

Assessment of Variability in Geographic, Mechanical and Morphological Properties of Long Fiber Date Palm Tree Composites Reinforced with Recycled Polypropylene

Sulaiman Al Siyabi¹, Mahmoud Al Safy², [Khalid Alzebdeh](#)²

¹University of Technology and Applied Science, Muscat, Oman. ²Sultan Qaboos University, Al Khod, Oman

Abstract

Date palm fibers (DPF), widely utilized natural fibers in the Middle East and abundantly available in the Sultanate of Oman, offer significant potential for sustainable material development. As large quantities of date palm agri-residual waste accumulate annually without proper utilization, this study explores their value in reinforcing polymers to produce eco-friendly composites for diverse industrial applications. Leveraging the unique mechanical, chemical, and physical properties of DPF, this research examines the inherent variability of these fibers based on geographic origin and fiber type, addressing a critical gap in understanding their applicability in modern composite industries.

The study focuses on assessing the variability in geographic, mechanical, and morphological properties of long-fiber date palm tree composites reinforced with recycled polypropylene (rPP). Natural fibers were collected from Al-Khalas date palm in three distinct regions of Oman Al-Batinah, Al-Dakhliyah, and Muscat and extracted from the midrib and pedicel parts of the trees. These fibers underwent hot water treatment, 5% NaOH chemical treatment, and were left untreated for comparative analysis. Comprehensive characterization included FTIR to analyze chemical composition and detect structural changes, SEM to examine microstructure, and tensile testing to assess mechanical properties, all following ASTM standards.

Composite materials were then fabricated using the treated and untreated fibers as reinforcements for recycled rPP. These composites were evaluated through tensile and flexural strengths and morphological analysis via SEM to investigate fiber-matrix interaction. The study identifies how fiber type, treatment method, and geographic origin influence the performance of both fibers and composites, providing valuable insights into optimizing performance.