CALIFORNIA STATE SCIENCE FAIR
2012 PROJECT SUMMARY

Name(s)
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Project Number
J0320

Project Title
Magnetic Body Armor

Abstract

Objectives/Goals
The purpose of this project is to see if treating Kevlar fabric with magnetorheological (MR) fluid, improves protection compared to untreated Kevlar used in body armor.

Methods/Materials
Sample targets were created by placing treated or untreated Kevlar fabric into sealed plastic bags which were then secured in a plexiglass holder. Magnets were inserted in the holder for samples that required a magnetic field. A rifle was fired 5 meters from the sample, and the depth of penetration into a clay witness mounted behind the sample target was measured. The procedure was repeated for nine 10-layer Kevlar samples: three untreated, three treated with MR fluid, and three treated with MR fluid and a magnetic field. Other thicknesses were used for comparison.

Results
As anticipated, the more untreated Kevlar layers, the less penetration; but unexpectedly with MR treated Kevlar, penetration actually increased, and increased even more when a magnetic field was added. Also, treated Kevlar had less thread deformation than untreated.

Conclusions/Discussion
It appeared that the oil in the MR fluid acted as a lubricant, allowing bullets to more easily rip through the Kevlar threads. Adding the field seemed to distort the fabric by drawing iron particles to the sides of the Kevlar, providing less protection. MR fluid might still prove useful in treating body armor providing the lubrication properties of the oil medium can be overcome.

Summary Statement
To see if megnetorheological fluid enhances Kevlar body armor by providing more protection and allowing less bulk and weight

Help Received
Father conducted ballistic tests and helped construct apparatus; Mother helped with editing