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# Predicting and Optimizing the Mechanical Behavior of a Flax Reinforced Composite

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**Abstract :** This study seeks to understand the mechanical behavior of a natural fiber reinforced composite (epoxy/flax) in more depth, utilizing both experimental and numerical methods. It is attempted to identify relationships between the design parameters and the product performance, understand the effect of noise factors and reduce process variations. Optimization of the mechanical performance of manufactured goods has recently been implemented by numerous studies for green composites. However, these studies are limited and have explored in principal mass production processes. It is expected here to discover knowledge about composite's manufacturing that can be used to design artifacts that are of low batch and tailored to niche markets. The goal is to reach greater consistency in the performance and further understand which factors play significant roles in obtaining the best mechanical performance. A prediction of response function (in various operating conditions) of the process is modeled by the DoE. Normally, a full factorial designed experiment is required and consists of all possible combinations of levels for all factors. An analytical assessment is possible though with just a fraction of the full factorial experiment. The outline of the research approach will comprise of evaluating the influence that these variables have and how they affect the composite mechanical behavior. The coupons will be fabricated by the vacuum infusion process defined by three process parameters: flow rate, injection point position and fiber treatment. Each process parameter is studied at 2-levels along with their interactions. Moreover, the tensile and flexural properties will be obtained through mechanical testing to discover the key process parameters. In this setting, an experimental phase will be followed in which a number of fabricated coupons will be tested to allow for a validation of the design of the experiment's setup. Finally, the results are validated by performing the optimum set of in a final set of experiments as indicated by the DoE. It is expected that after a good agreement between the predicted and the verification experimental values, the optimal processing parameter of the biocomposite lamina will be effectively determined.

**Keywords :** design of experiments, flax fabrics, mechanical performance, natural fiber reinforced composites
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