New Approaches to Accelerate Calculations and Improve Accuracy of Numerical Simulations in Liquid Composite Molding

François Trochu, Edu Ruiz, Vincent Achim, Sofiane Soukane
Centre de Recherches Appliquées Sur les Polymères (CRASP)
Département de Génie Mécanique, École Polytechnique de l'Université de Montréal, H3C 3A7, Canada

Through-thickness flows occur typically in resin transfer molding in the case of thick parts of high fiber volume content containing multi-layer fibrous reinforcements or in thin parts when the mold is heated at a different temperature than the resin. In this latter case, viscosity changes through the thickness of the part. This results in irregular flows, usually faster in the skin when the mold is maintained at a higher temperature than the resin. A new numerical approach was devised to improve the accuracy of numerical simulations of mold filling in Liquid Composite Molding (LCM). The motivation of this investigation is to avoid costly full three-dimensional simulations by using a new hybrid non-conforming element. A mesh is extruded through the thickness of the composite in order to reflect accurately the detailed structure of the laminate. Another way to speed up calculations is to optimize the triangular in-plane mesh of the part before mold filling simulations are carried out. In order to evaluate the advantages of these new approaches in terms of accuracy of the numerical solution and computer time, results obtained with the new finite element are compared with finite element solutions obtained with 2D triangles and 3D tetrahedrons. The numerical performance of calculations performed on an optimized mesh can also be assessed in terms of computer time and ability to conserve the resin mass during mold filling calculations.