

Mechanical Properties of Enset Fibers Obtained from Different Breeds of Enset Plant

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Abstract : Enset fiber is agricultural waste and available in a surplus amount in Ethiopia. However, the hypothesized variation in properties of this fiber due to diversity of its plant source breed, fiber position within plant stem and chemical treatment duration had not proven that its application for the development of composite products is problematic. Currently, limited data are known on the functional properties of the fiber as a potential functional fiber. Thus, an effort is made in this study to narrow the knowledge gaps by characterizing it. The experimental design was conducted using Design-Expert software and the tensile test was conducted on Enset fiber from 10 breeds: Dego, Dirbo, Gishera, Itine, Siskela, Neciho, Yesherkinke, Tuzuma, Ankogena, and Kucharkia. The effects of 5% Na-OH surface treatment duration and fiber location along and across the plant pseudostem was also investigated. The test result shows that the rupture stress variation is not significant among the fibers from 10 Enset breeds. However, strain variation is significant among the fibers from 10 Enset breeds that breed Dego fiber has the highest strain before failure. Surface treated fibers showed improved rupture strength and elastic modulus per 24 hours of treatment duration. Also, the result showed that chemical treatment can deteriorate the load-bearing capacity of the fiber. The raw fiber has the higher load-bearing capacity than the treated fiber. And, it was noted that both the rupture stress and strain increase in the top to bottom gradient, whereas there is no significant variation across the stem. Elastic modulus variation both along and across the stem was insignificant. The rupture stress, elastic modulus, and strain result of Enset fiber are 360.11 \pm 181.86 MPa, 12.80 \pm 6.85 GPa and 0.04 \pm 0.02 mm/mm, respectively. These results show that Enset fiber is comparable to other natural fibers such as abaca, banana, and sisal fibers and can be used as alternatives natural fiber for composites application. Besides, the insignificant variation of properties among breeds and across stem is essential for all breeds and all leaf sheath of the Enset fiber plant for fiber extraction. The use of short natural fiber over the long is preferable to reduce the significant variation of properties along the stem or fiber direction. In conclusion, Enset fiber application for composite product design and development is mechanically feasible.

Keywords : Agricultural waste, Chemical treatment, Fiber characteristics, Natural fiber

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