Permeability modelling for Non Crimp Fabrics

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Resin Transfer Moulding (RTM) has proven to be a cost effective production method for near-net shaped products with a high accuracy and a high reproducibility. The application of Non Crimp Fabrics (NCF) in RTM combines improved properties with this relatively low cost production process: the absence of undulation (or crimp) improves the in-plane properties relative to woven fabric composites, whereas the stitches in the material prevent a significant drop of the through-thickness properties.

Costly trial and error process development can be prevented by apt process simulations, which require the appropriate material property data, in this case the permeability of the fabric. So far, both measurements and predictions of the permeability have shown significant scatter, up to an order of magnitude difference.

Previous analytical work [1] has shown that the simulation of the permeability of NCFs requires a significant amount of flow channels in a Representative Volume Element, as the scatter in the local dimensions cannot be resolved by simple averaging. This work is now further elaborated to reach quantitatively correct permeability predictions. The geometry is modelled with more precision and extra features are included in the flow model, with significant effect on the resin flow.

References

[1] R. Loendersloot, The Structure-Permeability Relation of Textile Reinforcements, PhD thesis University of Twente, 2006, ISBN 90-365-2337-0.