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Complementary and normalized energies during static and dynamic uniaxial deformation of single and multi-layer foam-filled tube

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Abstract

This article investigates the quasi-static compressive behavior and the drop weight impact tests during the crashing of energy-absorbing structures such as aluminum foam-filled tubes. The closed-cell Al and A356 Alloy foams were cast and, after cutting, inserted into the Al thin wall tube as axial fillers of single-, double- and quad-layer structures. Then, the specific energy absorption (SEA), complementary energy (CE), normalized energy (NE), and specific normalized energy (SNE) are calculated based on static and dynamic test results under uniaxial loading. In this new method, values of NE and SNE are always between 0 and 1. Results show that the SEA-strain curves obtained from crashing the foam-filled tubes were linear and overlapping under static and dynamic loading. However, NE curves for dynamic tests were cyclic and in the static tests were asymptotic non-linear, and utterly separable. Results indicated that the SNE for Al, A356 single layer, Al-A356 double-, and Al-A356-Al-A356 quad-layer foam-filled tubes during dynamic tests were 0.25, 0.29, 0.31, and 0.31, while for the static tests, 0.14,0.15, 0.17, and 0.14 were recorded. It was found that CE and NE energies were better than the SEA energy for recognizing plastic deformation and crushing behavior.

Keywords

Al foam, complementary energy, normalized energy, crushing, foam-filled tube, Specific energy absorption

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