Resin Microwave Preheating in Liquid Composite Molding Process

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Abstract. Liquid Composite Molding (LCM) is one of the most widespread Out-Of-Autoclave (OOA) class of processes to manufacture components in composite material. In this process a dry preform of fibers is impregnated by a flow of liquid resin, which is forced to move through the reinforcement by a pressure gradient. One of the most challenging aspects in LCM processes is to achieve a complete impregnation of the reinforcing fibers. Unsatisfactory impregnation can occur at different scale, in form of dry spots (macro scale) or entrapped air between the tows (meso scale) or inside the tow between the fibers (micro scale). In order to achieve an acceptable component, fibers must be saturated of resin at each scale: typically, in structural application air content tolerance ranges from the 5% to the 0.1%. For this reason, the necessity to control the flow in LCM processes arises. Considering the reinforcement preform as a single porous medium, the resin flow through it can be described by means of the Darcy law, in which velocity of resin is related to the pressure gradient, the permeability of the medium and the viscosity of the permeating fluid. If uncured liquid resin is heated up, initially, its viscosity decreases of about one order of magnitude while temperature increase. When the exposure to high temperature activate the curing reaction, viscosity sharply grows up and the resin starts its solidification.

The aim of this work is to enhance the impregnation in a Vacuum Assisted Resin Transfer Molding (VARTM) laboratory scale system by applying this behavior. The resin is forced to pass through the resonant cavity of a microwave heater before the impregnation, in order to achieve a more uniform and more rapid permeation. Feedback signals are provided by thermocouples, positioned into the pipes, and dielectric sensor, disposed on the mold walls.