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Minimizing the Drilling-Induced Damage in Fiber Reinforced Polymeric Composites

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Abstract : Fiber reinforced polymeric (FRP) composites are finding wide-spread industrial applications because of their exceptionally high specific strength and specific modulus of elasticity. Nevertheless, it is very seldom to get ready-for-use components or products made of FRP composites. Secondary processing by machining, particularly drilling, is almost always required to make holes for fastening components together to produce assemblies. That creates problems since the FRP composites are neither homogeneous nor isotropic. Some of the problems that are encountered include the subsequent damage in the region around the drilled hole and the drilling – induced delamination of the layer of ply, that occurs both at the entrance and the exit planes of the work piece. Evidently, the functionality of the work piece would be detrimentally affected. The current work was carried out with the aim of eliminating or at least minimizing the work piece damage associated with drilling of FPR composites. Each test specimen involves a woven reinforced graphite fiber/epoxy composite having a thickness of 12.5 mm (0.5 inch). A large number of test specimens were subjected to drilling operations with different combinations of feed rates and cutting speeds. The drilling induced damage was taken as the absolute value of the difference between the drilled hole diameter and the nominal one taken as a percentage of the nominal diameter. The later was determined for each combination of feed rate and cutting speed, and a matrix comprising those values was established, where the columns indicate varying feed rate while and rows indicate varying cutting speeds. Next, the analysis of variance (ANOVA) approach was employed using Minitab software, in order to obtain the combination that would improve the drilling induced damage. Experimental results show that low feed rates coupled with low cutting speeds yielded the best results.

Keywords : drilling of composites, dimensional accuracy of holes drilled in composites, delamination and charring, graphite-epoxy composites
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