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# Mechanics of Microvoid Formation during Resin Transfer Molding

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## Abstract

In resin transfer molding (RTM), the formation of air voids within fiber preform depends on the flow rate and surface tension of the resin during mold filling. The resin velocity in regions between fiber tows is mostly controlled by the induced pressure gradient whereas the resin flow within each fiber tow depends more on the capillary pressure. As these two flows compete in their advancement, the size and location of air voids vary from point to point. Capillary number, defined as the ratio of the viscous force to the capillary force, has been found through experiments to be the critical parameter controlling the type of microvoids.

The present paper proposes a model that can account for the dependence of the size and quantity of air voids on the capillary number. At low capillary numbers, the soaking flow within individual fiber tows dominates mold filling, and hence voids are more likely to form between fiber tows. At high capillary numbers, the situation is reversed so that the inter-fiber-tow flow outruns the intra-fiber-tow flow resulting in voids within fiber tows. At an optimum capillary number, the two flows are comparable, minimizing the possibility of void formation. The proposed model can quantify the effect of capillary number on void formation. The model has been validated through experiments.