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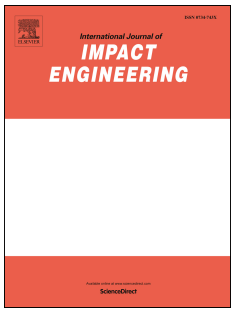

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Impact perforation of monolithic polyethylene plates: projectile nose shape dependence

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Abstract

Ductile thermoplastics, for example Ultra High Molecular Weight Polyethylene (UHMWPE), are of interest for their impact energy absorbing capabilities. While the impact perforation mechanisms of metallic targets have been investigated in some detail, far less progress has been made towards understanding the impact resistance of ductile polymers. The aim of this investigation is to identify the relationship between the projectile tip geometry and impact energy absorption of semi-crystalline thermoplastics. The focus of the study is light-weight monolithic plates of extruded polymer impacted normally by rigid projectiles at velocities up to 100 ms^{-1}. Three polymers will be considered: Low Density Polyethylene (LDPE), High Density Polyethylene (HDPE) and Ultra High Molecular Weight Polyethylene (UHMWPE). Polyethylene provides a convenient test material, as variations in microstructure provide a contrast in mechanical properties, without significant variations in density. Three distinct projectile nose shapes are considered: blunt, hemi-spherical and conical. For a conical tip, perforation occurs by ductile hole expansion. For this nose shape the high yield strength and strain rate sensitivity of HDPE offers an advantage over the other two polyethylenes. Perforation by blunt and hemi-spherical projectiles is more sensitive to deformation localisation. The high strain hardening of UHMWPE, which increases with strain rate, results in a significantly greater impact resistance than either HDPE or LDPE. The perforation