Interpretation of permeability in a unidirectional non-crimp stitched preform by geometrical description of the porosity

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ABSTRACT

In the domain of polymeric continuous fiber composites and in the domain of liquid molding processes like RTM, the understanding of the resin flow relies on the microstructural description of the porosity within the preform (fibers, yarns and plies). The more recent the permeability models are, the more the microstructure is taken into account (Gebart, 1992 Lundström, 1995 Lundström, 2001). To highlight the relationship between the microstructure and the permeability a unidirectional non-crimp stitched glass fabric (also called quasi-UD) was chosen for its apparent simplicity. But, even for this simple fabric, primary investigations had shown a complex relation between the geometrical parameters and the volume fraction of fibers (Bizet et al., 2003). In this paper we present on one hand experimental results on permeability (saturated and unsaturated values) and on the other hand a description of the pore structure in the final composite based on lineal size distributions (Matheron, 1967 Serra, 1982). Permeability is an areal hydraulic concept related to the porosity as the well-known Kozeny-Carman equation states. Lineal size distributions give length and area characteristics of this porosity considered at both scales (outside and inside the yarns). The comparison between the two sets of results allows to discriminate the important geometrical parameters from the weak ones for the assessment of permeability. The final goal is to establish a relation between these geometrical parameters and the permeability.

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