SAMPE Fall Technical Conference, Kansas, USA, October 2009

Pressure Behavior during Vacuum Assisted Processing (VAP)

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ABSTRACT

Vacuum-Assisted Resin Transfer Molding (VARTM) is widely used in industry for commercial and defense applications. This process is an inherently low-cost process due to decrease in labor, material and equipment expenses and enables the fabrication of large-scale parts with higher fiber volume fraction than wet lay-up. However in order to replace conventional manufacturing methods for aerospace quality part such as autoclave processing, the VARTM process repeatability and part quality must be improved. The Vacuum Assisted Process developed and patented by EADS uses a membrane permeable to air and volatiles but impermeable to resin, and has the potential to reduce overall void formation and improve mechanical properties. This additional layer provides uniform vacuum distribution and continuing degassing of the infused resin. Nevertheless, the unique pressure behavior results in significant differences in the post-infusion process compared to conventional VARTM which could lead to different fiber volume fraction and thickness in the final component. This work analyzes the pressure behavior of VAP processing during and after the filling stage and provides recommendation for process optimizations.

1st Joint Canadian & American Technical Conference, University of Delaware, September, 2009

An Experimental Method for Continuous Measurement of In-Plane Fabric Permeability as a Function of Compaction Pressure using Air Flow

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ABSTRACT

Resin Transfer Molding (RTM) and Vacuum-Assisted Resin Transfer Molding (VARTM) processes have the potential to produce complex shaped parts utilizing tailored fiber reinforcements and inserts. Existing simulation tools have the capability to predict the flow front advancement as the resin impregnates the fiber preform, thus minimizing trial and error approaches to successful mold filling. Accurate characterization of the fabric permeability in VARTM and RTM processing is necessary to model the flow through these porous preforms. Most traditional experimental methods allow permeability measurements at fixed fiber volume fraction and require many experiments to obtain permeability over a wide range of fiber volume fractions. This paper introduces an apparatus to measure saturated permeability for fibrous preforms using air flow. The measurement system has the capability to determine permeability as a function of applied pressure in one continuous experiment using the same preform.