ABSTRACT

Composite materials are one of the major developments in material technology in which the chief constituents are reinforcement and matrix. The current trend is to use the bio-degradable reinforcement like bamboo, jute, cotton and hemp etc., are greatly elongated substances produced by plant. Such natural fiber based composite materials have different applications. The objective of the present work is to fabricate the (SBFC) short bamboo fiber composite pipe as per ASTM standards using epoxy as matrix and studding the mechanical properties with conventional materials.

Keywords: short bamboo fiber composite and mechanical properties.
1. INTRODUCTION

The natural fiber reinforced composites (NFRC) are rapidly replacing petroleum based composites in different areas such as automotive, electrical construction and even building industries due to low-density materials yielding relatively light weight composites with high specific properties. One of the main important aspects of the behavior of NFRC is their response to an bending load and the capacity of the composites to withstand it during their service life. Some of the reported work has suggested that NFRC are very sensitive to impact loading [1]. The bamboo tree belongs to a group of woody perennial evergreen plants in the true grass family Phocaea, subfamily Bambusoideae, tribe Bambuseae. It is one of the fastest growing woody plants in the world. This is perhaps due to their unique rhizome system and is dependent on local soil and climate conditions. They are of economic and high cultural significance in East Asia and South East Asia where they are used extensively in gardens as building material as well as food source. In Nigeria, they are used for building supports and tooth picks. While wood has a hard center and becomes weaker toward the outer part, bamboo is hard in its outer, while weak in its inner parts, this leads to a much more stable construction. The more stable fiber structures are most dense where you find the highest stress. Accordingly, the adoption of bamboo fiber in composite application, especially in low strength areas will be most desirable.

As a fiber, the overall mechanical properties of bamboo are comparable to or even better than those of wood [7]. Moreover, the specific gravity of bamboo is relatively high when compared to the hardwoods or heavy tropical timber species which are normally used in composites panels manufacturing [6]. Thus, it should be used for the high-density composite products such as High-Density Fiber board. These advantages make it highly competitive nature fiber reinforcement in polymer composites.

2. OBJECTIVE

The knowledge gap in the present literature review has helped us to set the objectives of this Research work which is pointy highlighted below:

- Extraction of short bamboo fibers.
- Preparation of mould to obtain uniform cylindrical bamboo composite pipes.
• Fabrication of a new class of epoxy-based composites reinforced with short bamboo fibers.
• Evaluation of mechanical properties such as bending and twisting strength.
• The results were studied and compared with the conventional materials and it process that the material developed can be used in structural applications with strong dependence on its mechanical properties.
• The overall objective is to contribute advanced bamboo manufactured product to replace with conventional pipes.

3. METHODOLOGY

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EXTRACTION OF BAMBOO FIBERS

Drying under sun for sufficient time

PREPARATION OF MOULD

PREPARATION OF COMPOSITE

EPOXY RESIN

INSPECTION OF COMPOSITE

TESTING

RESULT DISCUSSION AND CONCLUSION
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a. EXTRACTION OF BAMBOO FIBERS

Soaking the bamboo straps under water for 72 hours to reduce bonding between the bamboo fibre. Hammering the long bamboo strap to extract long bamboo fibre. And finally the long fibre will be dried and will be cut into short pieces and this short fibre will be ready for use.

3.2 PREPARATION OF COMPOSITE

MATERIAL SELECTION

a. EPOXY RESIN

Epoxid resin has wide range of industrial applications because of their high strength and mechanical adhesiveness characteristic. Curing takes place at atmospheric pressure and room temperature after addition of hardener.

b. BAMBOO FIBER
Bamboo fiber has been used as a reinforcing material in all composite. The average length of a bamboo fiber is about 10 mm and average diameter is between 10-20µm.

c. PREPARATION OF MOULD

Fig.3.2(c) mould

Preparation of uniform wall thickness bamboo composite involves the preparation of mould as per ASTM standard having external diameter 33.22mm and internal diameter 25.40mm using PVC pipe, MS rod and end caps to avoid the leakage.

d. PREPARATION OF COMPOSITE

Fig.3.2(f) bio composite pipe

- The fabrication of composite was carried out by using epoxy as matrix material and bamboo fiber as reinforced material, mixed in the 60:40 ratio respectively (weight %).
- The mixture of fiber and epoxy resin is stirred and poured into the mould, making sure there are no trapped air bubbles in it.
- The mould is then closed for the purpose of curing, to enhance the mixture to take the desired shape of the mould.
- Then the composite is allowed to be cured in normal atmospheric condition for 24 hours then released using Universal Testing Machine.
4. RESULT

4.1 SEM TEST

![Fig.4.1(a) external Surface finish (x100)](image)

![Fig.4.1(b) internal surface finish of epoxy (x100)](image)

![Fig.4.1(c) edge point view (x250)](image)

![Fig.4.1(d) binding between epoxy and fiber (x500)](image)

![Fig.4.1(e) binding between epoxy and fiber(x1000)](image)

![Fig.4.1(f) breakage point (x100)](image)
4.2 3-BENDING TEST

Test Method: ASTM D 790-03
Test Conducted: 3 Point Bend Test

<table>
<thead>
<tr>
<th>TESTS</th>
<th>RESULTS-1</th>
<th>RESULTS-1</th>
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<tr>
<td>Initial Area mm²</td>
<td>30.00</td>
<td>30.00</td>
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<tr>
<td>3 Point Bend Load KN</td>
<td>1.35</td>
<td>1.41</td>
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<tr>
<td>3 Point Bend Strength MPa</td>
<td>45.32</td>
<td>47.27</td>
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</table>

Fig. 4.2(a) 3-point bending test report with graph

4.3 TORSION TEST

Test Method: ASTM D 790-03
Test Conducted: Torsion Test

<table>
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<th>RESULTS-1</th>
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<td>Initial Area mm²</td>
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<td>Torsion Load KN</td>
<td>2.92</td>
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<td>Torsion Strength MPa</td>
<td>97.37</td>
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Fig. 4.2(b) Torsion test report with graph
5. CONCLUSION

We have extracted shot bamboo fibers and fabricated biodegradable bamboo composite pipe with uniform wall thickness. By doing this project we have gained good knowledge about natural fibers and the mechanical tests were conducted and results were discussed. By seeing the test results, we here by conclude that the bamboo fiber with epoxy composite has achieved better result as per our result. By seeing the test results, here by we conclude that the bamboo fibre having 107.89Mpa torsion Strength and 47.27Mpa bending strength can be used as composite for Street light poles and light weight application

6. APPLICATIONS

- Street light poles
- Boarding’s
- Hoarding’s
- Water supply pipe
- Stair case rails
- Light weight applications

7. SCOPE OF FUTURE WORK

Composite pipe use has been established in flow line, gathering line, and distribution systems associated with natural gas transmission. Flow line and gathering line systems share common barriers, but they are for the most part being adequately addressed by industry. By far, the biggest technology challenge is finding stronger, less expensive, and longer lasting pipeline materials for large diameter and high-pressure/high-volume transmission fluid systems. The barriers to using composite in tubular and transmission lines are both financial, technology and perception based. Current resin/fiber-based composite pipe is far more expensive than steel in the sizes need especially for transmission lines. However, FRP are being looked at because of their superior corrosion resistance and high strength-to-weight ratio. Experimental results show that only AR-glass has the strong corrosion resistance. The other three are moderately corrosion
resistant. Therefore, it’s also necessary to look back FRP materials for further improvement.

All the areas listed above are potential research areas, but some such as transportation and handling would be further in the future. Research areas that could provide quick dividends include: composite materials – resins and fibers. Combinations of exotic fibers and traditional materials are useful to maximize strength and minimize cost. Compatibility of these materials with sour gases and natural gas products; joining of composite materials, composite-to-composite, and composite-to-metal; on site manufacture of continuous lengths of composite pipe – equipment design, materials; and on-site coating or overlay of steel pipe with a composite material prior to burial.

Finally, it is very attractive to think in the line of sustainable composite material development. This will bring more appealing environment-friendly