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Stochastic modeling of through the thickness permeability variation in a fabric and its effect on void formation during Vacuum Assisted Resin Transfer Molding

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1 Stochastic modeling of through the thickness permeability variation in a fabric and its effect on  
2 void formation during Vacuum Assisted Resin Transfer Molding

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7 Abstract

8 Resin flow during Vacuum Assisted Resin Transfer Molding (VARTM) process, when  
9 distribution media (DM) is placed on top of the reinforcement, is largely affected by variation in  
10 through the thickness permeability of a woven fabric. The variation in permeability is due to the  
11 random pinhole regions around the junctions of fiber tows as they are woven together to form a  
12 fabric preform. We characterize and model this pinhole effect on resin flow with the aim of  
13 exploring the role of DM permeability ( $K_{DM}$ ) on void formation. It was found that percentage of  
14 voids increases with higher  $K_{DM}$ . Five hundred simulations were executed for low, medium and  
15 high  $K_{DM}$  values and their effect on resin flow and void formation was investigated. Twenty  
16 experiments for each DM case were conducted. Flow along the bottom surface was recorded  
17 with time. It was observed that the flow front along the bottom became more uneven and  
18 irregular with higher  $K_{DM}$ , which resulted in higher percentage of voids formed during the  
19 process. The numerical simulations qualitatively and quantitatively agreed with the  
20 experimentally measured behavior exhibiting higher percentage of unfilled region with  
21 increasing DM permeability.

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