Impact measurements of different 40mm non-lethal sponge grenades

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In the world of kinetic energy non-lethal weapons (KENLW), the 40mm sponge grenade is a modern projectile that is widely being used. Indeed, it presents different advantages: firstly, thanks to its 40mm diameter, it can be fired with a classic cost-effective grenade launcher. Secondly, its big diameter makes it very unlikely to penetrate the human body, even for impact energy above 100J. Thirdly, it's a quite accurate projectile for long distance non-lethal impacts, typically between 20m and 50m. These considerations explain why many ammunition manufacturers tend to develop their own 40mm sponge grenade.

The 40mm sponge grenade is usually composed of a hard plastic body, with a deformable nose made in foam rubber. The deformation of the nose allows the projectile to absorb energy at impact, making it less lethal for a given velocity than an equivalent stiff projectile. The muzzle velocity is usually between 70m/s and 110m/s, and the mass between 30g and 40g. The muzzle kinetic energy is usually between 120J and 170J.

The main issue in the study of this kind of projectiles is its ability to deform at impact. On the one hand, it makes measurements of the impact phenomena more complicated than for a stiff projectile. On the other hand, most of the published studies about KENLW deal with stiff projectiles, and their conclusions may not be applicable for deformable projectiles.

Another problem is the wide variety of existing sponge grenades. As the way the projectile deform during the impact can vary from manufacturer to manufacturer, we can expect that the impact phenomena and its induced lethality can also vary, even for the same level of energy.

The objective of this study is to assess the impact of different sponge grenades with force sensors and a high-speed camera. The 2 main goals are the following:

- Different sponge grenades are shot at different velocities on a stiff surface equipped with a force sensor. The force and deformation occurring during the impact are measured for each projectile and then compared.
- A relationship between force and deformation during the impact is established, and then compared at different velocities, for different sponge grenades.