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PROCESS DEVELOPMENT FOR HIGH BLAST PAX EXPLOSIVES AT HOLSTON ARMY AMMUNITION PLANT

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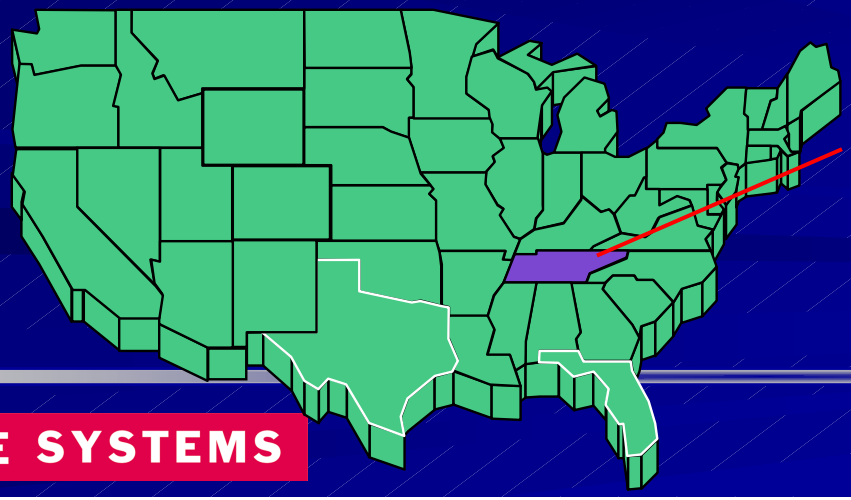

BAE SYSTEMS

HOLSTON

ARMY AMMUNITION PLANT

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U. S. ARMY MATERIEL COMMAND

High Blast Explosive Weapon Terminology

- Volumetric Weapons – Larger family of weapons consisting of thermobaric, fuel-air, etc.
- Thermobaric
  - Comes from the Greek words "thermo" (heat) and "baros" (pressure)
  - Designed to create an overpressure blast/wave and an intense fireball
- EBW – Enhanced Blast Weapons
  - Like Thermobarics, designed to create enhanced blast by extending the total impulse of the pressure wave
- FAE – Fuel Air Explosive
  - Also designed to create extended impulse pressure wave and an intense fireball, often dispersing the fuel prior to ignition
- These Terms Used Interchangeably Across the World
  - Thermobaric terminology and technology appear to have originated in Russia and Germany in World War II timeframe

Enhanced Blast Explosives

- Enhanced Blast Explosives – Deliver More Energy on Target than Traditional Explosives
- Four Types of Enhanced Blast Explosives
  - Metallized Explosives
  - Reactive Surround
  - Fuel Air
  - Thermobaric

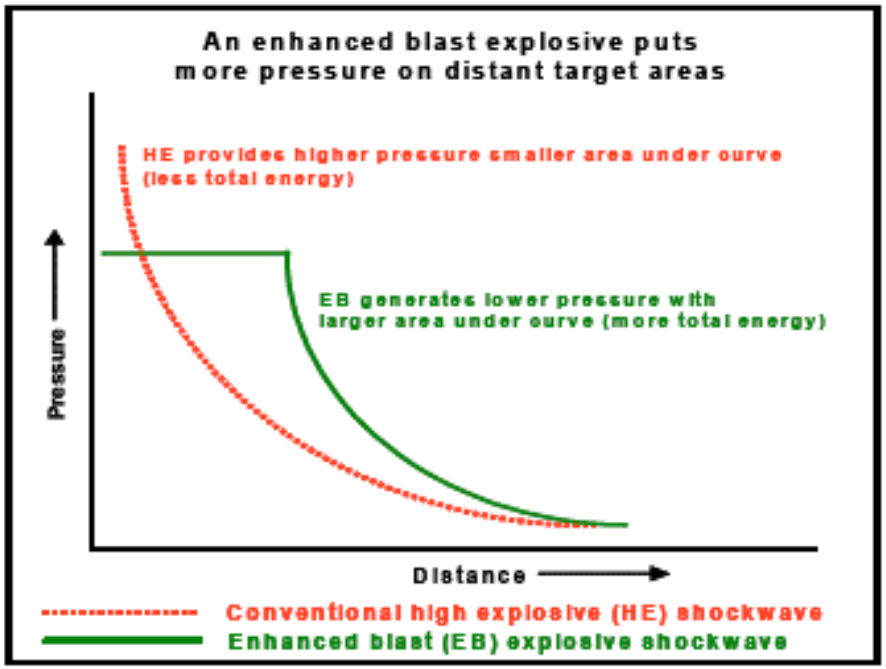


Fig. Comparison of conventional explosives and enhanced explosives.

Enhanced Blast Explosives

- Rely on Blast (Primary) and Heat (Secondary) for their Effects
- Effects Intensified in Confined Spaces (Buildings, Bunkers, Caves, Vehicles, etc.)
- Active Elements are an Explosive and a Fuel (metal)
- Vacuum or Oxygen Depletion Effect is Achieved

BAE SYSTEMS

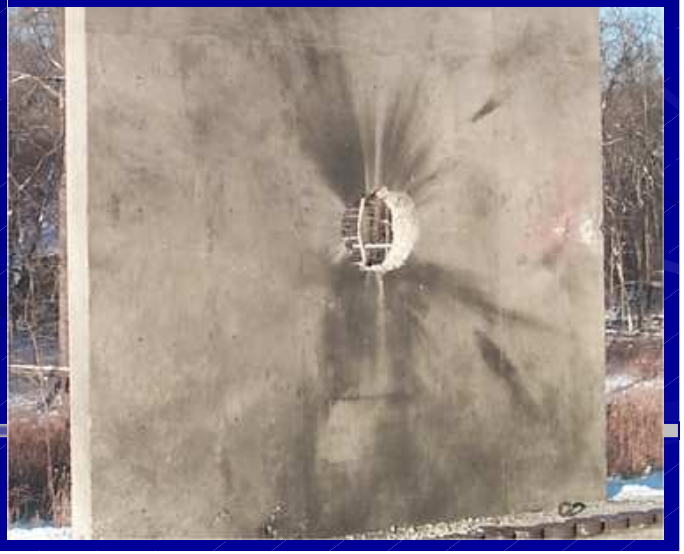
ALUMINIZED PBXs

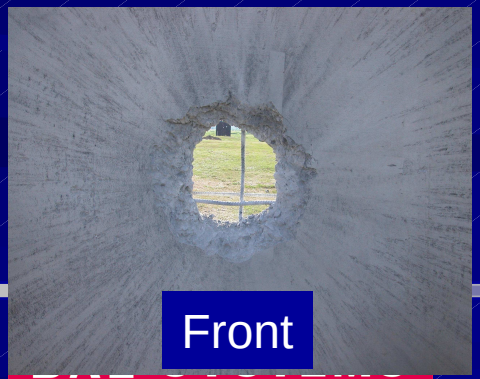
- Pressable Plastic Bonded Explosives (PBX) with Aluminum Incorporated
- Objective – One Munition for Two Targets (Armor and Bunker)

PAX-3

- PAX-3 – Developed by ARDEC
  - HMX
  - Cellulose acetate butyrate (CAB)
  - BDNPA/F plasticizer
- Replacement for Aluminized Comp. A-3
- Being Evaluated in SMAW, LAW, LOS-MP and Others

Concrete wall 10’ wide, 10’ tall 8” thick, reinforced with double steel rebar





PAX-3

- Processed Using Slurry Coating Methodology
  - Water replacement fluid used for fluidizing slurry
  - Must avoid oxidation of aluminum in slurry
- Lab Batches Made in 10 Liter Still
- DOE to Examine Process Parameters
- Initial Work Focused on Using Virgin Water Replacement Fluid

Bulk Powder (Magnified)

Bulk Powder

Pressed Pellets

PAX-3

PAX-3 COMPOSITE BLEND OF LAB BATCHES						
			Percent Passing USSS # (µm)			
Batch No.	Bulk Density (g/cc)	Flow	12 (1400)	20 (850)	40 (425)	80 (180)
1045-93	0.95	6	99.7	52.5	10.5	0.5

- Composite was a blend of 20 batches (1000 grams each) for a total of ~40 lbs. of product. Typical batch yields were >90%.

PAX-3 SENSITIVITY AND PERFORMANCE TEST DATA			
	PAX-3	**Al Comp A3**	**LX-14**
Impact (cm)(50%)	**39.5**	**80.4**	**26**
LSGT (50%)	**129.5**	**119+/- 3**	**199**
Detonation Velocity (m/sec)	**8070**	**8199**	**8680**

- Performance and sensitivity data provided by ARDEC

PAX-3

PAX-3 INSENSITIVE MUNITION TESTING

PAX-3 3.2” Generic Shaped Charge IM Test Summary*		
IM Test	**# of Tests**	**Reaction**
Bullet Impact (50 cal 2800 ft/s)	2	Pass No Reaction Pass No Reaction
Army Fragment Impact (Cube 6000 ft/s)	2	Pass Burn Pass Burn
Slow Cook Off (50 F /hr)	2	Fail Explosion/Deflagration** Fail Explosion/Deflagration**
Fast Cook Off	2	Pass Burn Pass Burn

* Initial Assessment

* * This reaction can be potentially mitigated by adequately venting the warhead

PAX-3 ISSUES

- Water Replacement Fluid Expensive
- Separation of Water Replacement Fluid from Solvent Difficult
- Work Currently in Progress
  - use of recycled water replacement fluid (lower cost approach
  - optimization of lab process for use of recycled water replacement fluid
  - analytical methods for water replacement fluid purity
  - development of rework procedure
  - scale-up to Production (500 gal.)

BAE SYSTEMS

ALUMINIZED MELT-POUR

- PAX-28
  - RDX
  - DNAN
  - Ammonium Perchlorate
  - Aluminum
- Processing Similar to PAX-21 (60mm Mortar Fill)
- Explosive Fill for U.S. Army 120mm Mortar Program

PAX-28

- Lab Scale Work Performed to Date to Test Formulation
- Manufactured in 5 Gallon Melt Kettle
- No Processing Issues

Known Issues

- AP particle size currently used is non-standard size and not available commercially
- ARDEC to determine if using a commercially available particle size AP has significant impact on formulation performance

CONCLUDING REMARKS

- PAX-3 Can Be Processed Using Slurry Coating Methodology
- Water Replacement Fluid Can Be Used to Slurry Powder and Perform Coating Operation
- PAX-3 Provides Enhanced Blast in a Variety of Warheads and a High Level of Insensitivity
- PAX-28 Can Be Processed in Standard Melt-Pour Equipment
- Pricing for PAX-28 from Production Scale Processing Will Be in Line with PAX-21 (~ $15/lb.)

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