Nanostructured viscoelastic materials evaluated for blast resistant designs

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Keywords: Viscoelastic, nanoparticles, shockwave, blast testing

Viscoelastic materials have extensive military applications due to their energy absorption capabilities, with the potential to reduce blast energy imposed on buildings, vehicles, and personal protection. However, based on literature review, there is limited information available regarding the mitigation of blast energy pertaining to these uses. Few studies have considered the suitability of these materials in shockwave mitigation and methods to enhance their performance—such as through nanotechnology—in military applications. This study aims to evaluate the impact of various thicknesses and nanoparticle additions in viscoelastic materials for mitigation of shockwave energy using suspended open-air blasts. The incident and reflected shockwaves were recorded using a high-speed camera and analyzed with Phantom Camera Control (PCC) software to determine energy dissipation in the material based on the ingoing and outgoing shock velocity difference. A pressure transducer was used to record a time pressure waveform to determine key characteristics of the shockwave through the material including peak pressure, impulse and rise time. Results were processed using a multivariate analysis of variance (MANOVA) to evaluate the effects of material thickness and nanoparticle additions on blast overpressure reduction. This increased understanding of viscoelastic material performance related to shockwave energy absorbance will enable them to be effectively incorporated into blast resistant designs.