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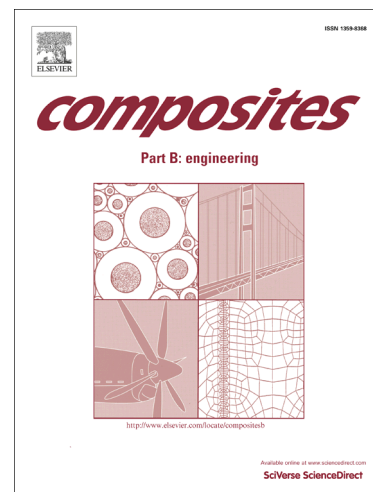
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EXPERIMENTAL INVESTIGATION OF THE ROLE OF FRICTIONAL YARN PULL-OUT AND WINDOWING ON THE PROBABILISTIC IMPACT RESPONSE OF KEVLAR FABRICS

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ABSTRACT

The probabilistic impact responses of single layer greige and scoured plain-weave Kevlar KM2 fabrics are experimentally studied. Single-layer, 101 cm × 101 cm fabric targets are mounted in a novel equilateral octagon (EO) fixture that leaves the principal yarns unclamped. A probabilistic velocity response (PVR) curve, which describes the probability of fabric penetration as a function of projectile impact velocity, is generated through a series of thirty impact tests using a spherical steel projectile impacted at velocities between 69-113 m/s. Additional experiments are conducted by impacting targets repeatedly at identical velocities, and comparing the resulting residual velocities of the penetrating projectiles. Fabric penetration in all cases is entirely accommodated by yarn pull-out and windowing, without any principal yarn failure at the impact site. The results indicate that frictional yarn sliding and pull-out are the primary energy dissipating mechanisms during these impact conditions. Controlled yarn pull-out experiments are conducted on the same greige and scoured fabrics to statistically characterize the yarn pull-out loads. Variability in pull-out forces in the greige fabrics are measurably higher than the variability in pull-out forces for the scoured fabrics, which correlates well with variability trends in the PVR and residual velocity ballistic experiments. Additional factors, such as yarn-projectile friction and differences in filament packing efficiency, are hypothesized to also contribute to the observed differences in the greige and scoured fabric impact responses.

Keywords: (A) Aramid fiber, (A) Fabrics/textiles, (B) Impact behavior, (B) Friction, (C) Probabilistic methods, (C) Statistics

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