

FOX-12 (GuDN): An IM Ingredient Candidate - Where Are We Today?

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The present development of energetic materials for military purposes is motivated by the need for 1) increased performance, 2) increased safety, and 3) customized or tailored capabilities. Several factors affect the development either directly or indirectly. The most important of these are the increased use of insensitive munitions (IM), the need for higher performance and other specific capabilities, environmental issues, standardization issues and increased systems integration. Requirements for and use of IM have increased following several accidents involving hundreds of fatalities, such as the fire on the US carrier Forrester and the loss of the UK destroyer Sheffield where the ammunition carried on board the ships was mainly responsible for the violent development of the events. The need for different types of IM-solutions is imminent with the increasing number of international operations our Swedish forces take part in. It is also a very important part of the interoperability questions we have with our partners on the international arena.

One of the purposes of the ongoing research on energetic materials in Sweden is to produce more powerful, safer and environmentally friendlier explosives that fit into the new action plan of the defence forces. One line of research is towards compositions with lower sensitivity, which improves the safety of ammunition. A problem with lower sensitivity energetic materials in munitions has been that insensitivity almost always has meant lower performance.

The interest for FOX-12 as an IM candidate stems from the substances low sensitivity combined with a performance larger than TNT but extremely insensitive. N-guanylurea-dinitramide (FOX-12 or GuDN) is a relatively new energetic material with extremely low sensitivity and good potential for use as a propellant or IM explosive. This paper gives a comprehensive overview of its basic characteristics (e.g. synthesis, mechanical and thermal sensitivity and performance) and reports its use as a low sensitivity ingredient in pressed and melt castable formulations. The performance is evaluated by detonation velocity measurements and by cylinder expansion measurements. The sensitivity was evaluated by large scale gap tests. Three different explosives were tested; melt cast GUNTOL (50/50 wt% FOX-12/TNT), GUNTONL1 (42.5/42.5/15 wt% FOX-12/TNT/Al-H2) and GUNTONL2 (42.5/42.5/15 wt% FOX-12/TNT/Al-A100).