THE EROSION THRESHOLD FOR HIGH VELOCITY GEO-PENETRATORS.

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Abstract

Presently introduced weapon systems with geo-penetrators mostly operate in the subsonic velocity regime. The appearance of deeply buried and hardened targets requires a significant increase of the performance of the penetrators. The most promising approach is the increase of the impact velocity of the projectile. Results based on numerical simulations presented in ref. ¹/¹/ show that the penetration performance of a projectile with an impact velocity of 1500 m/s can be increased by a factor of 10 with respect to the subsonic velocity regime. The assumption is that the projectile is not eroding and sustains structural stability of the nose shape during the penetration process.

In reality higher velocities lead first to the erosion of the penetrator tip and with still further increasing velocities to the erosion of the complete penetrator. Possible parameters that determine the onset of this phenomenon are the projectile and target materials and their strength behaviour as well as the geometrical design of the penetrator. To improve the understanding of this erosion phenomenon it is therefore necessary to analyse the physical processes during high velocity impact based on results from experiments and simulations.

Experimental results for projectile impact in the high velocity regime are presented. The penetrator was made of steel and had a cylindrical shape with a length to diameter ratio L/D=10 and a mass of 100 g. The targets were armoured concrete blocks with static compressive strength in the range from 35 to 55 MPa. The impact velocities were varied from 300 m/s up to 1700 m/s. The following data were recorded: penetration depth of the penetrator, residual penetrator length and residual penetrator mass. The data allow the determination of the onset of the erosion for the chosen combination of penetrator and target. To clarify the important parameters that influence the onset of erosion numerical simulations have been performed. In the first step the experiments were used to validate the simulation approach and the material models. In the second step the validated models were used for a systematic study of the high velocity impact phenomena and the identification of parameters that determine the onset of the penetrator erosion.
Figure 1. Recovered penetrators after high velocity impact

Figure 2. Numerical simulation of high velocity impact on concrete targets (material damage)

REFERENCES