Replacement of a Doublebase Sustainer by a Smokeless IM Propellant for Shoulder Launched Projectiles

Dr Klaus R. Menke
Fraunhofer Institut für Chemische Technologie
Joseph von Fraunhofer Str. 7
Postfach 1240
Pfinztal Baden-Württemberg D-76327
Germany
Phone: 0049 721 4640 213
Fax: 0049 721 4640 111
E-mail: klaus.menke@ict.fraunhofer.de

Co-authors: Sebastian Fischer, Sarah Helou, Hendrik Lips, Hartmut Kentgens

Two possible candidates for sustainer propulsion of a shoulder launched projectile ASM from Dynamit Nobel Defence have been developed and tested for their performance and properties to fulfil the criteria for Insensitive Munitions. Two propellant systems based on AN/RDX/GAP/NE and AN/RDX/TAGN/GAP/DNDA have been lab scale developed, investigated and tested in small scale ballistic firing tests in original ASM sustainer grain geometry. The first propellant system containing nitrate ester plasticizers exhibits good processibility, satisfying mechanical properties and chemical stability together with good thermodynamic performance and low impact and friction sensitivity. In the pressure region from 10 MPa to 15 MPa burn rates range between 8 mm/s and 12 mm/s and pressure exponents between 0.59 and 0.63. In 50 mm Gap tests initiation pressures are above 70 kbar allowing a hazard classification 1.3 C. In Slow Cook Off tests according to MIL Std. 2105 the reaction was classified to type III. Overall the AN/RDX/GAP/NE propellant fulfils the required base properties for minimum smoke propulsion of the ASM projectile. The 2nd propellant system based on AN/TAGN(RDX)/GAP/DNDA has been developed and tested according to its thermodynamic, burning and sensitivity properties. The propellants with DNDA plasticizer exhibit good chemical stabilities; the thermal degradation temperature was about 30°C enhanced and thus the thermal sensitivity together with impact and friction sensitivity significantly improved. The burning behaviour of DNDA propellants exhibits slightly lower burn rates 6 mm/s < r < 10 mm/s from 7 MPa to 13 MPa than the NE propellants together with pressure exponents 0.50 < n < 0.60 from 4 to 18 MPa. All investigated ASM propellants obey to minimum smoke or AA AGARD signature classification. The thermal sensitivity was investigated by ARC showing a small exothermic increase at 160Â°C followed by an endothermic decrease of heat evolution before a slow exothermal increase starts again at 220Â°C without coming to deflagration until 300°C. Thus the DNDA formulations could be identified as LOVA propellants and are expected to show a reaction type IV or type V in slow cook off tests according to MIL Std. 2105. Although mechanical and environmental properties should still be improved the propellants are promising candidates for future development and application for IM propulsion of projectiles from shoulder launched weapons.