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A.R. Aziz, M.A. Ali, X. Zeng, R. Umer, P. Schubel, W.J. Cantwell

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Transverse permeability of dry fiber preforms manufactured by automated fiber placement

AR Aziz[1], MA Ali[1], X Zeng[2], R Umer*[1, 2], P Schubel[2], WJ Cantwell[1]
[1]Department of Aerospace Engineering, Khalifa University of Science and Technology, Abu Dhabi, UAE.
[2] Centre for Future Materials, University of Southern Queensland, Toowoomba, QLD, 4390, Australia
*Corresponding Author Email: rehan.umer@usq.edu.au
Ph: +61 7 4631 5516

Abstract

This work presents a correlation between the transverse permeability of a preform and the process variability of the automated dry fiber placement manufacturing technique. In this study, an experimental and numerical analysis of the dry tape preform, with a focus on its through-thickness permeability, has been undertaken. Geometric models, containing flow channels of two different width dry tape carbon preforms, have been created in the TexGen modeller. A Computational fluid dynamics (CFD) simulation has been undertaken to obtain the predicted through-thickness-permeability of the dry tape preform. A parametric study on the effect of different dry tape gap sizes on the permeability of the preform is presented. An in-situ compaction study, carried out in an X-CT machine, revealed that the gap sizes were irregular throughout the manufactured preforms. In addition, an experimental investigation of the through-thickness permeability, which is based on a saturated flow condition at a thickness corresponding to full vacuum pressure, is also presented. The permeability prediction based on the X-CT re-constructed geometric model has been validated using the experimental data. A further parametric study has revealed that the process variablity in automated dry fibre placement influences the through-thickness permeability by a factor of upto 5.

Key Words: Modeling; Automated Fiber Placement; Layered structures; Resin flow