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Enhancing Fracture Toughness of CF/PAEK Laminates for High-Velocity Impact Applications: An Experimental Investigation

Authors : Johannes Keil, Eric Mischorr, Veit Würfel, Jan Condé-Wolter, Alexander Liebsch, Maik Gude

Abstract : In the aviation sector wastewater pipes are subjected to many different mechanical and medial loads. Worst-case scenarios include high-velocity impacts resulting from the introduction of foreign objects into the system. The industry is seeking to reduce the weight of these pipes, which are currently manufactured from titanium. A promising alternative is the use of fiber-reinforced polymers (FRP), specifically carbon fiber (CF) reinforced polyaryletherketone (PAEK) laminates. This study employs an experimental methodology to investigate the impact resistance of CF/PAEK laminates, with a particular focus on three configurations: crimp, non-crimp, and interleaved matrix rich films in cross-ply laminates. High-velocity impacts were performed using a gas gun resulting in three-dimensional damage patterns. Afterwards the damage behavior was qualitatively and quantitatively analyzed using ultrasonic scans and computed tomography (CT). Samples with an interleaved matrix-rich film led to a reduction of the damage area by around 40% compared to the non-interleaved, non-crimp samples, while the crimp architecture resulted in a reduction of more than 60%. Therefore, these findings contribute to understanding the influence of laminate architecture on impact resistance, paving the way for more efficient materials in aviation applications.

Keywords : fracture toughness, high-velocity-impact, textile architecture, thermoplastic composites
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