

Optimizing Eco-Friendly Composite Materials: A Statistical Approach for Cantala Fiber and MWCNT Reinforced Nanocomposites with Enhanced Impact Strength

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Abstract: This article aims to foster an environmentally friendly, low-cost natural fibre (Agave Cantala Fibre) and MWCNT (Multi-Walled Carbon Nanotube) composite by the robust experimental design approach. Specifically, the study's primary goal is to use the Mixture Design approach to optimize the composition of natural fibre-reinforced polymer nanocomposites for material impact strength. The study results show that MWCNT and Cantala fibre are starring in augmenting the composite's impact strength. Furthermore, it is discovered that interactions between one of the composition's second-order parameters are statistically significant. As a result, for the novel composite material, a Quadratic model with residual analysis is proposed. Furthermore, the approach aids in optimizing the mixture component amount of the novel composite material to maximize the impact strength. The study will help develop an optimal combination of component mixtures and establish a predictive model for an eco-friendly composite material through the structured statistical methodology, which will guide practitioners and academicians to optimize the composition of materials, focusing on natural fibre-reinforced nanocomposites. This material will assist in cleaner and greener manufacturing of composite materials. The approach adopted will help researchers as a template for robust composite material development.

Keywords: Agave Cantala Fibre; Multi-Walled Carbon Nanotubes (MWCNT); Natural Fibre-Reinforced Polymer Nanocomposites; Impact Strength Optimization; Quadratic Modeling; Residual Analysis