

Abstract

In this study, a five factor Box-Behnken Design (BBD) was applied to plan and perform experiments for the production of composite polyvinyl chloride (PVC) material. The Box-Behnken Design combined with Response Surface Methodology (RSM) was utilized to optimise the production variables, physical and tensile strength of composite PVC. Design Expert® software version 7.0.0, (Stat-ease, Inc. Minneapolis, USA) was used for the experimental design. The Design Expert® software utilizes the concept of randomization to generate the experimental design. This was achieved by scheduling the experiments in a random manner in order to minimise the effects of unexplained variability in the response. The design involved five different variables; three of which are the composite constituents (PVC, raffia palm and plantain peduncle) and the remaining two are the production variables (temperature and pressure). An assessment of the results showed that the quadratic model was suitable for modelling the responses considered in this study. The R² value was close to one while the standard deviation was equally small. The result of the experimental and RSM predicted results for tensile strength showed that for all responses considered, there was close similarity between the experimental results and those predicted by the quadratic model. The results of the parity plots obtained shown that there was a good fit between the model predictions and the experimental results, thus, validated. Besides, increasing the proportion of PVC resulted in a steep and significant increase in the tensile strength of the composite. Thus, the tensile strength was improved as a result of the synergistic effect of the PVC and the fiber. However, increasing the level of rattan and plantain peduncle did not result in an increase in the tensile strength of the composite and this was as a result of the low lignin content of these fiber materials. Similarly, increasing the temperature and pressure resulted in a decrease in the tensile strength of the composite pipes.