

Experimental and numerical analysis of mode-I interlaminar fracture of composite pipes

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Abstract: A common industrial production process for composites is filament winding, widely used for the production of axially symmetric components. In these composite components, delamination is a predominant failure mechanism. The current work focuses on investigating experimentally the effect of the initial crack and fiber bridging length on the mode-I delamination resistance curve (R-curve) behavior of various double cantilever beam (DCB) specimens. For this purpose, the magnitudes of initiation and propagation fracture toughness (GIC-init and GIC-prop) and the compliance C are calculated. DCB specimens with a stacking sequence of $[\pm 50]_6$ and various initial crack lengths of $a_0 = 33, 37, 59$ and 70 mm are manufactured from areal composite pipe using filament winding process. In order to evaluate the critical energy release rate in mode-I, various fracture tests are conducted on these specimens. The greatest bridging zone length due to good penetration of two adjacent layers of the delamination interface. Moreover, the results indicate that the fiber bridging length has a significant effect on the GIC and the largest value of fiber bridging causes a large fracture toughness value. Finally, numerical simulations are performed using finite element (FE) method and GIC-init measurements obtained experimentally are compared to the numerical findings. The numerical displacements and GIC-init, calculated from the numerical displacements, are found to be in good agreement compared to the experimental results.

Keywords : Filament wound composite, Critical energy release rate, Propagation energy release rate, DCB specimen, Fiber bridging