



Ordnance Environmental Program IPR Yellow Smoke for Hand Held Signals (PYRO 12-02)

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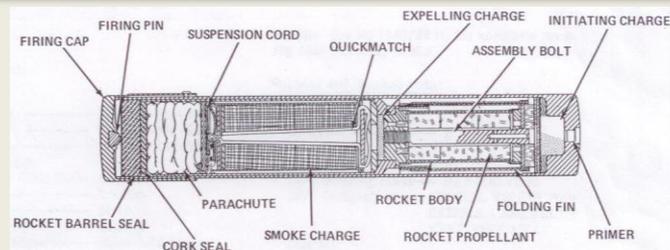


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Yellow Smoke for Hand Held Signals (PYRO 12-02)

Project Description

- ARDEC will develop and demonstrate an environmentally benign yellow smoke formulation in the M194 hand held signal form factor.
- Formulation development completed CY11-13.
- System demo kicked off in mid-2013, ended with minor ignition train problems.
- Current efforts are aimed to fix performance problems in flight tests. Completed June 2015.



Requirement/Impact

- Addresses AERTA PP-3-02-05
- Current/previous M194 Yellow Smoke Composition relies on toxic Vat Yellow 4 and Benzanthrone (Confirmed toxic by memo dated 07/15/2009 from Dr. Eck)
- User request to reintroduce M194 for training/operational support
- MCoE planned for production requirement for FY17 purchase

Progress Report

- Key dates
 - User Support Letter signed by Maneuver Center of Excellence: 4QFY10
 - Transition to PM CCS: 4Q-FY16
- Recent accomplishments/issues
 - Initial testing of new assembly designs at SSI in actual system hardware.
 - Solved ignition (“dud”) problems in hardware.
 - Initiated energetic material qualification (EMQ).



Ordnance Environmental Program IPR Perchlorate- and Barium-Free 40mm Illuminating Signals (PYRO 12-01)

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Perchlorate- and Barium-Free 40mm Illuminating Signals (Project PYRO 12-01)

Project Description

- ARDEC will demonstrate perchlorate- and barium-free (green only) 40 mm illuminating signals
- Prototyping and prove-out for M662.
- Prototyping and prove-out of M661 and M125A1 with barium-free formulation (based on boron carbide)
- System demonstration for M662 and M661
- M125A1 HHS formulations will be transitioned to PM-CCS and the M661 and M662 will be transitioned to PM-MAS for system/safety qualification and implementation into the technical data package (TDP)



40mm, M662,
RS Para (B505)

40MM M661 Green
Star Para (B504)

Requirement/Impact

- Addresses AERTA PP-3-02-05 by replacing perchlorate, barium and chlorine in 40 mm illuminating signals
- Federal (pending) drinking water limits for perchlorate
- If successful, ARDEC will eliminate 3,600 lbs Laminac/Lupersol, 3,600 lbs KClO_4 (200,000 units produced for each M661/2)
- Eliminate single point failure binder system

Progress Report

- Key dates
 - Endorsement signed by PEO Ammo: 3QFY13
 - End/transition point: 4QFY15
- Recent accomplishments/issues
 - Epoxy-based M661 proven out in-house.
 - Epoxy-based, perchlorate-free M662 proven out in-house.
 - Additional demo needed for M662.



Ordnance Environmental Program IPR Perchlorate-Free Smoke Composition Replacement for M274 2.75" Warhead (PYRO 05-02)

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Perchlorate-Free Smoke Composition for M274 2.75" Warhead (PYRO 05-02)

Project Description

- ARDEC will develop, demonstrate and transition a perchlorate-free flash/smoke formulation for M274 Smoke Signature Practice Warhead for the Hydra 70 2.75" Rocket System
- Leverage previous perchlorate elimination efforts
- Demonstrate producibility at manufacturer
- Conduct Qualification testing in coordination with PM JAMS to ensure performance
- Transition the formulation into the end item



Requirement/Impact Statement

- Addresses PGP-09-01: Potassium Perchlorate in Pyrotechnics and AERTA PP-3-02-05 by replacing perchlorate in M274 Warhead
- Performance, regulatory, other drivers: Federal (pending) drinking water limits for KP
- Magnitude of impact: Reduce perchlorate used at rocket training installations by over 1.5 tons per year
- Exit criteria: Eliminates KP from training rocket warhead while meeting/exceeding current performance and safety criteria

Progress Report

- Schedule:
 - Endorsement signed by PM JAMS: 4QFY07
 - Engineering Change Proposal to incorporate formulation drafted and reviewed; awaiting Final Hazard Classification determination to finalize
- Performance:
 - Passed all training system compatibility and Performance Testing
- Cost:
 - FHC and ECP support are funded



Ordnance Environmental Program and Airborne Lead Reduction Summer 2015 IPR

Environmentally Benign Red and Violet Smoke (PYRO 06-07)

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Environmentally Benign Red and Violet Smoke (PYRO 06-07)

Project Description

- ARDEC in conjunction with ECBC developed Red and Violet smoke formulations for integration into the M18 Colored Smoke Grenade.
- Red grenades have been made at the production level; however duds have occurred and the root cause is unknown.
- Violet dye is in production, Phase II of IV.
- Project transitioned to PM CCS and PM JS.



Requirement/Impact

- Addresses AERTA requirement AERTA PP-3-02-5 and Environmentally Sustainable Energetics Workshop List of Concerns PGP-09-02 for the removal of sulfur and hazardous dyes from current formulations.
- Replace the sulfur-based red and violet M18 formulations for all future production to reduce environmental impact of training operations.
- Exit Criteria: One formulation each color tested in M18 grenades with 10 production batches.

Progress Report

- Key dates
 - Endorsement signed by PEO Ammo: 3QFY13
 - Ongoing – Red dud investigation
- Recent accomplishments/issues
 - Failure analysis underway
 - Phase II blue dye accepted
 - Phase III blue not yet delivered



Biodegradable Case for M18 / M83 Smoke Grenades (PYRO 13-01)

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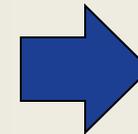


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Biodegradable Case for M18/M83 Smoke Grenades (PYRO 13-01)

Project Description

- ARDEC will develop and test a biodegradable case for the M18/M83 smoke grenade.
- Existing M18/M83 case uses metal components that are not consumed during use
- ARDEC will leverage existing M69 biodegradable material development and integrate existing composite body M18/M83 development
- Use commercially available bio-degradable materials - Mirel P1003 or P1004 as base material
- Test composite cases in full-up items



Requirement / Impact

- Addresses AERTA PP-3-02-05 by developing biodegradable casings to reduce the impact of UXO
- PM CCS interested in biodegradable items that can be left on range. Over 500K items are used per year and thousands of unrecovered M18s and M83s litter battlefields and training areas.
- A biodegradable M18 / M83 smoke grenade whose performance is equal to the existing systems, but degrades in an outdoor environment under desired conditions will reduce the clean-up requirements on training ranges.

Progress Report

- Key dates
 - Endorsement *signed by PEO Ammo: 3QFY13
 - End/transition point: 1QFY16
 - Recent accomplishments/issues
 - Injection molded parts (body and cap) completed with two biodegradable formulations
 - Two versions of cap produced: with and without integrated fuze housing
- * Overall EQT P2 Ordnance Environmental Program



Ordnance Environmental Program IPR Summer 2015

Formulation with Environmentally Sustainable High Explosive (CA 10-07)

August 12, 2015

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Formulation with Environmentally Sustainable High Explosive (CA 10-07)

Project Description

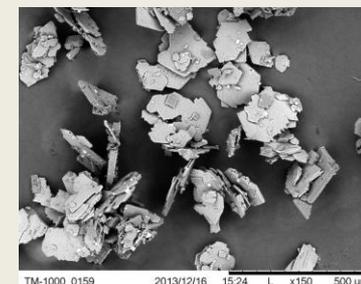
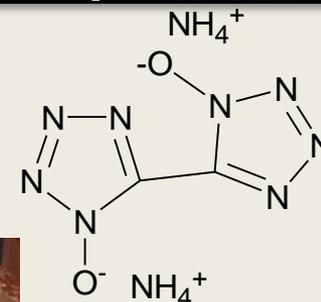
- ARL will produce more environmentally sustainable energetic formulations using novel high nitrogen energetic materials
- Characterize candidates in terms of DSC & VTS compatibility, lab/pilot scale production, safety testing, detonation velocity and shock sensitivity
- Incorporate novel energetics into formulations to assess for lethality (performance), IM properties (sensitivity) and suitability as less toxic RDX replacements for transition to JIMTP

Requirement/Impact

- Addresses AERTA PP-3-02-05 through design, characterization and testing of RDX replacement using novel energetic formulations for explosive and propellant applications
- Performance, regulatory, other drivers: Range clean-up levels for RDX, Insensitive Munition requirements
- Magnitude of impact: RDX used in 1000+ munitions in training, environmental regulators have/will halt or restrict Army operations due to RDX contamination
- EPA is reviewing benchmarks for more strict clean-up levels for RDX

Progress Report

- Key dates
 - Endorsement signed by PEO Ammo: 3Q-FY13
 - End/transition point: FY14 – TAGMNT based, PBXN 109 analog formulations transitioned to JIMTP (Task 14-3-33)
- Recent accomplishments/issues
 - Methods for purification of ABTOX evaluated and “clean up” determined to not be feasible
 - Plan for characterizing ABTOX detonation properties developed





Ordnance Environmental Program IPR Environmentally Sustainable High Explosive Chemical/Physical Characterization (CA 10-05)

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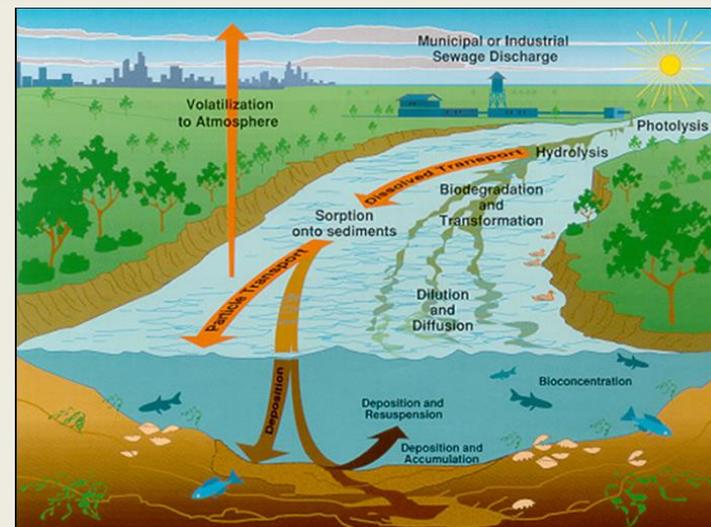


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Environmentally Sustainable High Explosive Chemical/Physical Characterization (CA 10-05)

Project Description

- ARL will characterize potential new RDX replacements for purity, solubility, estimated vapor pressure, K_{OC} , and K_{OW} .
- Physical constants to be included in PHC Toxicity Assessments and fate and transport models.
- Nearly all munitions that use explosives or gun propellants may be impacted.



http://toxics.usgs.gov/regional/emc/transport_fate.html

Requirement/Impact

- Addresses AERTA PP-3-02-05 by characterizing fate and transport parameters for novel energetics (RDX replacements)
- Drivers include need for accurate environmental fate and transport models to characterize chemical and physical and sensitivity properties of new RDX replacements.
- Impact of accurate physical constants for F&T models is environmental protection in manufacturing, testing, training, and disposal sites.

Progress Report

- Key dates
 - Endorsement signed by PEO Ammo: 3Q-FY13
- Recent accomplishments/issues
 - Characterized ABTOX, TKX-50 for purity.
 - Off-line meetings with ARDEC to discuss results and path forward.
 - DNAM and NBTN samples not yet received.
 - Purity issues have delayed K_{OC} , K_{OW} , etc.



**Ordnance Environmental Program IPR
Environmentally Sustainable High Explosive Formulation (1-kg
scale)
HATOAF
(CA 10-07)**

August 12, 2015

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ARDEC (Picatinny NJ)**



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ESHE Formulation (kg scale) (CA 10-07)

Project Description

- ARDEC will formulate with novel high nitrogen energetic materials
- **TECHNICAL APPROACH:**
 - Produce 1 kg (2lbs) of each novel ingredient for formulation effort
 - Improve and optimize synthesis & recrystallization process for all
 - Down select the suitable compound based on performance
- **WEAPON SYSTEMS IMPACTED:** 155 mm M795 artillery projectile, 120 mm M934 mortar, demolition explosive / charges, GP Bombs



The new formulators “toolbox”

Requirement / Impact

- Addresses AERTA PP-3-02-05 through design, characterization and testing for novel energetic formulations for explosive and propellant applications
- **PERFORMANCE, REGULATORY, OTHER DRIVERS:** RDX used in 1000+ munitions. Range clean-up levels, IM requirements
- **MAGNITUDE OF IMPACT:** Environmental regulators will halt or restrict Army operations if not addressed
- Successful demonstration of formulation utilizing energetic replacements which meet: reduced toxicity requirements and environmental assessments, munition performance, and IM requirements

Progress Report

- Key dates
 - Endorsement signed by PEO Ammo: 3Q-FY13
- Recent accomplishments/issues
 - Produced standard formulations
 - Favorable performance results obtained for one ingredient
 - Alternate ingredient formulations in process