

Accepted Manuscript

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PII: S0266-3538(17)31610-X

DOI: [10.1016/j.compscitech.2017.09.011](https://doi.org/10.1016/j.compscitech.2017.09.011)

Reference: CSTE 6900

To appear in: *Composites Science and Technology*

Received Date: 4 July 2017

Revised Date: 22 August 2017

Accepted Date: 9 September 2017

Please cite this article as: Aziz AR, Ali MA, Zeng X, Umer R, Schubel P, Cantwell WJ, Transverse permeability of dry fiber preforms manufactured by automated fiber placement, *Composites Science and Technology* (2017), doi: 10.1016/j.compscitech.2017.09.011.

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Transverse permeability of dry fiber preforms manufactured by automated fiber placement

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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 variability 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

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