Abstract: In this modern industrial world the need for bio degradable substance is demanding in all the fields including automobile and mechanical field. To overcome the needs we need to find an alternative natural product with similar kind of properties. Where these natural products attribute can be enhanced using some processing techniques and by adding suitable chemicals. Composite materials are the one which is ruling our world and the need for them is marginally high and we need to find new enhanced matrices which have much more good qualities than the old one and find the alternate for them in their existence. While in this project we are going to use natural fibers SISAL and FLAX, form composite laminates and test their mechanical properties in ASTM STD samples. In industries, the need of advanced materials to be innovated to achieve the better characteristics and properties over the traditional existing single phase materials, in which it is hard to achieve. The performance of an advanced material with desired physical and chemical properties can be achieved by thoughtful selection of suitable materials and processing techniques. Conventional monolithic materials have limitations in achieving good combination of strength, stiffness, toughness and density. To overcome these shortcomings and to meet the ever increasing demand of modern day technology, composites are most promising materials of recent interest. The composite material can provide the tailored properties to serve the desirable requirement of end product. In this project we are going to produce the natural FIBER with different concentration with respective to the matrix and we are going to test it using various tests which defines the important properties of the composite laminate with respective to the other FIBERs available commercially.[1-10]

Keywords: Flax, Sisal, Mechanical Characterization

1. Introduction

The need of modern composite materials is that they are light as well as strong. By choosing an appropriate combination of matrix and reinforcement material, a new material can be made that exactly meets the requirements of a particular application. Composites also provide design flexibility because many of them can be molded into complex shapes. Natural fiber reinforced composites are being increasingly used in many engineering applications like sliding panels, bearings, linkages, bushings. Polymer composite materials often possess mechanical and physical properties that make them better suited for a wide range of applications than the individual composite components. [11-16] The use of natural fibers development of polymeric materials that are produced from sustainable and ecologically composites typically have a fiber or particle phase that is stiffer and stronger than the continuous matrix phase and serve “composites are multifunctional material systems that provide characteristics not obtainable from any discrete material. The NFC extracted flax FIBERS have been found to have strength 20% higher than those extracted mechanically. The Fabrication Reinforced Composites (FRC) is increasing rapidly in the automotive, aerospace and wind energy sectors because of their high specific strength and modulus. This project work aimed at the usages of Natural plant fibers such as flax, sisal and producing a natural based material composite laminate made from renewable agricultural and forestry feedstock. The natural fiber used will be chemically treated to improves its performance and the laminate will be prepared with this treated fibers. Then it will be subjected to mechanical characterization and analysed. [17-22]
2. Materials and Methodology

In the present investigation, the first reinforcement was natural FIBER, and there are sufficient literatures published on the improvements in tensile properties through the addition of natural FIBER i.e. (SISAL, FLAX). Best FIBERs are chosen for the investigation, because best FIBERs has more tensile strength than the other type of natural FIBERs.[12]

Glass Fiber:

Glass-reinforced plastic (GRP) is a composite material or fiber-reinforced plastic made of a plastic reinforced by fine glass fibers. Like graphite-reinforced plastic, the composite material is commonly referred to as fiberglass. The glass can be in the form of a chopped strand mat (CSM) or a woven fabric.[14]

![Glass Fiber](image)

Table 1. Typical Mechanical Properties Of Natural Fibers

<table>
<thead>
<tr>
<th>MATERIALS</th>
<th>DENSITY (g/cm³)</th>
<th>TENSILE STRENGTH (MPa)</th>
<th>ELASTIC MODULUS (GPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>COTTON</td>
<td>1.5-1.6</td>
<td>400</td>
<td>5.5-126</td>
</tr>
<tr>
<td>KENAF</td>
<td>1.45</td>
<td>930</td>
<td>~53</td>
</tr>
<tr>
<td>SISAL</td>
<td>1.5</td>
<td>511-635</td>
<td>9.4-22</td>
</tr>
<tr>
<td>JUTE</td>
<td>1.3</td>
<td>300-700</td>
<td>20-50</td>
</tr>
<tr>
<td>BAMBOO</td>
<td>1.4</td>
<td>500-740</td>
<td>30-50</td>
</tr>
<tr>
<td>BAGASSE</td>
<td>1.30</td>
<td>450</td>
<td>8.1-8.5</td>
</tr>
<tr>
<td>HEMP</td>
<td>1.48</td>
<td>350-800</td>
<td>30-60</td>
</tr>
<tr>
<td>FLAX</td>
<td>1.45</td>
<td>500-900</td>
<td>50-70</td>
</tr>
<tr>
<td>BANANA</td>
<td>1.35</td>
<td>500</td>
<td>12</td>
</tr>
</tbody>
</table>

Sisal Fiber:

SISAL plant provides textile FIBER, the SISAL FIBER. It grows easily as it sets out young shoots and is most commonly found in hot tropical climates.[16] All varieties of SISAL plants have FIBERs in abundance. These FIBERs are obtained after the fruit is harvested and fall in the group of FIBERs. This plant has long been a good source for high quality textiles in many parts of the world.[23-25]

![Sisal Fiber](image)

Figurer 1. Sisal Fiber

SISAL FIBER is a natural best FIBER. It has its own physical and chemical characteristics and many other properties that makes it a fine quality FIBER.[18]
1. Appearance of SISAL FIBER is similar to that of FLAX FIBER but its fineness and spin ability is better.
2. It has highly strong FIBER
3. It has somewhat shiny appearance depending upon the extraction of spinning process.
4. It is light weight.
5. It has strong moisture absorption quality.
6. It is bio-degradable and has no negative effect on environment.
7. Its average fineness is 2400Nm.[26]

It is also surprisingly used as the FIBER core of the steel wire cables of elevators, being used for lubrication and flexibility purposes. Traditionally sisal was the leading material for agricultural twine or baler twine. Although this has now been overtaken by polypropylene. It is used in automobile industry with fiberglass in composite materials. Other products developed from sisal fiber include spa products, cat scratching posts, lumbar support belts, rugs, slippers, cloths and disc buffers. Sisal is used by itself in carpets or in blends with wool and acrylic for a softer hand.

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Flax Fiber:

FLAX FIBER is a best FIBER extracted or fabricated from natural FLAX, and possibly other additives, and is made from the pulp of FLAX plants. FLAX has gained popularity as a "green" FIBER.[19] Manufacturers the fact that FLAX can be cultivated quickly, can be used as a cash crop to develop impoverished regions of the third world, and is a natural FIBER. Whose cultivation results in a decrease in greenhouse gases. FLAX is extremely resilient and durable as a FIBER. In studies comparing it to cotton and polyester, it is found to...
have a high breaking tenacity, better moisture wicking properties, and better moisture absorption. FLAX has many advantages over cotton as a raw material for textiles. The high growth rate of FLAX and the fact that FLAX can grow in such diverse climates makes the FLAX plant a sustainable and versatile resource. [20]

**Figure 2. 18 flax fiber**

**Selection Of Resin And Property**

**Mechanical properties (EPOXY)**
- Tensile strength: 85N/mm²
- Flexural strength: 112N/mm²
- Compressive strength: 190N/mm²
- Water absorption: 5-10mg (0.062-0.068%) (24Hrs at 23degCel)

**Properties Of Resin**:
Anhydride- cured, low-viscosity standard matrix system with extremely long pot life. The reactivity of the system is adjustable by variation of the accelerator content. The system is easy to process, has good FIBER impregnation properties and exhibits excellent mechanical, dynamic and thermal properties. It has an excellent chemical resistance especially to acids at temperatures up to 80 °C. This epoxy system fulfills MIL specifications R 9300. [25]

**Hardener (Aradur Hy951):**
Aradur HY 951 is a two component, low viscosity, unfilled epoxy casting resin system curing at room temperature, designed for potting or encapsulating low voltage and electronic components. [26]

**Fiber Treatment:**
The fiber is soaked with 5% of NaOH for 8Hrs at 30deg/cel. The mixture took about 24 hours for complete dry. [21] The specimen then were cut into standard dimension according to ISO standard FIBER have improved significantly as compared to undertaken flax and sisal FIBER especially at the optimum level of NaOH. [22]

**Fiber Treated Method:**
1. First the fiber is to be washed with the distilled water.
2. Then take a beaker and put 50gms of NaOH for 1ltrs of distilled water.
3. Then pour the mixed solution (2ltrs) in the tray and soak the 4-natural FIBER.
4. The fiber have been soaked for 2hrs.
5. Then washed with the distilled water.
6. Washed with tap water.
7. Then the natural fiber have been kept for drying in sun light for 4hrs.

Most polymers may be used, including all thermoplastics, some thermosets, and some elastomers. There are tens of thousands of different materials available for injection moulding. [23] The available materials mixed with alloys or blends of previously developed materials means that product designers can choose from a vast selection of materials to find the one that has exactly the right properties. Materials are chosen based on the strength and function required for the final part; but also each material has different parameters for moulding that must be considered. Common polymers like Epoxy and phenolic are examples of thermosetting plastics while nylon, polyethylene, and polystyrene are thermoplastic. [24]

**Advantages:**
- Accuracy in weight of articles.
- Choice of desired surface finish and colours.
- Choice of ultimate strength of articles.
- Faster production and lower rejection rates.
- Faster start-up and shut down procedures.
- Minimum wastage.
- Stability of processing parameters.
- Versatility in processing different raw materials.
- Option in article sizes by changing the mould. Minimum post moulding operations.

**Design Procedure:**
1. RESIN OF 400ML FOR EACH LAYER
2. 300 X 300 mm appropriate Fiber mat
3. The fiber mat is a biaxial woven Glass and Natural fiber mat (0 and 90 degree mat)
4. 3 layers of mat and 4 layer of resin will make 3mm thick hybrid composite laminate

**Fabrication Process:**
Process used here is HAND LAYUP process.
1. First in the glass we have applied epoxy resin required amount.
2. Then above the applied resin we have placed the fiber.
3. Then this process continues for 3 times.
4. Finally the glass have been placed in the upper layer of the laminate.

**Resin Fiber Volume Calculation**

Glass fiber = 600gms

Laminate 300 X 300

Weight of the above glass fiber = 54gms

3 layer = 54 X 3

= 162gms

Composite weight = 420 + 162

= 584gms

Fiber weight % = \( \frac{162}{574} \times 100 \)

F W = 28 %

Similarly resin weight % = \( \frac{412}{574} \times 100 \)

= 71.77 %

**Figure 3.** Laminate prepared

Reference


