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Julie Hemmer, Christian Burtin, Sébastien Comas-Cardona, Christophe Binetruy, Thibaut Savart, Arthur Babeau

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Unloading during the infusion process: direct measurement of the dual-scale fibrous microstructure evolution with X-ray computed tomography

Julie Hemmer[a,b,*], Christian Burtin[a], Sébastien Comas-Cardona[a], Christophe Binetruy[a], Thibaut Savart[b], Arthur Babeau[b]

[a] *GeM Institute, UMR CNRS 6183, Ecole Centrale de Nantes, 1 rue de la Noe, 44321, Nantes Cedex 3, France*
[b] *CANOE plateforme, Cheminnov 2-ENSCBP, 16 avenue Pey Berland,33600 Pessac, France*

Abstract

Composites manufacturing using the infusion process involves an unloading phenomenon due to the vacuum bag flexibility. Additionally, during impregnation, woven or non-crimp fabrics exhibit a dual-scale flow. Usual modeling of both phenomena assumes that the fibrous preform is a continuous medium with a varying permeability. Nonetheless, the permeability is affected by the meso-pores size and spatial distribution, which depend on the compaction state. This paper proposes an experimental method to quantify the evolution of a given dual-scale fibrous microstructure under several controlled flow-induced compaction states. A downsized setup has been designed to conduct in situ infusion of quasi-unidirectional fabrics inside a X-ray Computed Tomography device. The downsized setup reproduces large scale infusion phenomena. Using image processing tools, it is observed that, while the stack thickness increases between dry and saturated states, tows swell and displace. The impact of this microstructural reorganization on the in-plane permeability is also identified.

Keywords: E. Vacuum infusion, D. CT analysis, B. Microstructures, B. Permeability.

*julie.hemmer@ec-nantes.fr