Protective Equipment

ONR efforts on Blast Mitigation to Prevent mTBI

Reductions of intracranial pressures and accelerations following blast events will contribute to reductions in mTBI episodes. ONR is funding researchers at the Naval Surface Warfare Center Carderock Division (NSWCCD) on the use of special polymer coatings over advanced ballistic-fiber shells, which demonstrate capability for reducing intracranial pressures and accelerations in surrogate full-size, head-neck manikins. The polymer coatings also improve the ballistic resistance of the helmet shells, which are produced under a cooperative research and development agreement (CRADA) between the US Navy and DuPont Corporation, without increasing its weight over the baseline ACH. In parallel, researchers at the Naval Research Laboratory are developing new strategies for the deflection and attenuation of blast waves incident on helmets. Hollow (deformable) ceramic microspheres are dispersed in a rate-sensitive polymer matrix, which enables large reductions in bulk modulus of the polyurea composite with minimal changes in its shear modulus. Since brain tissue is weak in shear, the polymer composite affords protection, and due to its viscoelastic nature, the polymer response increases in efficiency with the severity of the blast impact. An irreversible energy dissipation mechanism is provided by the thin-walled spheres, to further attenuate the blast wave amplitude. Preliminary bomb tests show approximately 30% reductions in acceleration and deflection, while the ballistic performance of the helmet is maintained. Researchers from Clemson University are supporting these efforts with advanced finite element computer modeling and simulation. The results are closely aligned with the results from experimental testing, demonstrating a predictive capability that will assist in pinpointing the best areas and thicknesses to employ the polymer to protect specific vulnerable brain regions and help identify families of polymers and fillers for improved performance. Currently, DuPont has fabricated 32 helmets shells that will have different coating thicknesses and special fillers, based on three coating formulations. Further tests on the helmets will be performed in FY15 to reveal the most effective coating in reducing mTBI risk.