USING SIMULATION TO ACCOUNT FOR PROCESS VARIABILITY IN LIQUID COMPOSITE MOULDING

Cristian Lira, Miroslav Stojkovic, Joseph Markey, Amit Visrolia and James Waldock.
The National Composites Centre, United Kingdom
GE-Dowty, United Kingdom

Within the last few years, liquid composite moulding (LCM) technologies have advanced to the point where they can provide an alternative to the use of prepreg laminates to achieve consistent quality. The aim of the research undertaken is to enable further enhancement in accomplishing higher quality of the manufactured part, by introduction of simulation technologies. Despite the existence of predictive tools it is evident that manufacturing is slow to adopt numerical modelling in the process development. It is the opinion of the authors that an important obstacle in the use of predictive tools is the fact they are mainly used to provide a solution at nominal conditions only. In order for modelling to more robustly describe the manufacturing process, the effect of realistic process variability should be considered by the virtue of running multiple scenarios. This approach in turns forms a "space solution", from which process limits can be defined.

This study describes the infusion simulation of a Resin Transfer Moulding (RTM) process within an industrial test case with complex geometry and layup. This paper describes the influence of variability in the reinforcement permeability on the outcome of the LCM manufacturing process. Understanding of the relationship between the controllable input parameters and achieved part quality is used to drive the development of a robust model. The development of a standardized method for the permeability measurement is seen to be an enabler for further exploitation of LCM process simulation; however the variability in this parameter is shown to have an important effect on the process outcome. The approach described in this paper can successfully be applied to a part qualification processes since it proves the consistency in manufacturing quality and links it with the process input parameters.