EFFECTS OF DRILLING PARAMETERS ON HOLE INTEGRITY WHEN DRILLING HYBRID FIBER COMPOSITE HALF CYLINDERS

BY

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10680

Dissertation submitted in partial fulfillment of

the requirements for the

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(Mechanical Engineering)

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CERTIFICATION OF APPROVAL

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UNIVERSITI TEKNOLOGI PETRONAS, TRONOH, PERAK

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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JASMAINE MARSELLA BINTI AKBAR

ABSTRACT

Hybrid composites consist of two or more types of reinforcing fibers in one or more types of matrices in its construction. This material is being widely used in applications such as aerospace, aeronautical and oil and gas. In conventional machining, drilling is the most applied method accounting for as much as 40% for all material removal process. Drilling of fiber reinforced polymer composite is substantially different from the metallic materials due to different mechanical properties. The drilling of this material may generate delamination of drilled holes on the hybrid composite. This problem has adverse effect on the performance of the structure developed from fiber composites and also their mechanical properties and reliability of produced parts. Machining problems occur mainly due to the diverse fiber and matrix properties, fiber orientation, and inhomogeneity of the material. This study is focused on the investigation of the damage occurred, internal surface roughness and microstructure of the drilled holes in a HFRE composite half cylinders. The parameters studied are narrowed to focus on the effects of the drilling parameters which are feed rate and spindle speed of 40% fiber volume fraction of woven glass and carbon fibers. Carbon and glass fiber reinforced epoxy half cylinders were fabricated using Hand Lay Up Technique. CNC Milling Machine was used to drill holes on the sample at different feed rate (mm/rev) and spindle speeds (rpm). The drilled samples were analyzed in terms of Average Surface Roughness (R_a) using Mitutoyo Surface Roughness Tester SV300, Damage Factor (F_D) using Mitutoyo 3-D Non-Contact Measuring System and Microstructural Analysis using Field Emission Scanning Electron Microscope (FESEM). Best results of Damage Factor (F_D) was obtained from sample A3 [lowest feed rate, 0.05 (mm/rev) and highest spindle speed 3000 (rpm)] with a damage factor of 0.96346 and minimized splintering problem. The F_d was analyzed in terms of splintering problems as there is no hole surface delamination identified from 3-D Non-Contact Measuring System. Best results of Average Surface Roughness (Ra) obtained is 1.343 (µm**)** of hole 2 from Sample A3. The micrograph observation shows no distinct relationship of the drilling

parameters with the results. The best result obtained from the FESEM is from sample C3 (3000rpm, 0.2mm/rev) with no know damages identified.

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