

# International Journal of Innovative Research in Science, Engineering and Technology

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## Effect of Carbon Nano Tubes on Banana Fiber Reinforced Materials

Vinitha T<sup>1</sup>, Santhosh Kumar D<sup>2</sup>, Pradeepkumar S L<sup>3</sup>, Deeban B<sup>4</sup>

Assistant Professor, Department of Aeronautical Engineering, Kalaignar Karunanidhi Institute of Technology  
Coimbatore, India<sup>1,2,3,4</sup>

**ABSTRACT:** The need of light weight components in aerospace applications result in the formation of new composite materials. The investigation of the effect of Carbon Nano Tube (CNT) with the natural banana fiber results in the improvement of tensile, flexural behaviour of multiwall Carbon Nano Tube. Carbon Nano Tubes are preferred and used because it is strong, flexible, and stiffest material and it is also a good thermal insulator. Banana fiber is preferred and used because of it is highly strong fiber, light in weight, smaller elongation. The cultivation of banana in India is plenty so the use of its fibre will be more attractive for economical production of composites. The unique chemical composition with multiwalled Carbon Nano Tubes microstructures and natural banana fiber brought into the improvement of mechanical properties of natural reinforced fiber composites.

**KEYWORDS:** Banana Fiber, Carbon Nano Tubes, Strong fiber, Natural fiber composite

### I. INTRODUCTION

Various materials that have been explored as an alternate to iron and steel for the use in automotive, plastics claim a major share. Plastics are used for almost everything from the articles of daily use to complicated structures, machine components etc. Plastics find an extensive application as they have less weight, low water absorption, high stiffness and strength. At present, due to uncertain conditions in the shortage and the cost of petroleum, and it's by products, there is a need to search for its alternate, which is nothing but natural fibers. In recent years the vegetable/plant fibers proves itself as an alternative fiber to its synthetic counterpart. Natural fibers are cheaper, bio-degradable and have no health hazard. Furthermore any natural fiber as reinforced fibers are seen to have very good potential in the future. Natural fibers are extracted from various plant parts such as jute, coir, banana, sisal, etc. these fibers are easily available in countries such as India, Sri Lanka, and some of the African countries now a days yarns, ropes, mats, matting, hangings, table mats, handbags, and purses are manufactured using these fibers. But some of the fibers such as pineapple, sisal, banana, coir etc. these fibers are also used for industrial purpose.

### BANANA REINFORCED FIBRES

Due to low density, high tensile strength, high tensile modulus, and low elongation at yield point of banana fibers, composites based on these fibers have very good potential use in the various sectors like construction, automotive, machinery, etc., As India is one of the largest banana producing countries in the world the use of its fiber and its wastes for producing useful components would be very attractive for the economy. Banana fiber and its composites can be further attractive if a suitable cost-effective design method of fiber separation and its composite production may increases its application to a greater extend

### CARBON NANO TUBES

Carbon nanotubes (CNTs) are cylindrical molecules that consist of rolled-up sheets of single-layer carbon atoms (graphene). They can be single-walled (SWCNT) with a diameter of less than nanometer (nm) or multi-walled

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(MWCNT), consisting of several concentrically interlinked nanotubes, with diameters reaching more than 100 nm. Their length can reach several micrometers or even millimeters. CNTs also have unique thermal and mechanical properties that make them intriguing for the development of new materials



Figure 1: carbon nano tubes

## II.MANUFACTURING TECHNOLOGIES

The composite reviewed in this Paper are manufactured by using molding technology. Open molding method is mainly used to produce the high volume and critical application products. The design of the materials can be easily changed by using this method of molding and cost to finish the making of products are less compared to closed molding method. The disadvantage of following this method is that the operator should be very skilled in manufacturing the products. The types of open molding processes are spray lay-up, hand lay-up, filament winding, sheet molding compound, expansion tool molding and contact molding.

### HAND –LAY UP MOLDING

Hand lay-up is the earlier method to manufacture the composite parts. Here, the layers of fibers are arranged in unidirectional or different directions for the improvement of laminated composite materials in order to achieve the desirable properties. The catalyzed resins are impregnated by hand into woven, knitted, stitched fibers. After that, nip roller type impregnators are rotated over the fiber and resins to make those into fabricated materials. Then, the laminates are kept for curing under standard atmospheric conditions. Hand layup method is a type of continuous fiber reinforced composites. The advantage and drawbacks of this method are sandwich constructions and waste factor can be high respectively.

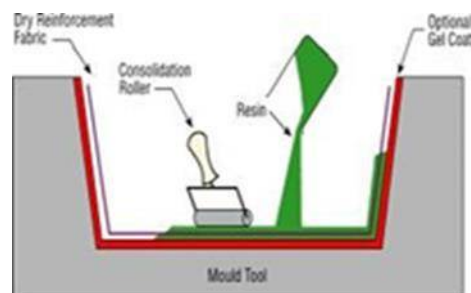


Figure 2: Hand-layup process

## III.PREPARATION

**Banana Fiber Processing and Weaving:** The extraction of the natural fiber from the plant required certain care to avoid damage. In the present experiment, initially the banana plant sections were cut from the main stem of the plant and then rolled lightly to remove the excess moisture. Impurities in the rolled fibers such as pigments, broken fibers,

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coating of cellulose etc., were removed with a special machine was designed and developed for the extraction of banana fibers in a mechanically automated manner. It consist mainly of two horizontal beams whereby a carriage with an attached and specially designed comb, could move back and forth. The fiber extraction using this technique could be performed simply by placing a cleaned part of the banana stem on the fixed platform of the machine, and clamped at the ends by jaws. This eliminated relative movement of the stem and avoided premature breakage of fibers. This was followed by cleaning and drying of the fibers in a chamber at 20<sup>0</sup>c for three hours. This fibers were then labeled and ready for lamination process. After extraction of fiber, weaving is done in the looms as per normal process like any other material.



Figure 3: Banana fiber

**Preparing samples with carbon nanotubes:** Carbon nanotubes are mixed with acetone for chemical treatment in the ratio of 1000mg: 500ml. Acetone is used as solvent in order to make resin less viscous and to make the carbon nano tubes dispersed in the epoxy. Acetone need to be removed, in case antraces of acetone might effect curing and stiffness of the composite.



(a)

Figure 4 (a) Mixing of acetone with CNTs



(b)

(b) Magnetic stirrer

The ratio of mixing carbon nano tubes to epoxy is 6%,this mixture is stirred mechanically by using magnetic stirrer under 60 centigrade with 300 rpm till the evaporation of acetone from the mixture, then harder is added to the mixture and resin is impregnated using hand layup.

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Figure 5: Banana fiber with CNT composite

## IV. TESTS

**Tensile Test:** The specimens cutted in ASTM A 370 : 2017 size prepared and for tensile test, the testing is done using UTM to measure the force required to break a polymer composite specimen and the extent to which the specimen stretches or elongates to that breaking point



Figure 7: Testing in UTM

S.NO	COMPOSITE MATERIAL	YIELD STRESS (N/mm <sup>2</sup> )	TENSILE STRENGTH (N/mm <sup>2</sup> )	ELONGATION AT BREAK (mm)
1	Banana fiber epoxy	6.79	11.41	0.9508
2	Banana fiber with CNT	11.73	14.741	3.152

Table 1: Comparison between Banana Fiber epoxy and Banana Fiber with CNTs of Tensile Test

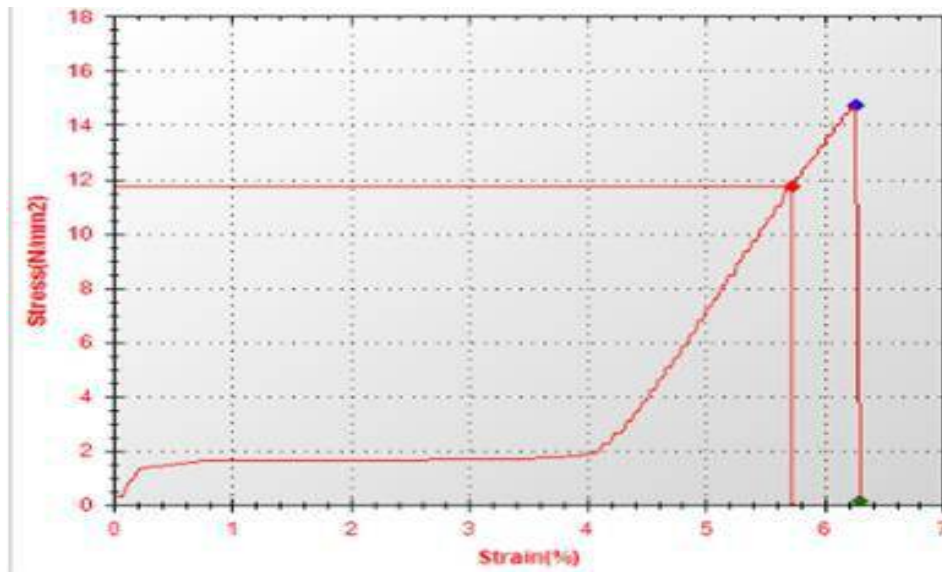
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## Stress vs strain

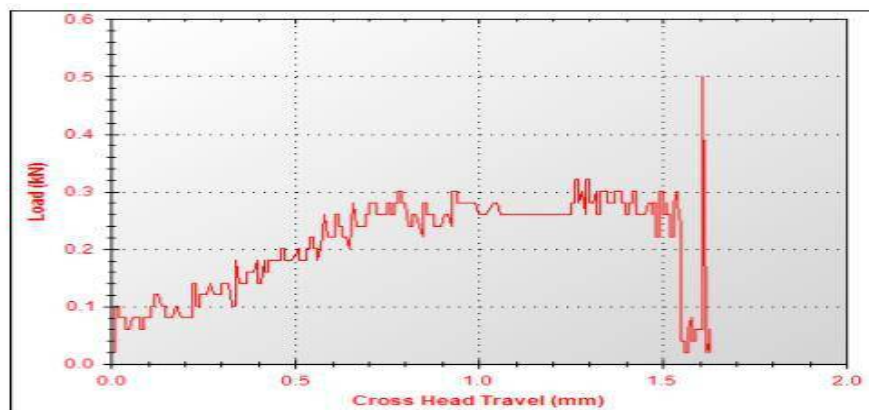


Graph 1: Stress vs Strain for Tensile Test

The composite of banana fiber with CNTs will have more yield stress, tensile strength and elongation at break in comparing with composite of banana fiber epoxy

**Flexural strength:** It is defined as a materials ability to resist deformation under load. It is a 3-point bend test, which generally promotes failure by inter-laminar shear. This test is conducted as per ASTM A 370 : 2017 standard using UTM. Flexural MR is about 10 to 20 percent of compressive strength depending on the, size, volume and type of coarse aggregate used. Anyway the best correlation for specific materials is obtained by laboratory tests for given materials and mix design.

## Load Vs Elongation



Graph 2: Load vs Elongation for Flexural Test

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S.NO	COMPOSITE MATERIAL	LOAD AT PEAK (KN)	SHEAR STRENGTH (N/mm <sup>2</sup> )
1	Banana fiber epoxy	0.030	1
2	Banana fiber with CNT	0.500	3.556

**Table 2: Comparison between Banana Fiber epoxy and Banana Fiber with CNTs of Flexural Test**

The composite combination of banana fiber with CNTs will have more load at peak and shear strength in comparison with composite of banana fiber epoxy.

#### IV.CONCLUSION

In this paper, Mechanical properties of banana fiber composite with carbon nano tube is investigated. The treatment of banana fiber with CNTs has improved the mechanical properties like tensile, and flexural strength than the banana fiber epoxy composite. The application of banana fiber composite with CNTs have a great potential to make light weight sustainable finished products for aircraft flooring, which reduce tremendous amount of energy consumption in the aerospace industry and it also find application in automotive seat shell. Natural fibers have been used as reinforcements in composites due to their low cost and their availability.

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