Nikki Rasmussen

An advanced weapon and space systems company

Development of New Insensitive TNT-Based Explosives with Excellent IM Characteristics

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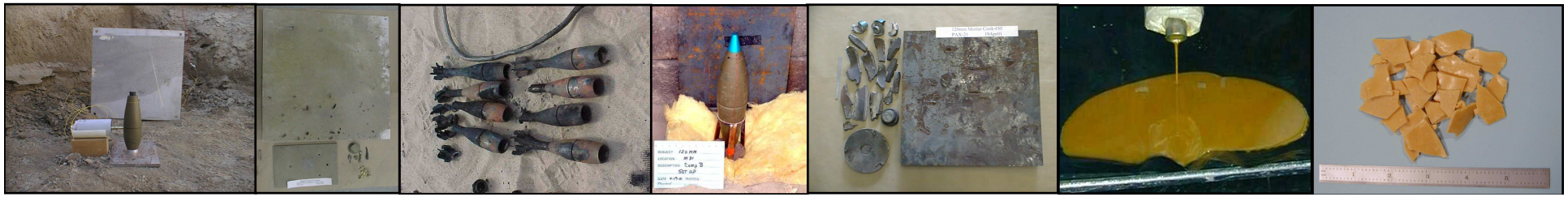

Problem Statement

•There are several problems with current IM compounds , such as:

- **High cost**
- **Additional production steps for melt-pour facilities**
- **Some IM compounds require extensive investment in existing facilities**
- **Multiple compounds needed to produce limited IM results**
- **Toxicity concerns for personnel and waste management**
- **Life-cycle analyses are limited**
- **Lethality degradation**
- **Sensitivity concerns**
- **Balance between impact and thermal threats**
- **Currently, there are unique solutions for different munitions**

There Exists A Need For A Common, Low-Cost IM Solution For Bomb And Artillery Fills!

Why TNT-Based Insensitive Common Explosives?

- **TNT is the historic common explosive.**
- **TNT processing is well understood.**
- **TNT already has low impact sensitivity and good thermal sensitivity.**
- **TNT is low cost.**
- **Manufacturing and loading infrastructure is already in place.**
- **TNT offers tailorable performance (Comp B, Tritonal, Octol, etc.)**
- **Formulation only needs to be less sensitive than TNT at same or improved performance.**

→ **Insensitive Common Explosive (ICE)**

TNT Has Been The Explosive of Choice for 100 Years.

Desensitizing TNT

- **Utilizing current technologies based on PAX-35**
  - Similar desensitizer moieties used to desensitize TNT
- **Formulations tested thus far are relatively simple**
  - TNT + Desensitizer
  - TNT + Desensitizer + Aluminum
  - TNT + Desensitizer + Nitramine
- **TNT-based formulation + Desensitizer**
  - Desensitizer must be:
    - Low Cost
    - Environmentally friendly
    - High Performance
- **Maintain "drop in" capability for loading operations**
  - Minimal modifications to manufacturing and melt/pour facilities will be required

PAX-44 (TNT + Desensitizer) Formulation is Being Developed for 155mm HE Projectiles

Test Evaluation Series

- **Sub-Scale Tests**
  - Dent/Rate using instrumented NOL pipe
  - BI against a 3” pipe
  - SCJI against a 3” pipe using a 25mm SCJ
  - SCO against an 81mm mortar
- **Mid-Tier Tests**
  - Dent/Rate using instrumented ELSGT pipe
  - BI against 155mm section
  - SCJI against 155mm section using 50mm Rockeye SCJ
  - Blast Overpressure
- **Full-Scale Tests**
  - Tests are planned

Sub-Scale Tests

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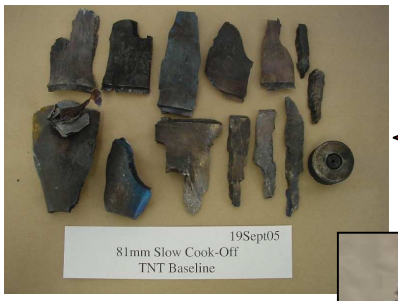
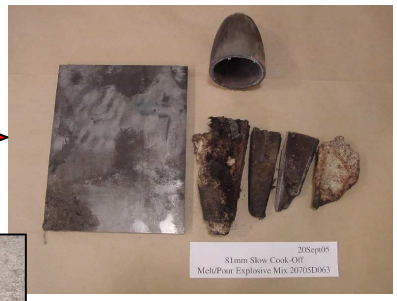
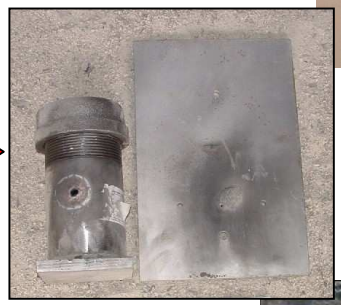
TNT		TNT + Desensitizer
Dent / Rate Data: 0.32 inch (85 RB) 6.64 km/s	Performance	Dent / Rate Data: 0.324 inch (87 RB) 6.40 km/s



Slow Cook-off



Shaped Charge Jet Impact



Bullet Impact

TNT + Desensitizer reduces reaction severity without compromising performance.

Mid-Tier Tests

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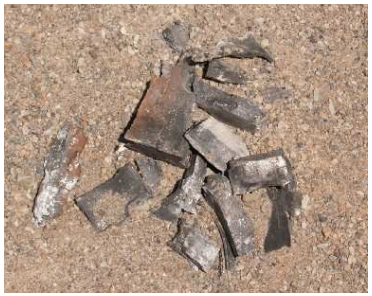
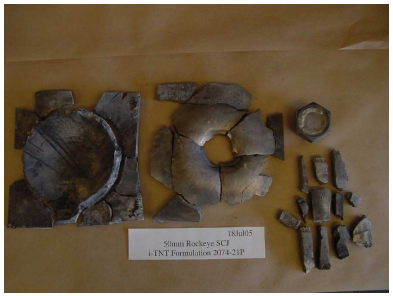
TNT		TNT + Desensitizer#1	TNT + Desensitizer#2
Baseline Blast	Performance	~99% TNT	~75% TNT

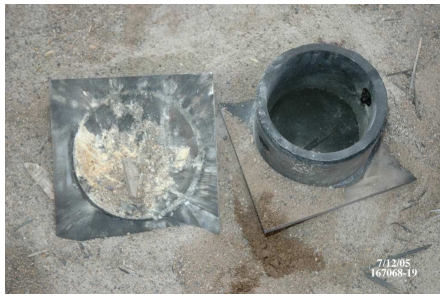
50mm SCJI



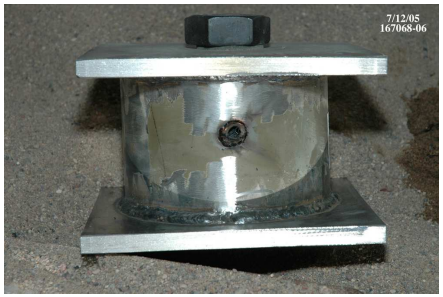


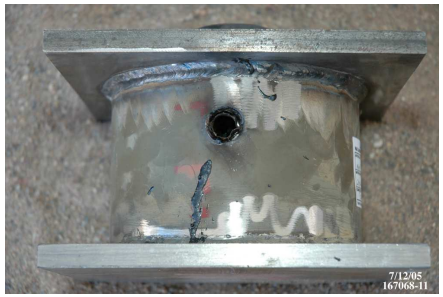
Fail

Pass



Bullet Impact





Performance and IM characteristic trade-offs noted with Desensitizers. Optimization with different desensitizers & nitramines needed.

Early Tritonal Results

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Tritonal

TNT + Desensitizer + Aluminum

Baseline Blast

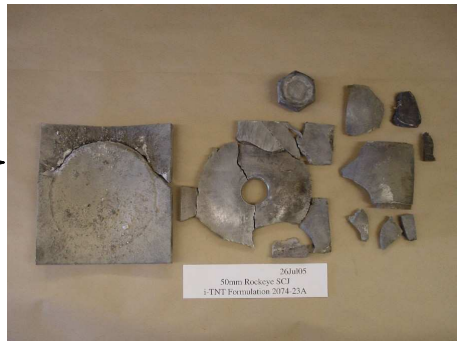
~90% Tritonal Blast Overpressure

Dent / Rate Data:
0.62 inch (71 RB)
6.8* km/s

Performance

Dent / Rate Data:
0.61 inch (69 RB)
6.47 km/s

50mm SCJI



Pass

Quality: Less Settling of Aluminum

Tritonal Counterparts with Desensitizers also look Promising.

Summary

- **Preliminary formulation work shows promising results reaction severity of:**
  - Bullet Impact (BI)
  - Shaped Charge Jet Impact (SCJI)
  - Thermal Characteristics
- **Preliminary formulation work shows minimal reduction of performance:**
  - Dent / Rate Performance shows similar performance
  - Blast Overpressure shows similar performance
- **Desensitizers in TNT at low levels show promise to:**
  - Allow tailor able IM and explosive performance possible
  - Compatible with current LAP facilities
  - Workable for Tritonal replacements

TNT+ Desensitizers look promising. Additional testing and evaluation planned.