Mercerisation optimization of bamboo (Bambusa vulgaris) fibre reinforced epoxy composite structures using Box-Behnken design

ABSTRACT

The objective of this research is to optimize the alkaline treatment variables, including sodium hydroxide (NaOH) concentration, soaking, and drying time, that influence the mechanical behavior of bamboo fiber-reinforced epoxy composites. In this study, a Box–Behnken design (BBD) of the response surface methodology (RSM) was employed to design an experiment to investigate the mercerization effect of bamboo fiber-reinforced epoxy composites. The evaluation of predicted tensile strength as a variable parameter of bamboo fiber (Bambusa vulgaris) reinforced epoxy composite structures was determined using analysis of variance (ANOVA) of the quadratic model. In this study, a total of 17 experiment runs were measured and a significant regression for the coefficient between the variables was obtained. Further, the triangular and square core structures made of treated and untreated bamboo fiber-reinforced epoxy composites were tested under compressive loading. It was found that the optimum mercerization condition lies at 5.81 wt.% of the NaOH, after a soaking time of 3.99 h and a drying time of 72 h. This optimum alkaline treatment once again had a great effect on the structures whereby all the treated composite cores with square and triangular structures impressively outperformed the untreated bamboo structures. The treated triangular core of bamboo reinforced composites gave an outstanding performance compared to the treated and untreated square core composite structures for compressive loading and specific energy absorbing capability.

Keyword: Alkaline treatment; Optimization; Bamboo fibers; Response surface methodology