A STUDY ON THE PROPERTIES OF PLANTAIN PSEUDO-STEM FIBRES, PLANTAIN BUNCH FIBRES AND RICE HUSK FOR CONSTRUCTION APPLICATION

Conference Paper · May 2021

CITATIONS
0

READS
204

1 author:

Humphrey Danso
Akenten Appiah-Menka University of Skills Training and Entrepreneurial Development
89 PUBLICATIONS **1,208** CITATIONS

SEE PROFILE

A STUDY ON THE PROPERTIES OF PLANTAIN PSEUDO-STEM FIBRES, PLANTAIN BUNCH FIBRES AND RICE HUSK FOR CONSTRUCTION APPLICATION

Humphrey Danso
Department of Construction & Wood Technology Education, Akenten Appiah-Menkah University of Skills Training and Entrepreneurial Development, P. O. Box 1277, Kumasi Ghana
Email: hdanso@uew.edu.gh; dansohumphrey@yahoo.co.uk

ABSTRACT
In the past decade, the substitution of conventional composite materials with natural fibres such as agricultural by-products have become common in production of sustainable construction materials. The purpose of this study is to assess the properties of plantain pseudo-stem fibres, plantain bunch fibres and rice husk as source of reinforcing elements for composite materials especially for construction application. Experiments conducted revealed that the fibres and the husk have different lengths and diameter, and their surface texture was rough which is likely to improve bond with matrix. It was also found that the specific weight, water absorption, tensile strength and stress-strain properties of the fibres and the rice husk are within acceptable parameters for natural fibre application. The study therefore concludes that the plantain pseudo-stem fibres, plantain bunch fibres and rice husk possess properties that are suitable for use as reinforcement in composite materials for construction application.

INTRODUCTION
The use of conventional building materials such as cement and steel rods has globally contributed to environmental issues, resulting in increased greenhouse gas emission due to the release of CO2 in the atmosphere. Some of the materials can be substituted with natural fibres especially in composite. According to Bonnet-Masimbert et al. (2020), a number of studies used natural fibres such as bagasse, hemp, coir, flax and pineapple as reinforcement and have shown a great potential as building material. The use of natural fibres as building material also helps in reducing the energy footprint of buildings thereby contributing to sustainable construction application. Recent advances in the application of natural fibres as reinforcement in composite materials are applicable in aerospace parts, automotive components, sporting equipment and building construction (Ighalo et al., 2020).
A number of natural fibres properties have been investigated, including oil palm, coconut, bagasse, raffia fiber, cassava, ambarella, Cocos Nucifera and oil palm broom fibres (Danso, 2017; Stanislasa et al., 2020; Prakash & Kavitha, 2020; Danso et al., 2017; Momoh et al., 2020). However, there are other natural fibres that have potential for composite materials such as plantain pseudo-stem, plantain bunch and rice husk which their properties have not yet be investigated. This study, therefore, seeks to assess the properties of plantain pseudo-stem fibres, plantain bunch fibres and rice husk as source of reinforcing elements for composite materials especially for construction application.
The fibres and husk used in this study are plantain pseudo-stem fibres, plantain bunch fibres and rice husk. These fibres were sourced from different locations in Ghana. The properties of the fibres and the husk were determined through laboratory experimental testing. The various analysis and tests conducted on the fibres and the husk are scanning electron microscope (SEM) analysis, energy dispersive spectrometer (EDS) analysis, length and diameter test, specific weight test, water absorption test and tensile strength test.

RESULTS AND CONCLUSIONS

The result obtained from the SEM analysis is shown in the Fig. 1, and their surface texture was rough which is likely to improve bond with matrix. The physical and mechanical properties of the fibres and the husk are presented in the Table 1. The plantain pseudo-stem fibres were characterized as long lengths because the fibres can take the entire height of the plantain tree which can grow even beyond 4m. The mean lengths of the plantain bunch fibres and the rice husk were 391.33 and 8.94mm respectively. The fibres and the husk recorded mean specific weight of 0.35, 0.48 and 0.67g/cm3 respectively for plantain pseudo-stem fibres, plantain bunch and rice husk. The difference between the specific weight of the fibres and the husk was found to be positive and significant (t=5.381 and p=0.016). The result shows mean absorption rate of 245, 174 and 58% respectively for plantain pseudo-stem fibres, plantain bunch fibres and rice husk, with t-test result of t=2.917 and p=0.048 suggesting that the difference between them are positive and significant. The mean tensile strengths recorded are 59.9, 77.1 and 101.6N/mm2 respectively for plantain pseudo-stem fibres, plantain bunch fibres and rice husk, and the difference between them are positive and significant (t=6.574 and p=0.022). it was also observed that the plantain bunch fibres had the highest strain, followed by the plantain pseudo-stem fibres, while the rice husk had the least strain. The study therefore concludes that the plantain pseudo-stem fibres, plantain bunch fibres and rice husk possess properties that are suitable for use as reinforcement in composite materials for construction application.

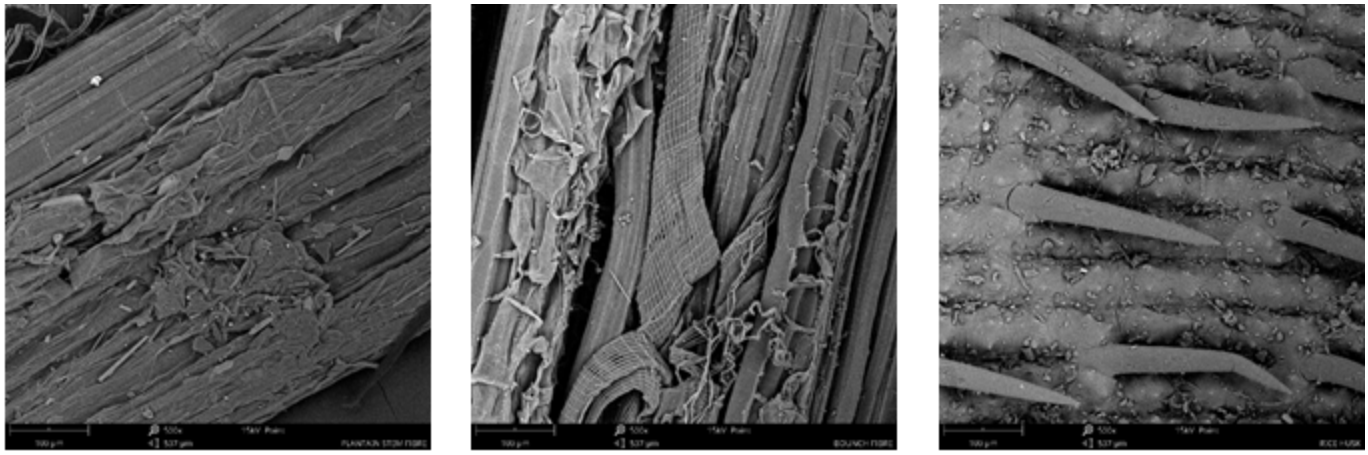

Fig. 1. SEM images of the fibres and the husk

Table 1: Properties of fibres and husk

Fibre/husk	Length (mm)	Diameter (mm)	Specific weight (g/cm^3)	Water absorption (%)	Tensile strength (N/mm^2)
Plantain pseudo-stem	Long	0.65 ±0.36	0.35±0.043	245 ±37.03	59.9 ±10.62
Plantain bunch	391.33 ±80.8	0.52 ±0.21	0.48±0.051	174 ±29.38	77.1 ±12.76
Rice husk	8.94 ±0.9	1.90 ±0.44	0.67 ±0.089	58 ±6.12	101.6 ±20.02
t-value	-	2.326	5.381	2.917	6.574
p-value	-	0.0128	0.016	0.048	0.022

REFERENCES

[1] Bonnet-Masimbert P.-A., Gauvin F., Brouwers H.J.H., Amziane S. (2020). Study of modifications on the chemical and mechanical compatibility between cement matrix and oil palm fibres. Results in Engineering, 7, 1-9, https://doi.org/10.1016/j.rineng.2020.100150

[2] Danso, H., Martinson, D. B., Ali, M. & Williams, J. B. (2017). Mechanisms by which the inclusion of natural fibres enhance the properties of soil blocks for construction. Journal of Composite Materials, 51(27), 3835–3845

[3] Danso H. (2017). Properties of Coconut, Oil Palm and Bagasse Fibres: As Potential Building Materials. Procedia Engineering, 200 (2017), 1–9.
[4] Ighalo J. O., Adeyanju C. A., Ogunniyi S., Adeniyi A. G. & Abdulkareem S. A. (2020): An empirical review of the recent advances in treatment of natural fibers for reinforced plastic composites, Composite Interfaces, https://doi.org/10.1080/09276440.2020.1826274
[5] Momoh E. O., Osofero A. I., Martinez-felipe A. & Hamzah F. (2020). Physico-mechanical behaviour of Oil Palm Broom Fibres (OPBF) as eco-friendly building material, Journal of Building Engineering, https://doi.org/10.1016/j.jobe.2020.101208.
[6] Prakash T. S. & Kavitha, S. (2020). Development of Non-Woven Landscape Fiber Mat with Cocos Nucifera Fiber and Its Testing Property. Tathapi, 19(29), 164-169.
[7] Stanislasa T. T., Tendob J. F., Ojoa E. B., Ngasoha O. F., Onwualuc P. A., Njeugnad E. & Juniore H. S. (2020). Production and Characterization of Pulp and Nanofibrillated Cellulose from Selected Tropical Plants. Journal of Natural Fibers, https://doi.org/10.1080/15440478.2020.1787915