# Robust Design of RTM Process with Statistical Characterization of Permeability and Flow Simulation

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## ABSTRACT

Resin transfer molding (RTM) process has gained extensive attention for its capability for producing complex structural parts. Researchers have made significant progress towards improving the process. However, in the course of actual manufacturing processes, some process parameters may change noticeably, which makes maintaining consistent part quality difficult. Among these parameters, preform permeability, especially race-tracking permeability, significantly affect resin flow patterns in the process, requiring further investigation. This paper presents a statistical approach for characterizing race-tracking permeability values. One-dimensional permeability measurement experiments were conducted to obtain permeability values. Results indicted that the ratio of race-tracking permeability over the average value for a rectangular mold could be represented as Weibull variables. It was found that the existence of race-tracking during the RTM process less repeatable. Further, both filling time and flow patterns demonstrated noticeable variations.

With the results from this statistical analysis of permeability, this study introduces an optimization approach for minimizing the sensitivity of the mold design to material property variations. Using RTM flow simulation with the generated statistical data for permeability, this robust mold design approach chooses the best locations for gates and vents. The paper provides examples of the new RTM process design approach.

Keywords: Resin transfer molding  Robust design  Process simulation  Process optimization