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Exploring the potential of waste leaf sheath date palm fibres for composite reinforcement through a structural and mechanical analysis

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Abstract

This work proposes a multi-scale study of the properties of leaf sheath date palm fibres currently considered as agricultural waste. Firstly, by using optical and electronic microscopy, two main types of bundles were identified which have profoundly different structures. Biochemical analysis and X-ray diffraction (XRD) revealed a low degree of crystallinity but a significant lignin content of about 17% giving the bundles a very cohesive structure as well as a good thermal stability in addition to a singular behaviour in dynamic vapour sorption. An average cell wall stiffness in the order of 16 GPa was highlighted by Atomic Force Microscopy in mechanical mode but tensile tests on bundles have revealed low stiffness and strength but a high elongation. These results combined with the cellular structure of these bundles, provides the potential of these wastes as cost effective and environmentally friendly composite reinforcements for high energy absorption and improved acoustics functions.

Keywords: Natural fibres; Chemical analysis; Microstructural analysis; Mechanical properties

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