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DEFENCE R&D DÉFENSE

RIGHTTRAC

Revolutionary Insensitive, Green and Healthier Training Technology with Reduced Adverse Contamination

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Objectives

- Decrease environmental contamination
- Decrease health hazards
- Improve munitions performance
- Decrease vulnerability (Insensitive Munitions, or IM)

Technology Demonstration Project

- Five-year project
- 105-mm Howitzer round
- Technology designed to be transferable to other calibers
- Sponsored by Director General Environment, DND, Canada

Recyclability of Explosive and Propellant Formulations

Objectives: Verify the feasibility of recovering valuable energetic materials for reuse and/or produce high-value by-products

Experimental Procedure: Small scale tests were carried out to demonstrate the feasibility of recycling some ingredients.

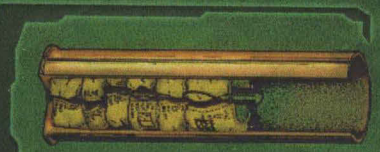
Formulation	Ingredients	Method
GIM	HMX	Solubilization of HMX with EtOAc
	TNT	Extraction of TNT with MeOH
	ETPE	
CX-85	HMX	Swell PBX with $CHCl_3$ and precipitate HMX out of solution
Single base	NC	Extraction with ACN
	TEGDN	Ongoing
Triple base	NG	Soxhlet extraction with water
	NC	Agitation with acetone and precipitation of NC out of the solution
	TEGDN	Ongoing
HELOVA	HMX	Solubilization with EtOAc
	NC	Precipitation with water
	ETPE	Ongoing
	TEGDN	Ongoing

Military Impact

- Sustain military training and maintain troop readiness by decreasing the environmental pressure on ranges and training areas
- Reduce safety hazards in training
- Decrease the need for a regular surface clearance
- Need for only one type of gun propellant
  - No more use of 7 different types of bags
  - No burning of excess gun propellant
- Reduce overall costs of life cycle by recycling the components of obsolete rounds into new ammunition
- Proof of due diligence
- Reduce potential law suits

Selection Criteria

- Environment (30%): Environmental fate, bioavailability, ecotoxicity, air emissions, recyclability
- IM (25%): Bullet impact, fragmentation impact, slow cook-off, fast cook-off, sympathetic detonation and shaped charge jet
- Technical feasibility (20%)
- Cost (15%)
- Performance (10%): must be at least as good as in-service ammunition



Fuze System

- Development of a self-destruct capability to reduce the actual dud rate of current artillery munitions
- Implementation of the self-destruct device in the existing C32A1 Multi-Options Fuze Artilley (MOFA) and/or the Point Detonation (PD) M739 fuze

Gun Propellant

Candidates

- No dinitrotoluene (DNT), nitroglycerin (NG), dibutylphtalate (DBP), or diphenylamine (DPA) in any of the candidates
- Downselection May 2010

1. Double-base propellant
   - Nitrocellulose (NC) and triethylene glycol dinitrate (TEGDN)
2. Triple-base propellant
   - NC, TEGDN, and nitroguanidine (NQ)
3. High Energy Low Vulnerability Ammunition (HELOVA):
   - NC, TEGDN, HMX, and Energetic Thermoplastic Elastomer (ETPE)

Air Residues

- Firing trials were held in a semi-closed chamber equipped with gas sampling ports in Nicolet in October 2009 with the reference propellant formulation
- Firing trials with the chosen propellant candidate will be performed in 2012
- Results will be compared to those of closed vessels

Ecotoxicology

- Three candidates under study by the Biotechnology Research Institute (BRI)
- See Monteil-Rivera *et al.* for HELOVA results (poster 144, Dec 1st)

Fate and Transport

- Three candidates under study by BRI and INRS-ETE
- Indoor adsorption tests on sand column (20 x 3.7 cm) ongoing
- Outdoor dissolution test on fritted disk ongoing
- Preliminary results from indoor and outdoor experiments indicate that:
  - TEGDN leaching rate : Double base < triple base < HELOVA
  - Weight of TEGDN : HELOVA < Double base < Triple base
  - The amount of TEGDN released from the Triple base is 4x higher than HELOVA's.

Setup for the residues collection

Main Explosive Charge

- No RDX in any candidate
- Downselection March 2011

1. Green/IM Explosive (GIM)
   - ETPE, HMX and TNT
   - Melt-cast formulation
2. CX-85 (plastic-bonded explosive, or PBX)
   - Hydroxy-terminated polybutadiene (HTPB) and HMX
   - Cure-cast formulation

Distribution of Explosive Residues

- First trial with pipe bombs
- Detonated with C4
- Measure of the blast wave and the residue distribution
- Next trial with shells

Pipe bomb

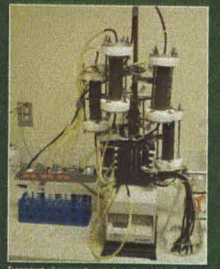
Setup for the residues collection

Ecotoxicology

- Two candidates under study by BRI

Fate and Transport

- Two candidates under study by BRI and INRS-ETE



Transport of energetic residues through soil columns

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ANNEX E: Summary of Lot-Acceptance Test Results