

# Mechanical Characterisation of Palm Fiber Reinforced Epoxy Composites Filled With Nanoclay

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**ABSTRACT:** The utilization of natural fibers in composite laminates increases day by day because they are abundantly available in nature, bio-degradable, inexpensive and eco-friendly in nature. The current green manufacturing motto is well met by the natural fiber. The objective of this research is to introduce new natural fibers as reinforcement in a polymer matrix along with nano powder as filler material and to develop light weight composite materials. The Borassus fruit fiber (*Borassus flabellifer*) is one such kind which is lingo cellulosic and the fibers can be extracted easily with less energy consumption. The Borassus fruit fibers are inexpensive, naturally available renewable, eco-friendly and hence, the investigation of its potential properties to the technical world is essential. The fiber has better interface with the matrix

**KEYWORDS:** Natural borassus fiber, epoxy resin, nano clay powder, montmorillonite clay

## 1. INTRODUCTION

The objective of this research is to introduce new natural fibers as reinforcement in a polymer matrix and to develop light weight composite materials. Borassus fruit fiber (*Borassus flabellifer*) is one such kind which is lingo cellulosic and the fibers can be extracted easily with less energy consumption. The palm trees bearing Borassus fruits are available all over the world, especially in India. In this work, Borassus fruit fibers were extracted using the retting process. The fibers were alkali treated with the NaOH concentrations and the effects of mechanical properties of Borassus fruit fibers were found experimentally

The resin was prepared with a mixture of epoxy and hardener. Epoxy resin and chopped Borassus fruit fibers were mixed with nano powder clay and the composites were manufactured using compression moulding technique. The specimens were prepared according to the testing standards. The mechanical tests were conducted on these specimens

Then the behaviour of borassus fruit fiber with epoxy resin and nano particles was studied. The result from the complete study of the fiber and nano particles would lead to the path of making applications product to prove the viability of the borassus fruit fiber epoxy nano composites.

The detailed experimentation on borassus fruit fibre and their reinforcement in epoxy resin brought out following conclusions. The composite products manufactured that were light in weight, low cost, and asthetic in appearance. . Also the performance of the products paved the way for the replacement of synthetic fibers by Borassus fruit fibers in making commercially valued products.

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## II. MATERIALS AND METHODS

In this project the main requirements of the composites are made up of the following raw materials. They are

- Palm fiber
- Epoxy resin
- Hardener
- Nano clay powder
- Sodium hydroxide solution
- Grease
- Compression moulding equipments

The palm tree containing Borassus fruits are available all over the world, especially abundantly in India. The palm tree is a native of tropical Africa but cultivated and naturalized throughout India. The palm is a large tree which may grow up to 30 m height and the trunk may have a circumference of 1.7 m at the base. There may be 25-40 fresh leaves. Leaves are leathery, grey green, fan-shaped, 1-3 m wide, folded along the midrib are divided at the center. Their strong stalks, 1-1.2 m long, are edged with hard spines.

The palm trees are usually grown well in the dry areas and are drought resistant. The life of the trees will be more than 100 years. In India, it is planted as a windbreak on the plains. It is also used as a natural shelter by birds, bats and wild animals. The coconut-like fruits are three-sided when young, becoming rounded or more or less oval, 12-15 cm wide and capped at the base with overlapping sepals. When the fruit is very young, this flush is hollow, soft as jelly and translucent like ice and is accompanied by a watery liquid, sweetish and potable.

The Borassus fruit fiber is a cellulosic fiber. The cellulose is a long chain polysaccharide made up of glucose monomer units, which are alternately rotated to 180 degrees. Cellulose molecules align to form micro fibrils of diameter of about 3-4 nm. Matured Borassus fruit contains cellulosic semi-solid flush which is reinforced by the Borassus fruit fibers. The botanical name of Borassus fruit fiber(a) is **Borassus flabellifer** of family palmae.



(a)



(b)

In this progress the natural borassus fruit fiber are extracted directly from the palm tree. Then the fruit are made to dry to get a raw fiber for the progress of composites. Then the raw fiber are treated with the sodium hydroxide solution to remove the impurities and to make the fiber spongy and to remove the sticky nature of the fiber. Then the fiber are chopped to small sizes to create a matrix composites with resin.

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The chopped fibers are then made to mix with the epoxy resin and the hardener to form a plate. Another specimen is formed using the nano clay powder with some proportions. Then the mixed matrix are set in the compression moulding equipments and some force is applied. The epoxy resin will take a setting time of 12 hours. Then the specimens are cut for the testing purposes. After the cutting process the specimens are tested

### III. EXPERIMENTAL RESULTS

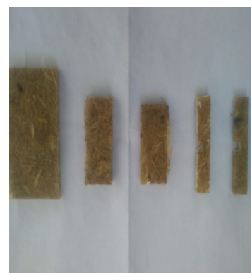
The tensile and flexural test specimens (a) are made without nano powder and tested and their results are tabulated below. Then the specimens with nano powder (b) are tested and the results are tabulated below. Then the specimens are tested for the impact and the hardness test without nano powder (c). Then the specimens with nano powder are tested for the impact and hardness test (d).



(a)



(b)



(c)



(d)

#### TESTING RESULTS (A) TENSILE TEST

#### (B) FLEXURAL TEST

MATERIAL	SPECIMENS	ULTIMATE STRESS (Mpa)
With nano powder	T1	17.564
	T2	22.414
	T3	24.204
Without nano powder	T1	27.329
	T2	24.990
	T3	10.217

MATERIAL	SPECIMEN	COMPRESSIVE STRENGTH (Mpa)
With nano powder	F1	1.445
	F2	1.826
	F3	1.206
Without nano powder	F1	2.686
	F2	1.020
	F3	1.423

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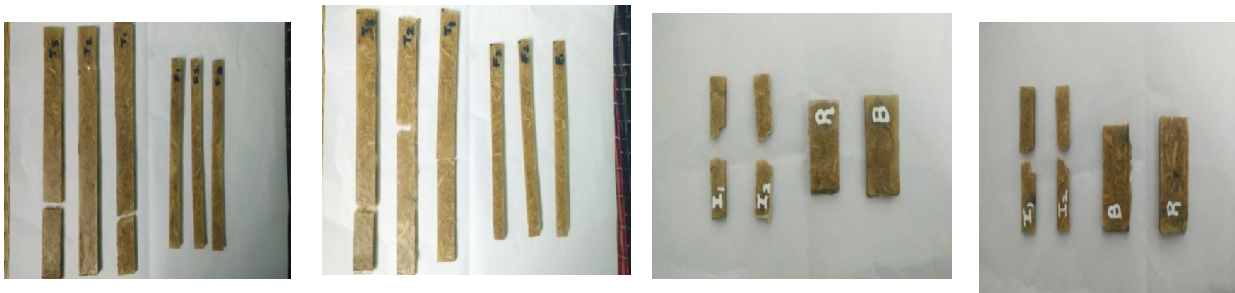
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(c) IMPACT TEST

(D) HARDNESS TEST

NOTCH	PALM AND EPOXY COMPOSITES	PALM AND EPOXY WITH NANO COMPOSITES	TESTS	PALM AND EPOXY COMPOSITES	PALM AND EPOXY WITH NANO COMPOSITES
U NOTCH	IMPACT STRENGTH IS 34 JOULE	IMPACT STRENGTH IS 26 JOULE	BRINELL HARDNESS	147.84BHN	1137BHN
V NOTCH	IMPACT STRENGTH IS 36 JOULE	IMPACT STRENGTH IS 32 JOULE	ROCKWELL HARDNESS	67.3RHN	56RHN

The tested specimens after the testing process are figured below. The test specimens in the tensile test and flexural test without nano powder(e) and with the nano powder(f) are figured below. Then the specimens with the nano powder (g) and without nano powder(h) are exhibited below that are tested for the impact and the hardness test that are listed below.



(e)

(f)

(g)

(h)

From the above tested specimens and the tested results of the various specimens the following conclusions is made. It is found that the specimen with the nano powder possess low strength than the specimen without the nano powder. The specimen with the nano powder possesses low strength in all the mechanical testing process. In other case the material that is made with the palm fibre and the epoxy resin posses high strength.

### IV. CONCLUSION

From the above testing process the mechanical characteristics of the fiber nano composites are sorted out. We have implemented an material such that the material made up of nano material posseses low tensile and flexural strength than the material made up of palm fiber and the epoxy composites

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### REFERENCES

1. Abdelmouleh, M., Boufi, S., Belgacem, M. N. and Dufresne, A. "Short Natural-Fiber Reinforced Polyethylene and Natural Rubber Composites: Effect of Silane Coupling Agents and Fibers Loading", *Composites Science and Technology*, Vol. 67, pp.1627-1639, 2007.
2. Acharya, S. K., Punya Priya Mishra and Mehar, S. K. "The influence of fiber treatment on the performance of Bagasse fiber-reinforced polymer composite", *Journal of Reinforced Plastics and Composites*, Vol. 28, No. 24, pp. 3027-3036, 2009.
3. Ahmad Alawar, Hamed, A. M. and Khalifa Al-Kaabi. "Characterization of treated date palm tree fiber as composite reinforcement", *Composites: Part B*, Vol. 40, pp. 601-606, 2009.
4. Alexandre Gomes, Takanori Matsuo, Koichi Goda, and Junji Ohgi. "Development and Effect of Alkali Treatment on Tensile Properties of Curaua Fiber Green Composites", *Composites: Part A*, Vol. 38, pp. 1811-1820, 2007.
5. Alireza Ashori, Zaker Bahreini. "Evaluation of calotropis gigantean as a promising raw material for fiber- reinforced composite", *Journal of Composite Materials*, Vol. 43, pp.1297-1304, 2009.
6. Alix S., Philippe E., Bessadok A., Lebrun L., Morvan C. and Marais S. "Effect of chemical treatments on water sorption and mechanical properties of flax fibers", *Bioresource Technology*, Vol. 100, pp.4742-4749, 2009.
7. Alok Kumar Jha, Sisir Mantry, Alok Satapathy, and Amar Patnaik. "Erosive Wear performance analysis of Jute-Epoxy-Sic Hybrid Composites", *Journal of Composite Materials*, Vol. 44, No. 13, pp. 1623-1641, 2010.
8. Amoriello, S., Bianco, A., Eusebio, L. Gronchi P. "Evolution of two acid steps sol-gel phases by FT-IR", *Journal of Sol-Gel Science and Technology*, Vol. 58, pp. 209-217, 2011.