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A MODIFIED COHESIVE ZONE MODEL FOR THE SIMULATION OF MIXED-MODE FRACTURE OF CO-CONSOLIDATED THERMOPLASTIC LAMINATES CONSIDERING FIBER BRIDGING

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Fiber bridging is a mechanism that might significantly influence the interfacial fracture behavior of composite laminates, adhesively bonded laminates, welded laminates, and co-consolidated laminates [1]. It is therefore of great importance for the simulation models to account for that mechanism. While such models have been developed for thermosetting laminates [2,3], this is not the case for thermoplastic laminates and thermoplastic joints. In the present work, a numerical model based on the cohesive zone modelling (CZM) approach has been developed to simulate mixed-mode fracture of co-consolidated low melt PAEK thermoplastic laminates by considering fiber bridging. A modified traction separation law of tri-linear form has been developed by superimposing the bi-linear behaviors of the matrix and fibers. Initially, data from mode I (DCB) and mode II (ENF) fracture toughness tests were used to construct the R-curves of the joints in the opening and sliding directions. The constructed curves were incorporated into the numerical models employing a user-defined material subroutine developed in the LS-Dyna FE code. The J-integral method was used to extract the fiber bridging law directly from the simulation results, thus eliminating the need for the continuous monitoring of crack opening displacement during testing. The model was used to simulate fracture of a single-lap shear specimen in which a considerable amount of fiber bridging was observed on the fracture area. The numerical results show that the developed model has an improved accuracy in comparison to the bi-linear traction-separation law in terms of the strength and displacement at failure of the joint.
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