fabrication of the composite material was carried out through the hand-lay-up technique.

(a) Top plate (b) Bottom plate

**Figure 4.2: -** Mould for composite preparation.

## 4.4 Fabrication of Composite Laminates

The composite laminates were prepared by the hand lay-up process. Composite was made using mild steel mold measuring 250 X 200 X 4 mm length, width and depth respectively. The bottom slab of the mold was thoroughly cleaned with thinner; smoothen by wax polish which acts as releasing agent and the same procedure followed by top slab also. To help complete removal of the composite from the mold, a polyethylene sheet is laid on the clean and dry mould before fabrication of the composites. Initially, resin and hardener were mixed together (2:1)with the weight percentage applied between two layers for an effective binding as shown in figure 4.4. Graphene were mixed with mixture of resign/hardener with different percentages (5, 10 and

15%) and stirred well for proper mixing of graphene and resign/hardener. The fibers were laid uniformly over the mould before applying epoxy, mixture of graphene and resin/hardener are poured over the fibers, a roller were used to evenly spread the graphene and resin/hardener mixture ascending to the required dimensions, compressed and distributed evenly until it achieved the thickness of 4mm, with the help of nuts and bolts the mould were completely compressed to remove the bubbles. The curing time was around 20-24 hours applied at the room temperature condition, after the curing process, test samples were cut to the required sizes prescribed in the ASTM standards.

## 4.5 Mechanical Testing

The mechanical testing is carried out to understand the mechanical performance of the composites by using Universal Testing Machine (UTM).

### 4.6.1 Tensile Test

Tensile strength is a measure of a materials ability to resist being pulled apart. The tensile test is generally performed by Universal Testing Machine (UTM) which is presented in figure 4.3.Tensile testing of specimens prepared according to ASTM D-638, the specimen is 160 X 12.5 X 4 mm length, width and depth respectively as shown in figure 4.5 and 4.6, the tensile modulus and elongations at the break of the composites were calculated from the load-displacement curve four specimens were tested for each set of samples and the mean. Tensile test samples were presented in figure 4.7.

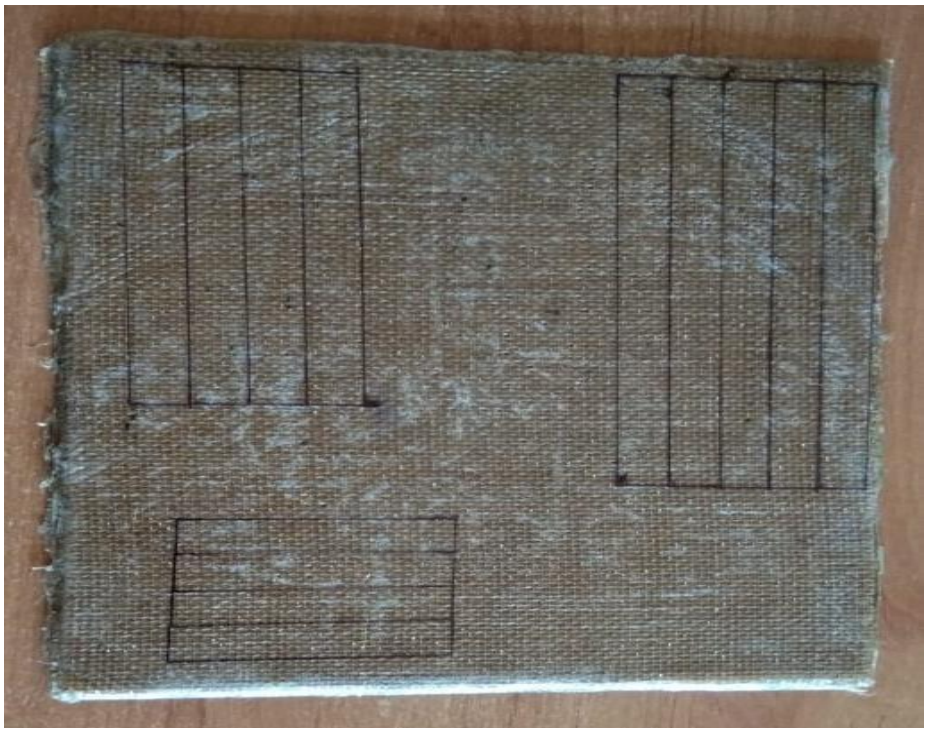


**Figure 4.3: -** Prepared composite laminates with marking.

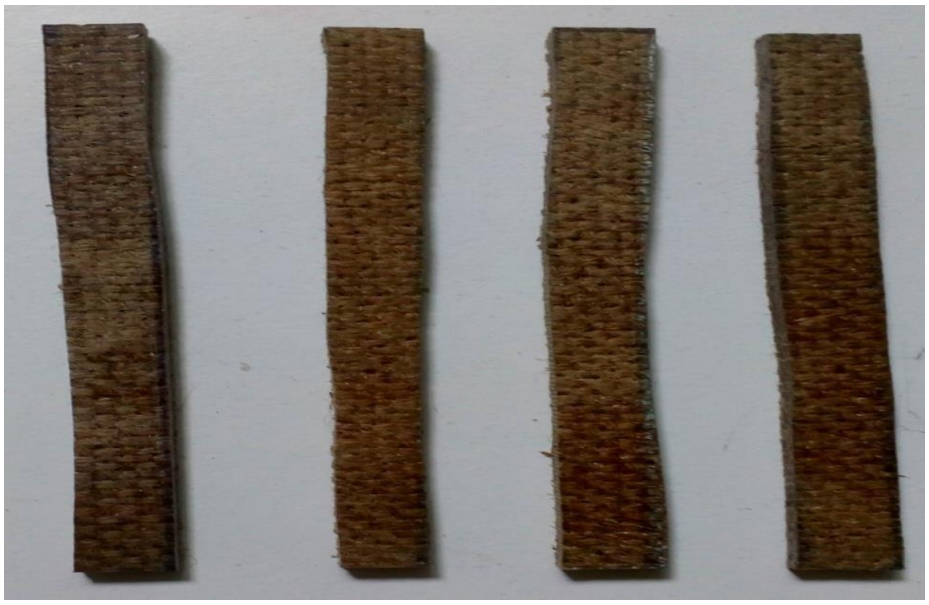


**Figure 4.4: -**Tensile test specimens (Unmixed 5, 10 and 15%).

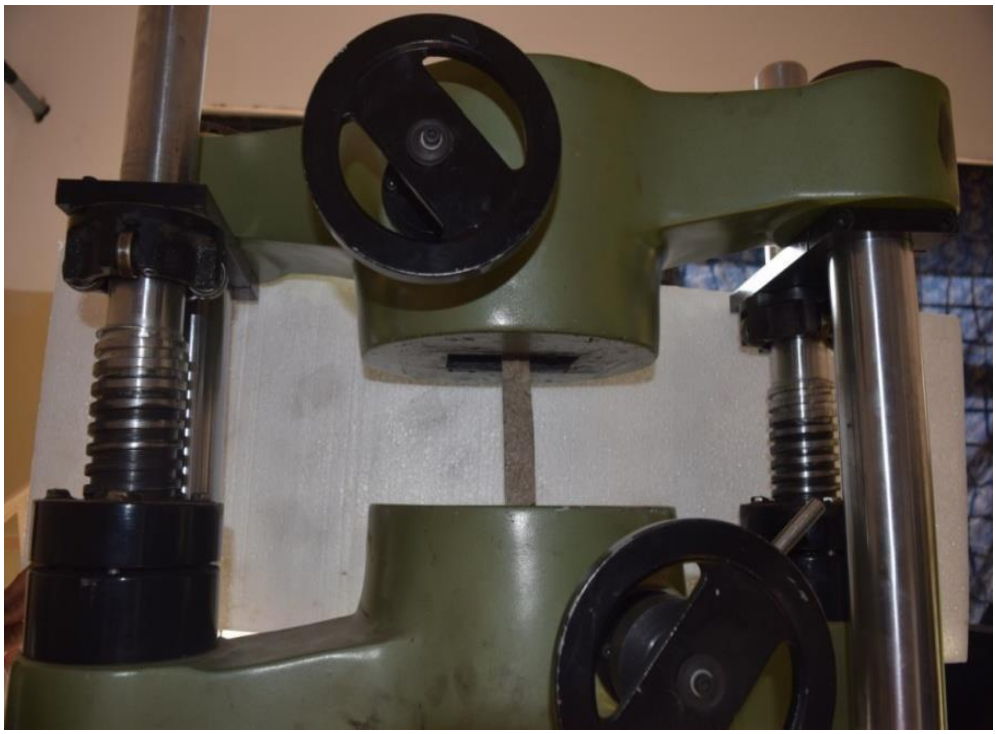


**Figure 4.5: -**Test specimen in universal testing machine.

**Apparatus:-**

It requires universal testing machine that comprises of the following.

- Grips – For holding the test specimen.
- Static member for holding one end of the specimen.
- Secondary member which holds the specimen and moves vertically.

**Test Setup:-**

- Pre-load:- Not applicable.
- Constant head speed: - 5mm/min.
- Gauge length:-100mm.

**Procedure:-**

The specimen is cut according to ASTM D-638.

- Tensile test was conducted according to ASTM.

- Specimen plate is enclosed between the grippers of universal testing machine.
- Load was slowly applied by deforming the specimen.
- Load corresponding to deformation is noted down.
- Specimen deformation occurs upon gradual load.
- Load corresponding to deformation and stress and strain is noted down.
- Procedure is repeated for different trails.

### 4.6.2 Flexural Test

The flexural test is performed by three point bending method according to ASTM D-790 represented in figure 4.8. The specimen is 127 X 12.7 X 4 mm length, width and depth respectively, four specimens were tested, and the average was calculated, the specimen was freely supported by a beam, the maximum load was applied in the middle of the specimen until the it fracture and breaks. The test results include flexural strength and displacement, the specimen used for conducting the flexural test is presented in figure 4.9.

**Flexural Test Setup:-**

- Pre-load:- Not Applicable
- Constant head speed :- 2mm/min
- Span length :- 70mm

**Procedure:-**

- Flexural test was conducted as per ASTM.
- Specimen plate is placed as simply supported beam and central load were applied.
- Loads were slowly applied by deforming the specimen.
- Load at which maximum deformation was noted down.
- Procedure is repeated for different trials.

### 4.6.3 Impact Test

Izod impact test specimens were prepared in accordance with ASTM D-2240 to find the impact strength. The sizes of the specimens were 64 X 127.7 X 4 mm length, width and depth respectively as shown in figure 4.10, the sample tests were performed by impact testing machine and the impact strength was calculated. The impact test samples presented in figure 4.11.

**Procedure:-**

- The samples used for the SEM remarks were dried at room temperature.
- The sample for SEM analysis was mounted on a conductive substrate such as aluminum stub and it is gold with vacuum.
- The samples are kept on the sample stage of the microscope.
- The samples can be tilted as well can move in X, Y and Z directions.
- Further, the data signals are released due to interaction between the bombarding electron and the atoms of the specimen.
- The fracture surface images of the specimen provide the information regarding the grain size, shape, internal behavior of the fiber and the structure of the specimens were observed in the system.

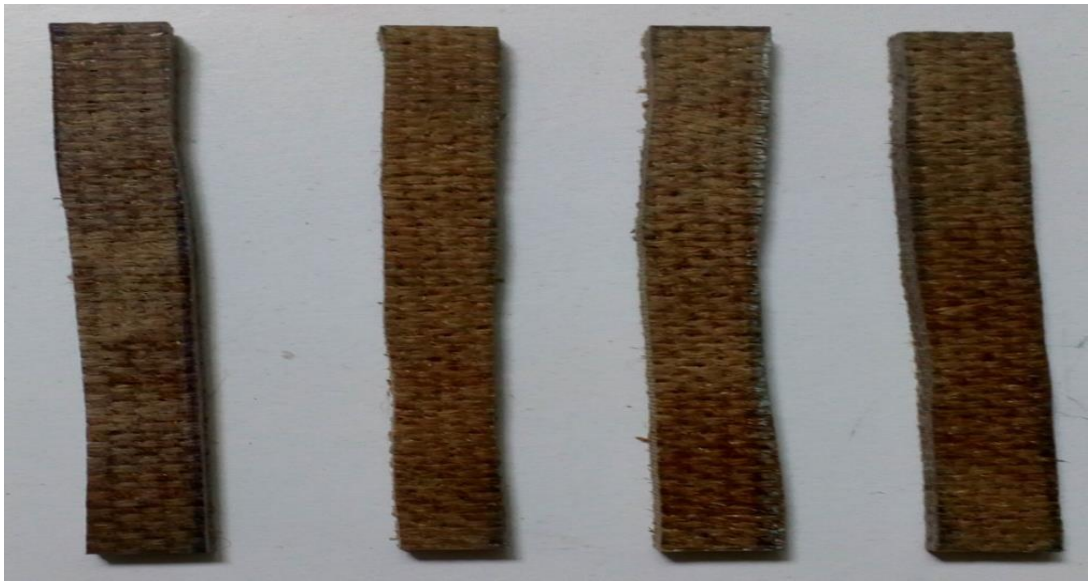


**Figure 4.6: -**Flexural test specimens (Unmixed, 5, 10 and 15%).

**Figure 4.7: -** Test specimen under 3-point bending attachment.

**Figure 4.8: -**Impact test specimens (Unmixed, 5, 10 and 15%).

**Figure 4.9: -** Test specimen with impact izode test attachment.

# CHAPTER 5

# RESULT

## 5.2 Tensile Properties

This chapter highlighted the effect of graphene treatment with different percentages of concentrations, the experimental results of tensile, flexural and impact strength were discussed and reported in figures 3-5. From the experimental results the tensile strength of unmixed 5, 10 and 15% treated composites are 78.3, 115.5, 135.12 and 120.12MPa respectively and figures 3 and also observed that the variations in tensile strength with the increases in the graphene treatment up to 10%, and further increases in the % of graphene concentrations for 15% that leads to decreases in the tensile strength.

## 5.3 Flexural Properties

Figure 4 shows that the experimental results of flexural strength of untreated and treated fabrics composite and also shows that the flexural strength of treated composite are more than the untreated composite.

## 5.4 Impact Properties

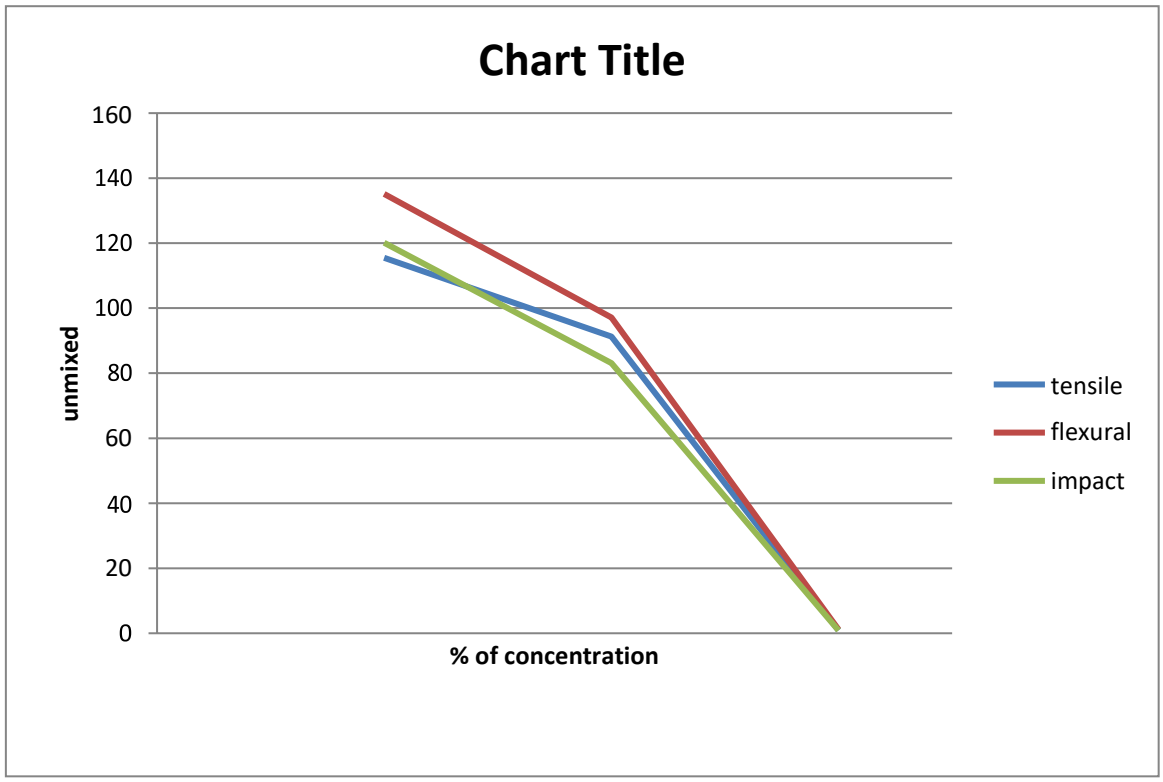
The impact strength of treated composite was higher compared to untreated. The maximum impact strength for 6% treated composite are 1.12 J/m2 was observed and the lowest value for untreated are 0.58 J/m2 as shown in figure 5.

The tensile, flexural and impact test results were presented in table 5.2.

**Table 5.2: -**Mechanical propertiesof treated fabrics.

| Name of the test | Percentages' of concentrations | | | | |
|---|---|---|---|---|---|
| | unmixed | 5 | 10 | 15 | |
| Tensile(MPa) | 78.3 | 115.5 | 135.12 | 120.12 | |
| Flexural(MPa) | 75.23 | 91.23 | 97.12 | 83.12 | |
| Impact($J/m^2$) | 0.65 | 0.90 | 1.12 | 0.85 | |

# GRAPHS




**Graph 5.3:-**unmixed v/s % of concentration

# CHAPTER 7

# CONCLUSION

From the above study, we can see the more effective utilization of natural fibers in polymer composites. NaOH treatment: the 5% NaOH treatment gave the increment of strength by 34 times and load carrying capacity by 9 times in tensile test with respect to pure epoxy sample .3% Permanganate on further treatment has increased the load carrying capacity by 1.3 times and the deflection has decreased by 2.9 times with respect to pure epoxy sample.The composite is stable until the temperature of 344 degree and then burns with exothermic reaction. Treatment of natural fibers help increase the strengths of the matrix. The results from tensile test of the material we found that 3% alkaline treated hemp yielded more than five times that of untreated hemp. Whereas with the increase in reinforcement the strength is reduced. In case of permanganate treatment the higher strength was found at 5% potassium permanganate treatment. The reason for decreased strength of the untreated hemp may be improper dispersion of hemp and the bonding capability of hemp with the epoxy. With the specialized chemical treatment fibers become rougher and bonding becomes easier. Cellulose depolymerize exposing short length crystallites. Thus we can conclude that treatment of hemp fibers help achieving higher strengths.

# REFERENCE

[1]. H. Peltola, B. Madsen, R. Joffe, and K. Nättinen, 2011. Experimental study of fiber length and orientation in injection moulded natural fiber/starch acetate composites , Advances in Materials Science and Engineering,

[2]. Gupta, A. Kumar, A. Patnaik, and S. Biswas 2011, Effect of different parameters on mechanical and erosion wear behavior of bamboo fiber reinforced epoxy composites, International Journal of Polymer Science,

[3] S. Kalia, L. Avérous, J. Njuguna, A. Dufresne, and B. M. Cherian 2011, Natural fibers, bio- and nanocomposites, International Journal of Polymer Science,

[4]S. C. Mishra, Low cost polymer composites with rural resources 2009, Journal of Reinforced Plastics and Composites,

[5]Sukhdeep Singh, Dharmpal Deepak, Lakshya Aggarwal, V.K. Gupta 2014 Tensile and Flexural Behavior of Hemp Fiber Reinforced Virgin-recycled HDPE Matrix Composites, In Procedia Materials Science,

# INTRENSHIP DETAILS

| SL.NO | Name of the Students | USN | Company Name | Duration (Days) |
|---|---|---|---|---|
| 1 | Balaraj T M | 1NC16ME012 | ROBOTICS PVT LTD | 30 |
| 2 | Bharath RG | 1NC16ME014 | MARUTHI SUZUKI | 30 |
| 3 | Bharath AH | 1NC16ME013 | MARUTHI SUZUKI | 30 |
| 4 | Sudarshan MN | 1NC16ME096 | MARUTHI SUZUKI | 30 |

ROBOTICS

Innovation + Application

**ROBOTICS PVT LTD** Certifies

BALARAJ T. N

for successfully completing

Training and Internship Programme Conducted for a

period of 30 days between 20 JAN to 22 FEB.

We take the pleasure in recognizing the achievement

with the award of

**"Internship Certificate"**

in

Working of Electronic discharge Machine & Compression moulding Process

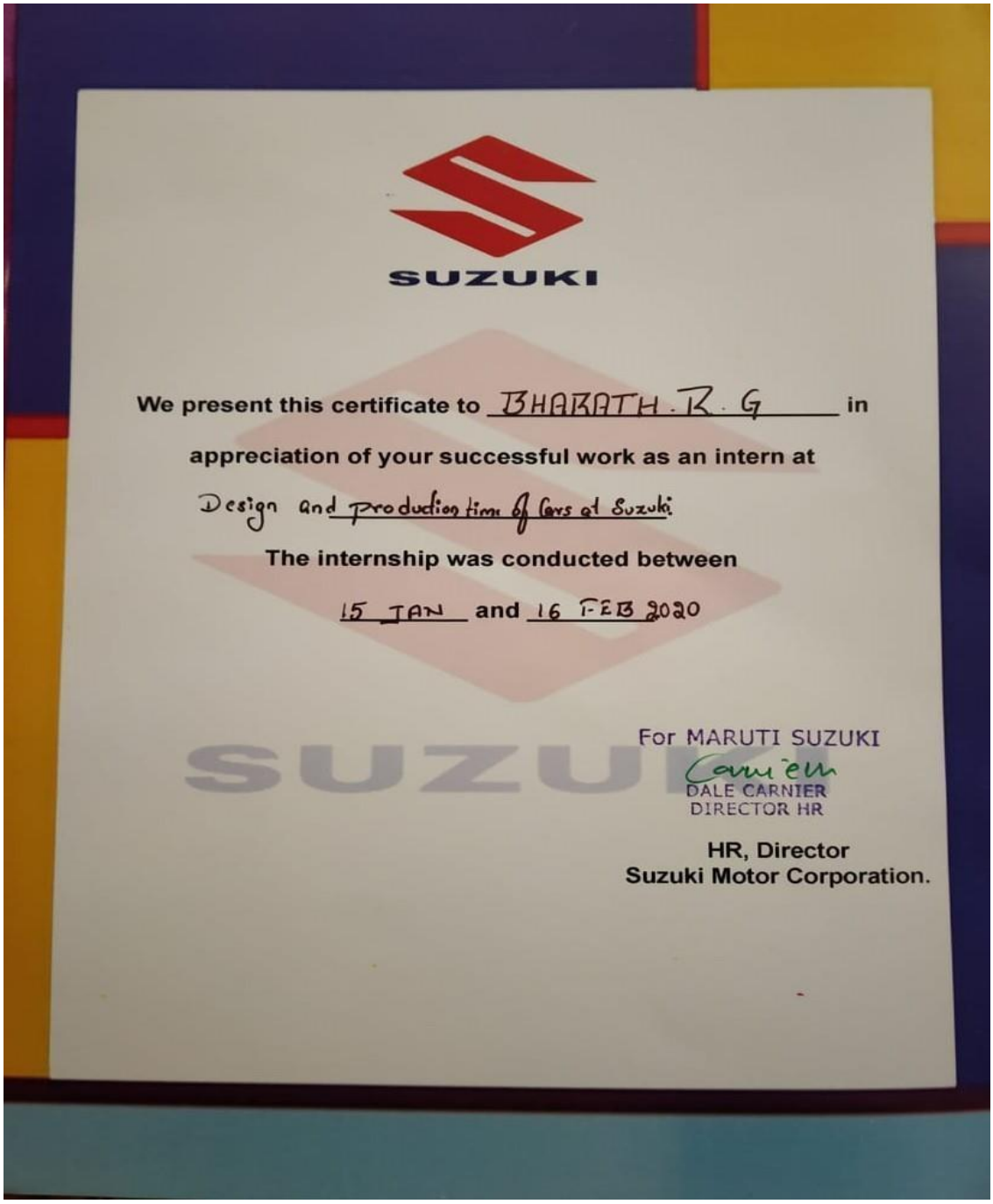
given on the 25 day of Feb 2020

For Robotics Automation (India) Pvt. Ltd.

Pranav BP
Director HR

**HR, Director**
**ROBOTICS PVT LTD**

**82, 1st floor, 4th Cross Rd, 3rd Block East, LIC Colony, Jayanagar 3rd Block East, Jayanagar, Bengaluru, Karnataka 560011.**



SUZUKI

We present this certificate to BHARATH. R. G in

appreciation of your successful work as an intern at

Design and production time of Cars at Suzuki.

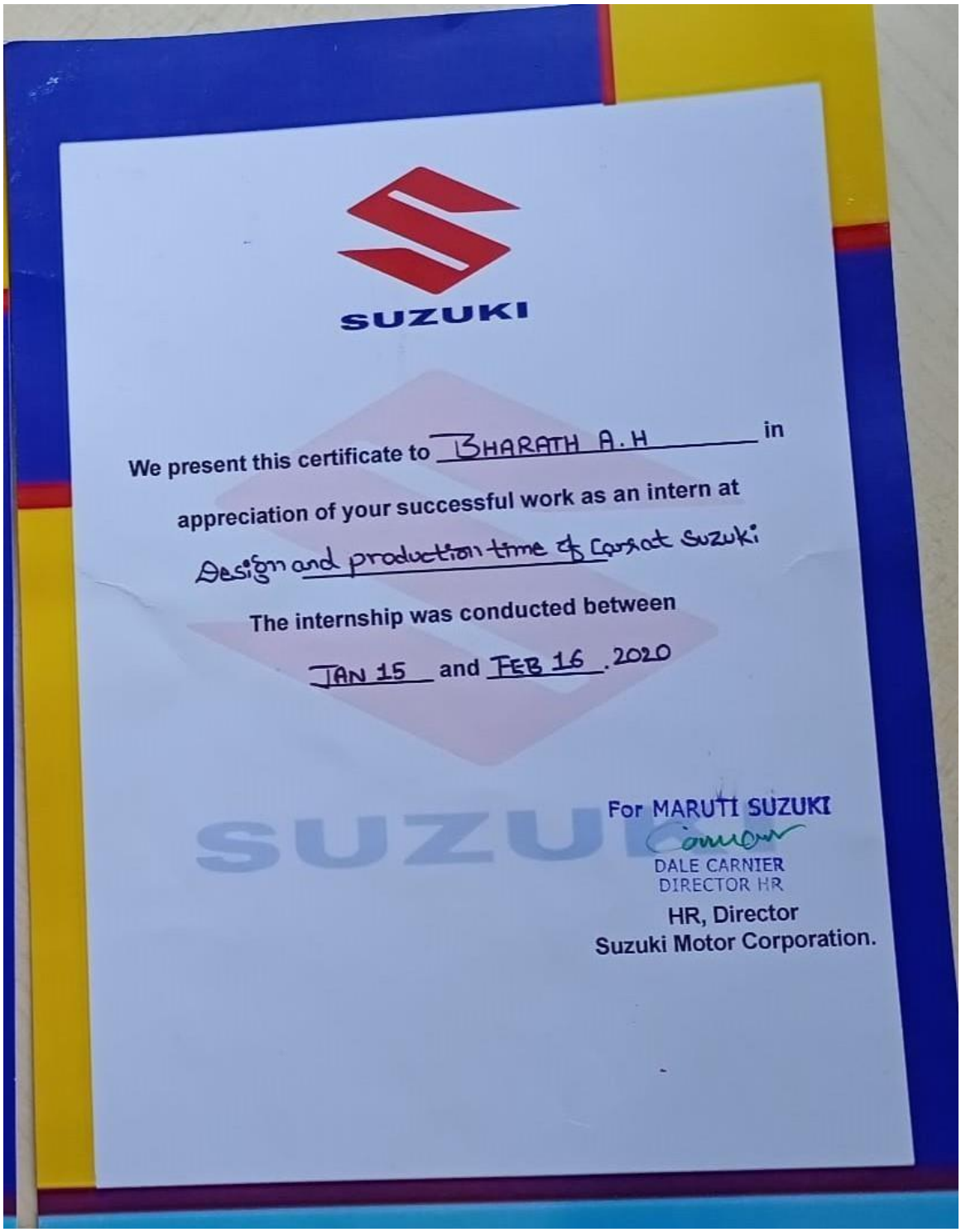
The internship was conducted between

15 JAN and 16 FEB 2020

For MARUTI SUZUKI

DALE CARNIER
DIRECTOR HR

HR, Director
Suzuki Motor Corporation.



SUZUKI

We present this certificate to BHARATH A.H in

appreciation of your successful work as an intern at

Design and production time of Corsat Suzuki

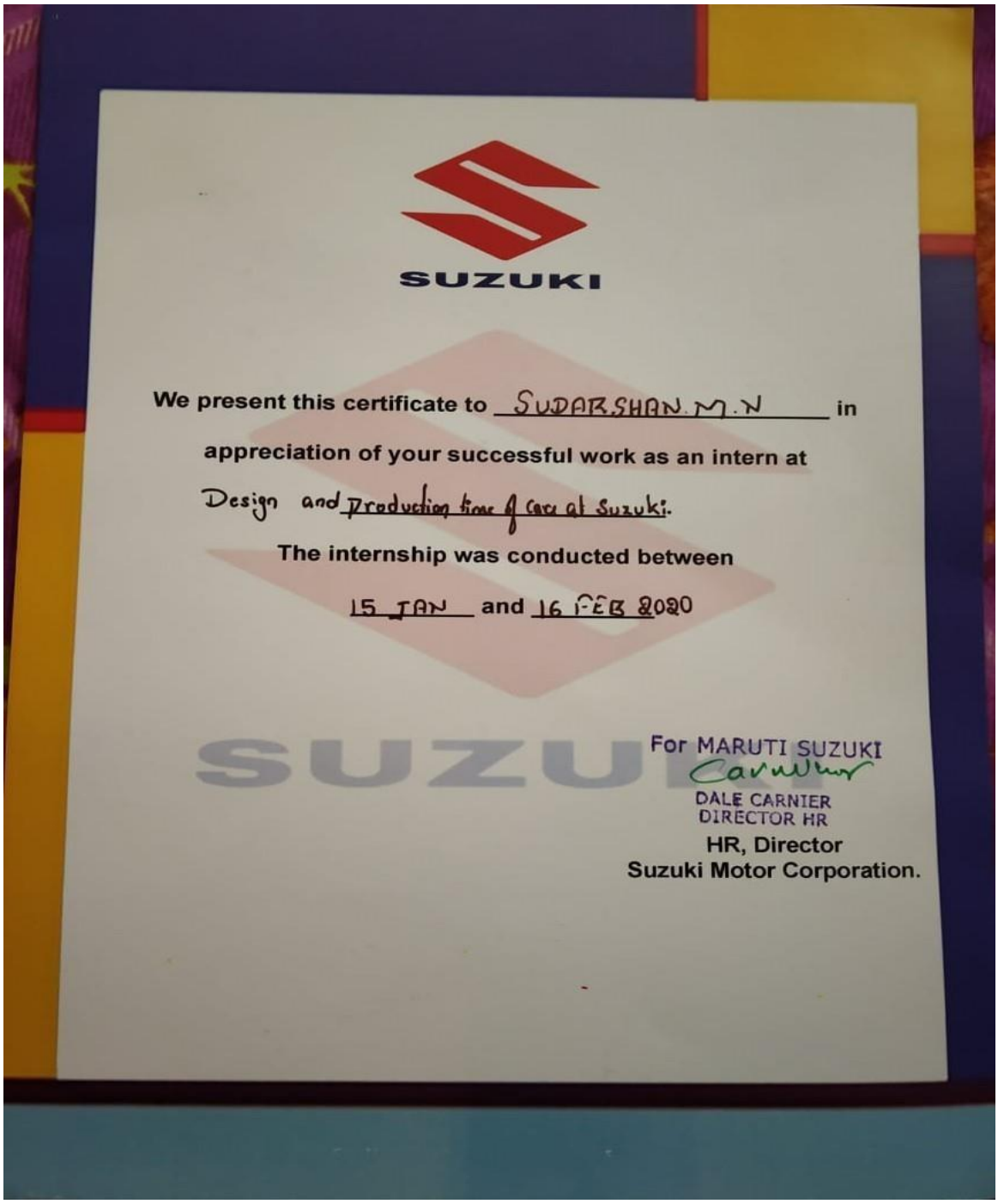
The internship was conducted between

JAN 15 and FEB 16 . 2020

For MARUTI SUZUKI

DALE CARNIER
DIRECTOR HR

HR, Director
Suzuki Motor Corporation.



SUZUKI

We present this certificate to SUDARSHAN.M.N in

appreciation of your successful work as an intern at

Design and Production time of Cars at Suzuki.

The internship was conducted between

15 JAN and 16 FEB 2020

For MARUTI SUZUKI

DALE CARNIER
DIRECTOR HR

HR, Director
Suzuki Motor Corporation.