Advancements in the commingling technology for improved composite properties

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ABSTRACT

Development of composites from commingled towpregs is relatively new but rapidly growing technology and now becoming very important method to develop thermoplastic composites. It demonstrates significant advantages over thermoset composites in several applications including aerospace, marine, sporting and automotive. Although commingling technique has very high potential to produce towpregs with good blending of matrix and reinforcing fibers, these towpregs tend to de-mingle due to non-uniform stretching of the commingled towpregs during textile and other preform making processes. This would lead migration of stiffer reinforcing fibers from matrix forming fibers. Furthermore, this will result in non-uniform distribution of fibers in the final composite part and lead insufficient impregnation. Consequently, poorly impregnated zone of the laminate deteriorates the mechanical properties of composites. Therefore, in present study an attempt has been made to study the commingling behavior of the reinforcing fibers and matrix forming fibers aiming to obtain improved composite properties with less severe consolidation conditions. The present work shows that, the Computational Fluid Dynamics (CFD) modeling can be used to optimize the nozzle design parameters to develop commingled towpregs with better properties. The commingling process parameters as well as characteristics of matrix forming fibers significantly affect the structure and properties of commingled towpregs and their composites. Further, by identifying these parameters, this research may point to new directions for further improvement in stability and processablity of commingled towpregs for composite manufacturing