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Puncture properties of a hybrid continuous-discontinuous sheet moulding compound for structural applications

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Abstract

A novel two-step curing resin system and adapted moulding approach enables the manufacturing of hybrid continuous-discontinuous SMC in a one-shot process. Hybridization led to a significant increase of maximum force (+36%) and puncture energy (+35%) if specimens were punctured in a quasi-static manner. The effect of hybridization was less distinct under dynamic loading (increase of 13% and 7%, respectively), due to a negative rate dependency of the continuous carbon fibre SMC. An increase from $4.4 \cdot 10^{-5}$ $m \cdot s^{-1}$ to 4.4 $m \cdot s^{-1}$ resulted in a positive rate dependence of the hybrid SMC with increased maximum force (+33%) and puncture energy (+18%). Important failure mechanisms were inter-bundle and inter-fibre fracture of the continuous SMC and pseudo-delamination (intra-laminar) of the discontinuous component. Delamination took place at both considered loading rates but was more important if hybrid SMC was punctured in a dynamic manner.

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