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Title: Experimental and theoretical fracture toughness investigation of PUR foams under mixed mode I plus III loading

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Abstract: Foam materials can be subjected to tensile and out-of-plane sliding deformation during their service life. Hence, catastrophic brittle fractures initiated from the pre-existing cracks under combined influence of modes I and III is one of the possible failure mechanism in rigid foams. However, at the best knowledge of authors there are no mixed mode (I + III) fracture toughness data for foam materials in the literature. To fill this research gap, in this research unique and new sets of mixed mode I/III fracture toughness data (i.e. K-IC and K-IIIc) are obtained and reported for the first time for PUR foam materials with different densities. The fracture experiments were conducted using "edge notched disc bend" (ENDS) specimen which has been recently developed for conducting mixed mode VIII investigations by the authors. Based on the obtained results, by increasing the contribution of out-of-plane sliding deformation the fracture growth resistance of the tested foams was decreased, such that the ratio of pure mode III fracture toughness over pure mode I fracture toughness (K-IIIc/K-Ic) is about 0.65. Furthermore, by increasing the foam density the mixed mode fracture toughness envelope (K-Ic - K-IIIc) becomes greater for all mode mixities. Indeed, when the density increases from 100 to 300 kg/m(3), the corresponding modes I and III fracture toughness values increase up to 400%. Meanwhile, the experimental fracture toughness results are predicted very well using the maximum tangential strain density.

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