Quasi-static penetration and ballistic properties of kenaf-aramid hybrid composites

ABSTRACT

In this research, quasi-static penetration and ballistic properties of non-woven kenaf fibres/Kevlar epoxy hybrid laminates with thicknesses ranging from 3.1 mm to 10.8 mm by hard projectile at normal incidence have been experimentally investigated. Hybrid composites were fabricated by hand lay-up technique in a mould and cured at room temperature for 24 h by static load. Hybrid composites consist of Kevlar layers and non-woven kenaf layers at three different configurations, i.e. kenaf at the innermost layers, outermost layers and at the alternating layers. Kevlar/epoxy and kenaf/epoxy composites were also fabricated for comparison purpose. Quasi-static experiments were conducted using a tensile testing machine at the speed of 1.27 mm/min and 2.54 mm/min. Ballistic tests were conducted using 9 mm full metal jacket bullet using a powder gun at speeds varying from 172 to 339 m/s, with the initial and a residual velocity of the projectiles is measured. The tested sample was carefully examined with respect to failure modes. Results showed the effect of hybridization in term of forceï displacement curves, energy dissipation and damage mechanisms for quasi-static test. Maximum force to initiate penetration is higher in hybrid composites compared to kenaf/epoxy and Kevlar/epoxy composites. Hybridization of kenafï Kevlar resulted in a positive effect in terms of energy absorbed (penetration) and maximum load. In the case of ballistic tests, hybrid composites recorded lower ballistic limit (V50) and energy absorption than the Kevlar/epoxy composite. The V50 of hybrid composites with kenaf at the outermost layers is superior to other hybrid composites. These finding inspired further exploration of hybrid composite for ballistic armour spall-liner application.

Keyword: Kenaf fibres; Epoxy matrix; Aramid fibres; Hybrid composites; Ballistic limit; Energy absorption