INTEGRATED IN-PLANE INFILTRATION SIMULATIONS IN THE DESIGN OF LIQUID COMPOSITE PROCESSING

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ABSTRACT

Composites manufacturing via the liquid processing route is a multi-stage process involving at least two totally different types of materials, the fibre reinforcement and the liquid curing resin. Hence, the computer modelling of such processes comprises the integration of simulations using numerical algorithms from multidisciplinary areas, covering both solid and fluid mechanics. This study adopts the two-phase flow approach in the infiltration of a porous fibrous preform, considering a varying degree of fluid saturation across the preform. The infiltration simulations have been integrated with the numerical results of forming simulations based on the solid mechanics, finite element approach. The local fibre orientation and local fibre fraction predicted from the forming simulations, employing ABAQUS Explicit, are used in a permeability model to predict the in-plane distribution of permeability components across the shaped preform. The predictions of FLOWPOR, an in-house developed two-phase flow algorithm for both orthogonal and non-orthogonal structured grids, are successfully compared with experimental data of the flow progress in in-plane radial diverging flow, in-plane radial converging flow and flow in a hemispherical hat preform geometry. Computer simulations of the infiltration have also been performed for the same case-studies using ABAQUS and a discussion is included of any arising problems.