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Experimental and numerical analysis of mode?I interlaminar fractureof composite pipes

F M L.REKBI, M.Hecini, A.KHECHAI

Abstract: A common industrial production process for composites is filament winding, widely used for the production of axially symmetriccomponents. In these composite components, delamination is a predominant failure mechanism. The current workfocuses on investigating experimentally the effect of the initial crack and fiber bridging length on the mode-I delaminationresistance curve (R-curve) behavior of various double cantilever beam (DCB) specimens. For this purpose, the magnitudesof initiation and propagation fracture toughness (GIC-init and GIC-prop) and the compliance C are calculated. DCB specimenswith a stacking sequence of [± 50]6 and various initial crack lengths of a0 = 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, variousfracture tests are conducted on these specimens. The greatest bridging zone length dues to good penetration of two adjacentlayers of the delamination interface. Moreover, the results indicate that the fiber bridging length has a significant effect onthe GIC and the largest value of fiber bridging causes a large fracture toughness value. Finally, numerical simulations areperformed using finite element (FE) method and GIC-init measurements obtained experimentally are compared to the numericalfindings. The numerical displacements and GIC-init, calculated from the numerical displacements, are found to be in goodagreement compared to the experimental results.

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