Simulation and Verification of Tooling Forces Exerted on Rigid Non-planar LCM Tools

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ABSTRACT: Mould tools used for Liquid Composite Moulding (LCM) processes such as Resin Transfer Moulding (RTM) and Compression RTM (CRTM) must withstand significant forces generated by the fluid and the fibrous reinforcement. Prediction of these forces will allow for optimizations in setup costs and time, and maximize the usage of the capabilities of peripheral equipment (such as presses).

SimLCM is being developed at the University of Auckland as a generic LCM simulation package. It has the capability to predict clamping forces and stress distributions acting on mould tools during complete moulding cycles. Both mixed-elastic and viscoelastic reinforcement compaction models are implemented within the package. A series of experiments have been undertaken to validate predictions made using SimLCM. A non-planar (truncated pyramid) geometry is considered. Consideration of both the normal and shear components of the fibre preform compaction stress and the internally generated fluid pressure is required for non-planar geometries. This is especially important to extend the capabilities of SimLCM from rigid tool processes (such as RTM and CRTM) to include flexible tool processes such as RTM Light and Vacuum Assisted RTM (VARTM). A friction-based model is used to account for the shear component of compaction stress.

Two series of experiments were undertaken; the first employing velocity-controlled compaction throughout, the second employing force-controlled secondary compaction for CRTM. Experimental force traces are compared to predictions made using both reinforcement compaction models implemented in SimLCM. Observations of flow front progression and race-tracking are made using a transparent top mould, and will be compared to predicted progressions.