Guns, Flames, and Steel 2.0: Creation of a Non-Newtonian Fluid-Based Body Armor

Prucka, Elizabeth

Reed, Madison

As technology evolves, weapons evolve, and the need for an armor that can protect against modern weapons grows. The purpose of this project is to determine the viability of developing a body armor through the implementation of a shear thickening non-Newtonian fluid for military personnel protection. Ratios of 300, 400, and 600-proof PEG to silicon dioxide were used to create different fluids. Three different Kevlar weaves were treated with evenly diluted, 200-proof ethanol, baked at 60ºC for 8 hours in a drying oven, and subjected to ignition, puncture, and ballistics tests. Cases with treated Kevlar prove to show higher resistance in puncture, stress, and ballistics tests as opposed to any case with untreated Kevlar. All penetration was reduced by at least 10 mm in scenarios with treated Kevlar. Puncture test results show that 57.5% fewer layers of the treated Kevlar would be needed to stop penetration in comparison to penetration of untreated Kevlar. Similarly, ballistics testing shows that 55.5% fewer layers of treated Kevlar would be needed to stop a projectile in comparison to the penetration of untreated Kevlar. Standard error bar analysis suggests statistical significance of groups using 300-proof PEG and statistical insignificance of groups using 400 and 600-proof PEG. Calculated 95% confidence intervals show that the means of larger data groups would comply with these findings. These data and results support non-Newtonian fluid implementation as viable and efficient body armor without significant weight gain and without compromising the inherent flexibility and flame resistance of Kevlar.

Awards Won:

Fourth Award of $500