Retraction

Retraction: Mechanical behaviour of natural coconut/banana fiber reinforced composites (*IOP Conf. Ser.: Mater. Sci. Eng.* **1145** 012095)

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[1] Cabanac G, Labbé C and Magazinov A 2021 arXiv:2107.06751v1

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Mechanical behaviour of natural coconut/banana fiber reinforced composites

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Abstract. In today's trend, research on composites is growing, and there is always a need for alternative materials. Natural fibre reinforced composites were chosen over man-made fibres because they are easier to fabricate and use less energy. It's also affordable and has a power that's equivalent to synthetic fibres. A composite is made up of a matrix phase and a non-matrix phase. A composite is made up of two phases: matrix and reinforcement. Resin + hardener are the matrix phases used. It is a primary phase that has a constant shape. This step is normally more ductile and less hard. coconut and banana fibre form the reinforcing process, which has a discontinuous form. As compared to matrix process, it normally has more power. The properties of a 0%, 1%, 3% and 5% of nano material imposition were compared. In comparison a plate with 5% Nano Silica has maximum (tensile & flexural) strength. The plate with a 1% Nano silica has the highest impact strength.

Keywords: Composites, Coconut and Banana fiber, Orientation

1. Introduction

Fibers are weightless and has high level of strength and stiffness, they have been extensively used in a variety of applications. [1] Fiber and matrix are the two elements that make up FRC. In contrast to natural fibre composites, synthetic fibre composites (SFC) have superior mechanical properties (NFC). However, synthetic fibres cannot be degraded easily and causes massive contamination of the atmosphere, which is a source of concern for the officials. As a result, the use of synthetic fibres must be limited or substituted completely with natural fibres, based on the function and intensity specifications of the FRC. Natural fibres are appealing alternatives to man-made fibres. [2,3], such as in automobile [4] and in a number of customer profit-making schemes. Congenital fibres have many properties that make them suitable to be used as a filler or insulation in polymer components, including less mass to weight ratio , its capacity to decompose, ample abundance, non-abrasiveness, and being less or not toxic. [5-8].
Table 1. Properties of banana fiber

| Chemical constituents (%) |  |
|---------------------------|---|
| Cellulose                | 60-64 |
| Hemicellulose            | 6-19  |
| Lignin                   | 5-10  |
| Wax                      | 1.5   |
| Ash                      | 1     |

Physical properties of Banana fiber

|                           |     |
|---------------------------|-----|
| Diameter (μm)             | 80-250 |
| Density (kg/m³)           | 1350 |
| Tensile strength (MPa)    | 540-900 |
| Young’s modulus (GPa)     | 34.8 |
| Microfibrillar angle      | 11   |
| Elongation at break (%)   | 4-6.54 |

The current study looks at how banana fibre reinforced epoxy composites with Nano silica filler are processed and characterised. Banana fibre is a fibre extracted from the pseudo-stem of the banana plant (Musa acuminata) and is readily grown anywhere on the globe. The global scenario reveals that banana fibre production is rising due to the wide range of applications. The study's main results indicated that sodium hydroxide treatment strengthened the composite's tensile properties and hardness. It also has a difficult time absorbing moisture.

Table 2. Properties of coconut fiber

| Properties                              | Coconut Fiber |
|-----------------------------------------|---------------|
| Density (kg/m³)                         | 1500          |
| Flexural modulus (GPa)                  | 175           |
| Tensile strength (MPa)                  | 175           |
| Young’s modulus (GPa)                   | 4-6           |

Tensile pressure, modulus, expansion strain at break, and tensile at break are among the tensile tests. Coconut fibre is harvested from the husk of the coconut fruit and is one of the natural fibres common in tropical areas. Not only the physical, chemical and mechanical properties of coconut fibres are shown; but also properties of composites (cement pastes, mortar and/or concrete etc), in which coconut fibres are used as reinforcement, are discussed [9–11].
2. Experimental

2.1 Materials

Fibers like Coconut and Banana were bought from local farmers, Coimbatore, Tamil Nadu, India. Resin, Hardner, Wax polish aasmaa – 200 GM brown was purchased from Covai Seenu and Company, Coimbatore. The physical characteristics of coconut and banana fibers are given in the above Tables 1 and 2.

2.2 Alkali Treatment

Coconut and Banana fiber of size 300 X 300 mm was handled for 1 hour with Sodium hydroxide solutions of concentration 1% respectively. Fresh water is used for washing the fibers and they are dried by keeping in room temperature.

2.3 Preparation of Composite

The coconut palm (Cocos nucifera) can be found all over the tropics, where it is deeply ingrained in the lives of the locals[12]. According to a report, the world produces at least 30 million tonnes of coconut per year, which is plentiful in tropical countries’ coastal regions[13]. It’s made from the leaves of the coconut tree (Cocos nucifera), which have long been used in herbal medicine in northeastern Brazil to cure diarrhea and arthritis[14]. The physical and mechanical properties of banana and coconut fibers are fantastic. The incorporation of coconut and banana fibers greatly increased all of the concrete’s technical properties, including compressive, tensile, and flexural resilience[15].

2.4 Preparation of plate

Wax is applied to both the top and bottom plates of compression moulding machine. Resin Ly 556 (220.5 gm) and Hardener Hy – 951 (24.5 gm) are mixed well. The ratio of resin to fiber mixture is 70% to 30% by mass respectively. The coconut fiber (Layer 1) is kept in the bottom plate with the 0 degree orientation. By using the hand lay-up method, the epoxy applied above. Then, the banana fiber (Layer 2) is kept above with the same 0 degree orientation. Again, the epoxy is applied above the fiber. The compression moulding machine is pressed with the pressure of 1500 psi and the temperature is kept constant with 100 degree Celsius. Then, it is heated for a 1 hour and cooled for 3 hours. Finally, the plate is formed with the thickness of 3mm. Figures 1 and 2 shows the Compression moulding machine setup and Composite plate.

Figure 1. Compression moulding machine setup

Figure 2. Composite plate
3. Result and discussion

3.1 Result

3.1.1 Tensile test

The highest amount that can be withstood by a component before breaking is known as tensile strength. The dog-bone type is the widely used model for tensile testing. ASTM D638 (200x20x3.2 mm) Standard. The specimen dimension is indicated below. The material includes ultimate tensile and yield point for everlasting deformation and the point of rupture (R) or failure where the specimen is separated into pieces. The tensile test is executed on the Instron 1195 (UTM), and tests are evaluated to determine the composite sample tensile power. The values of the tensile test as shown in the Table 3. The Variation of tensile robustness as shown in the Figure 3.

Table 3. Tensile strength

| S.NO | SAMPLES                          | TENSILE STRENGTH (MPa) |
|------|---------------------------------|------------------------|
| 1    | Hybrid composite 0% Nano material | 68.15                  |
| 2    | Hybrid composite 1% Nano material | 77.24                  |
| 3    | Hybrid composite 3% Nano material | 86.21                  |
| 4    | Hybrid composite 5% Nano material | 91.28                  |

Figure 3. Variation of Tensile strength

3.1.2 Flexural test

Flexural resistance is known as the capacity of the materials to withstand deformation under load. It is a tri-point bend experiment, which normally upgrades inter-laminar shear failure. This test is conducted
as per ASTM D790 (127x12.7x3.2mm) standard using UTM. It is measured by loading desired shape specimen with a span length at least three times the depth. The values of the bending test is shown in the Table 4. The Variation of flexural strength as shown in the Figure 4.

Table 4. Flexural strength

| S.NO | SAMPLES                                | FLEXURAL STRENGTH (MPa) |
|------|----------------------------------------|-------------------------|
| 1    | Hybrid composite 0% Nano material      | 38.5                    |
| 2    | Hybrid composite 1% Nano material      | 47.25                   |
| 3    | Hybrid composite 3% Nano material      | 42.26                   |
| 4    | Hybrid composite 5% Nano material      | 51.25                   |

Figure 4. Variation of Flexual Strength

3.1.3 Impact test

A test designed to provide information on how a specimen of a known material can react to a force that is unexpectedly applied, such as shock. A notched check piece is usually used, and either the Izod or the Charpy checks are the two methods of general use. ASTM D256 (63.5x12.7x3.2 mm) standard; The result is usually stated as the energy needed for fracturing the test piece in KJ. The values of the impact test is shown in the Table 5. The Variation of collision strength as shown in the Figure 5.
Table 5. Impact strength

| S.NO | SAMPLES                        | IMPACT STRENGTH (Joules) |
|------|--------------------------------|--------------------------|
| 1    | Hybrid composite 0% Nano material | 2.6                      |
| 2    | Hybrid composite 1% Nano material | 3.23                    |
| 3    | Hybrid composite 3% Nano material | 2.2                      |
| 4    | Hybrid composite 5% Nano material | 2.91                    |

Figure 5. Variation of Impact Energy and strength

4. Conclusion

The hybrid composite specimens inculcated with nano-material composite are fabricated. The hybrid composites are allowed to undergo tensile, flexural and impact test. Based on the outcomes, the following results are drawn.

- The result indicated that the hybrid composite shows maximum tensile strength when 5% nano-silica is added and can hold the strength up to 91.28 Mpa.
- The result indicated that the hybrid composite shows maximum flexural strength when 5% nano-silica is added and can hold the strength up to 51.25 Mpa.
- The result indicated that the hybrid composite shows atmost collision energy when 1% nano-silica is added and has the value of 3.23 joules.
References

[1] P.K. Mallick (2007), Fiber-Reinforced Composites: Materials, Manufacturing and Design, CRC Press.
[2] M. Kabir, H. Wang, k. Lau, F. Cardona (2012), Chemical treatments on Plant-based natural fiber reinforced polymer composites an overview, Compos, B Eng, 43 2883-2892.
[3] A. Mohanty, M. Misra, G. Hinrichsen, Biofibers (2000), biodegradable polymers and biocomposites: an overview, Macromol. Mater. Eng. 276 1–24.
[4] M. Karus, M. Kaup (2002), Natural fibers in the European automotive Industry, J. Ind.Hemp 7 119–131.
[5] T. Sathishkumar, P. Navaneethakrishnan, S. Shankar, R. Rajasekar (2014), Mechanical properties and water absorption of short snake grass fiber reinforced isophthalic polyester composites, Fibers Polym. 15 1927 1934.
[6] M. Sanjay, B. Yogesha (2017), Studies on natural/glass fiber reinforced polymer hybrid composites: an evolution, Mater. Today: Proc. 4 2739–2747.
[7] L. Yusriaah, S. Sapuan, E. Zainudin, M. Mariattu (2014), Characterization Of physical, mechanical, thermal and morphological properties of agro-waste betel nut (Areca catechu) husk fiber, J. Cleaner Prod. 72 174–180.
[8] M. Chandrasekar, M.R. Ishak, S.M. Sapuan, Z. Leman, M. Jawaid (2017), Review on the characterisation of natural fibers and their composites after alkali treatment and water absorption, Plast. Rubber Compos. 46 119–136.
[9] Kenneth Paul D’SOUZA, Loyd D’SOUZA 2017 Processing and characterization of banana fiber reinforced polymer nano composite, Nanoscience and Nanotechnology 7 (2), 34-37.
[10] Surajit Sengupta, Sanjoy Debnath, Papai Ghosh, Izhar Mustafa Journal of Natural Fibers, 2019, Development of unconventional fabric from bamboo (Musa acuminate) fibre for industrial uses.
[11] M. Suganya and H. Anandakumar, Handover based spectrum allocation in cognitive radio networks, 2013 International Conference on Green Computing, Communication and Conservation of Energy (ICGCE), Dec. 2013.doi:10.1109/icgce.2013.6823431. doi:10.4018/978-1-5225-5246-8.ch012
[12] Haldorai and A. Rani, An Intelligent-Based Wavelet Classifier for Accurate Prediction of Breast Cancer, Intelligent Multidimensional Data and Image Processing, pp. 306–319Florindo Gaspar, Arpan Joshi (2020), Building insulation materials based on agricultural wastes, in Bio-Based Materials and Biotechnologies for Eco-Efficient Construction
[13] Daniele Esquenazi, Marcia D Wigg, Mônica MFS Miranda, Hugo M Rodrigues, João BF Tostes, Sonia Rozental, Antonio JR da Silva, Celuta S Alviano (2002), Antimicrobial and antiviral activities of polyphenolics from Cocos nucifera Linn.(Palmae) husk fiber extract, Research in microbiology 153 (10), 647-652.
[14] Raphael Chacko, S Hema, M Vadivel (2016), Experimental studies on coconut fibre and banana fibre reinforced concrete, International Journal of Modern Trends in Engineering and Science 3 (07), 208-211.