

## ABSTRACT

In the contemporary world, natural fibre reinforced polymer composite materials are of great interest owing to their eco-friendly nature, light weight, life cycle superiority, biodegradability, low cost, noble mechanical properties along with their developing demand for the environmental sustainability of engineering materials. In this regard, this current study aims to fabricate and optimise the composites using various influencing parameters such as Duration of fibre treatment, Fibre treatment % of NaOH, Fibre Hybridization Proportion, Fibre Length. Gongura, Madar and hibiscus fibres were used in varying parameters to create polyester-based natural fibre composites. After fabrication, the mechanical characterization like tensile, flexural, and water absorption properties of the composites were tested. Taguchi experimental design was applied, and the results were analysed using experimental Taguchi analysis, minitab analysis, and Taguchi- grey relational analysis. It was observed that a combination of 18 hours of Fibre treatment, Fibre treatment 10 % of NaOH, Fibre hybridization Proportion 60%, Fibre Length 6mm had the most desirable mechanical properties in the fabricated composites. From this analysis; duration of fibre treatment is the main significant factor contributing 48% to tensile and flexural strength, duration of fibre treatment and fibre length are the main significant factors contributing 34 % to water absorption. The confirmation test carried out to validate the optimized results and it was found that the Experimental - Taguchi analysis, MINITAB analysis, Taguchi grey relational analysis results were similar to the obtained results.

**Keywords:** Natural Fibre Reinforced Composite, Taguchi Method, MINITAB tensile strength, Flexural strength, Water absorption.