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Machinability Analysis in Drilling Flax Fiber-Reinforced Polylactic Acid Bio-Composite Laminates

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Abstract : Interest in natural fiber-reinforced composites (NFRC) is progressively growing both in terms of academia research and industrial applications thanks to their abundant advantages such as low cost, biodegradability, eco-friendly nature and relatively good mechanical properties. However, their widespread use is still presumed as challenging because of the specificity of their non-homogeneous structure, limited knowledge on their machinability characteristics and parameter settings, to avoid defects associated with the machining process. The present work is aimed to investigate the effect of the cutting tool geometry and material on the drilling-induced delamination, thrust force and hole quality produced when drilling a fully biodegradable flax/poly (lactic acid) composite laminate. Three drills with different geometries and material were used at different drilling conditions to evaluate the machinability of the fabricated composites. The experimental results indicated that the choice of cutting tool, in terms of material and geometry, has a noticeable influence on the cutting thrust force and subsequently drilling-induced damages. The lower value of thrust force and better hole quality was observed using high-speed steel (HSS) drill, whereas Carbide drill (with point angle of 130^o) resulted in the highest value of thrust force. Carbide drill presented higher wear resistance and stability in variation of thrust force with a number of holes drilled, while HSS drill showed the lower value of thrust force during the drilling process. Finally, within the selected cutting range, the delamination damage increased noticeably with feed rate and moderately with spindle speed.

Keywords : natural fiber reinforced composites, delamination, thrust force, machinability
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