A DATA CORRELATION MODEL FOR THE PENETRATION BEHAVIOR OF PROJECTILES INTO UHMWPE COMPOSITES

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Summary

The analysis of terminal ballistics is complex due to the amount of variables involved. It is usually approached on one of three levels listed as the complexity increases: experimental data correlation, engineering model development and numerical simulation. The first level represents a simple mean to understand the basic physics of the phenomenon, and interpolates or predicts its behavior on a closed range. The second level reduces the system analysis to a basic mathematic form by means of simplifications on the phenomenon behavior laws. The third level is designed to include all the relevant physics but presents a higher set of requirements as specialized software, efficient algorithms, a full material behavior description and an experimental mean for model validation.

In this paper a set of formulas are derived using the experimental data correlation method. These formulas correlate trauma, impact penetration depth, impact velocity, impact-on-panel location, panel areal density and backing material hardness. These formulas were developed by means of dimensional analysis (Pi Buckingham Theorem).

This paper includes the data acquired from 112 impacts on 16 flexible unidirectional UHMWPE composite panels. Panels were lay-up with areal densities ranging from 4.2 kg/m² to 5.9 kg/m². Finally, impact test were conducted with velocities of 430 m/s and 447 m/s for an 8 g projectile mass.