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Manufacturing of the Thermobaric Explosive PBXIH-18 at Holston Army Ammunition Plant

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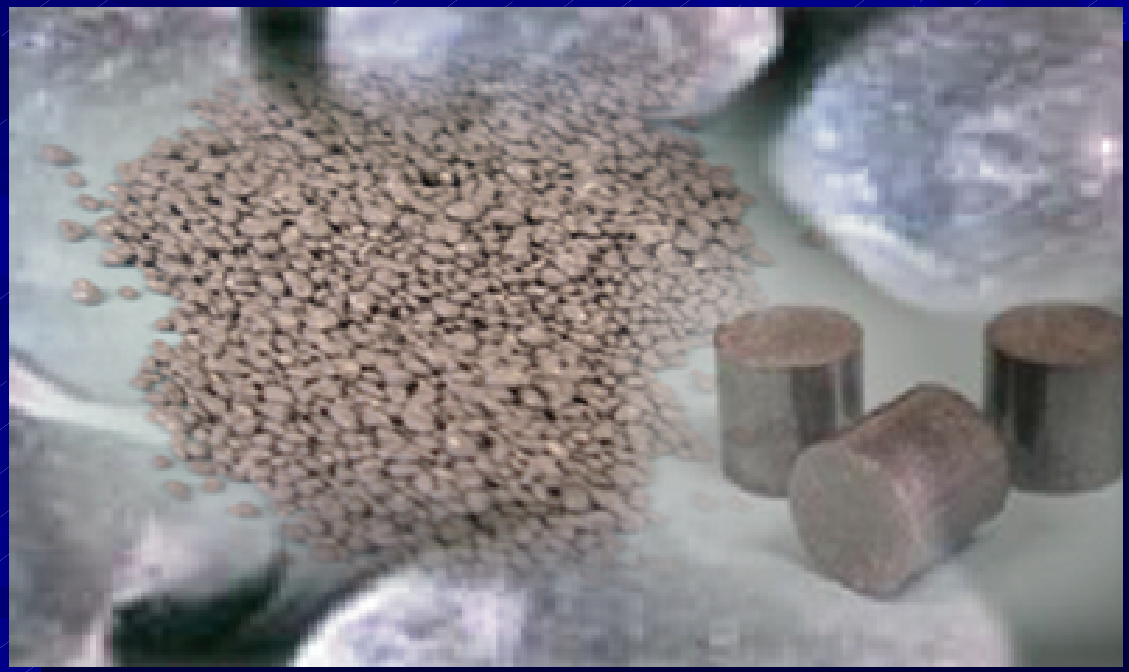
Briefing Aims

- Background
- Program Objectives
- Experimental
- Production
- Summary



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Background

Thermobaric Bomb Test

- Thermobaric Explosives
  - Higher sustained blast pressures
  - Increased lethality in confined spaces
- Limited Manufacturing Capability for Thermobaric Explosives
  - Current processes are small-scale and expensive
- Explosive Formulation
  - PBXIH-18
- U. S. Navy Sponsored Program for PBXIH-18 Scale-Up
  - NSWC Indian Head, Yorktown Detachment

Program Goals

- PBXIH-18 Explosive
  - Lab-Scale Process Development
    - Evaluations
      - HMX/DOA Premix vs. Individual Intermediates
      - Water Replacement Fluid (WR Fluid)
      - WR Recovery and Re-Use
  - Elimination of Water from PBX Coating Technique
  - Scale-up: Small Production Batch (≈ 300 pound)

PBX Processing at HSAAP

- Uses Solvent-Lacquering Technique
  - Explosive intermediates slurried in water
  - Polymer / plasticizer dispersed in solvent
  - Coating / processing cycle
  - Recovery / reuse of solvent
- Large-Scale Operation at HSAAP
  - 500 and 6,000 gallon capacities

6,000 gallon 7A Still

Processing PBXIH-18

- Traditional Methods Incompatible with Thermobaric PBX
  - Aluminum powder oxidized by water
  - Safety issues significant at production-scale operations
- "Water Replacement" (WR) Fluid Evaluated
  - Non-reactive with metal powders
  - Fluidizing effect of water
  - Colorless, nonflammable liquid
  - Similar boiling point range as water
- Recovery of WR Fluid Key to Controlling Product Cost

WR Fluid Slurry

PBXIH-18 Process Development

- Phase I of U. S. Navy Program
  - Lab-scale process development
- Design of Experiments
  - Systematic evaluation of process parameters for PBXIH-18
  - Lab-scale replicates of HSAAP PBX production stills
  - Typical lab batch size of 1,000 grams
  - Evaluation of WR Fluid recycle
  - Evaluation of HMX / DOA Premix
- Analytical Properties on PBXIH-18 Lab Batches

Lab PBX Still (13-Liter)

PBXIH-18 Process Development

- Properties of PBXIH-18 Modified w/ Process Conditions
  - Granulation, Bulk Density, Press Density & Impact Sensitivity

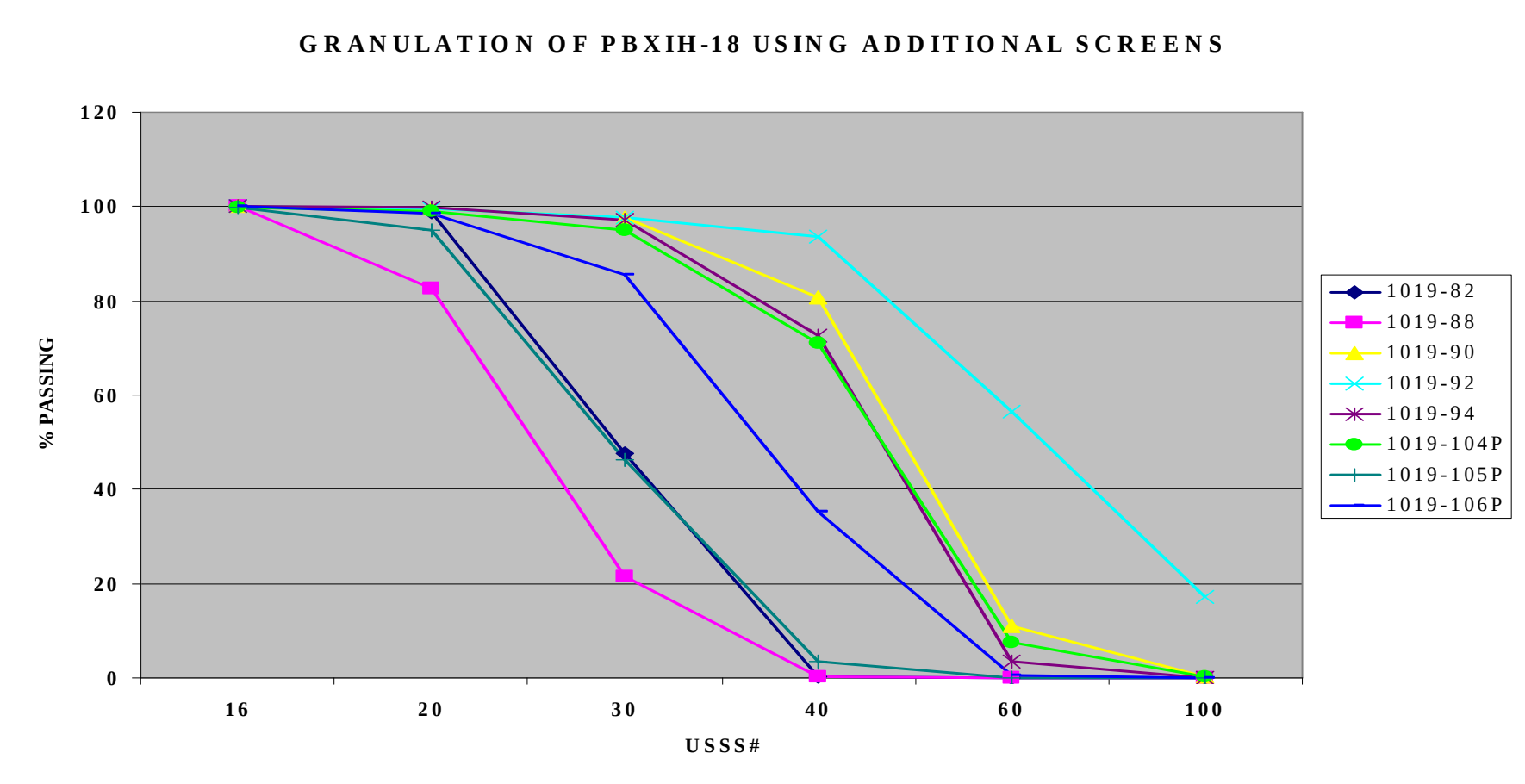
LABORATORY PROCESS DEVELOPMENT OF PBXIH-18

PBXIH-18 Lab Batch #	Process Condition No.	Impact Sensitivity (cm)	Bulk Density (g/cc)	Granulation (Wt. % Passing USSS Sieve No.) 6	16	60	100	Pressed Density (g/cc)
1019-82	"A"	43.35	0.939	100	100	0	0	1.92
1019-88	"B"	39.81	0.999	100	100	0	0	1.92
1019-90	"C"	32.89	0.89	100	100	10.02	0.2	1.93
1019-92	"D"	30.41	0.97	100	99.8	54.9	13.2	1.93
1019-94	"E"	30.31	0.965	100	100	4	0	1.94
1019-104P	"F"	52.12	0.94	100	99.4	7.5	0.8	1.93
1019-105P	"F"	58.48	0.98	100	99.9	0	0	1.94
1019-106P	"F"	56.23	0.98	100	99.8	0.3	0	1.94
1019-125PR	"G"	53.16	1.064	100	98.9	0	0	1.95

As Presented at 2004 IMEM Symposium

PBXIH-18 Process Development

- Granulation Profiles of Various PBXIH-18 Lab Batches



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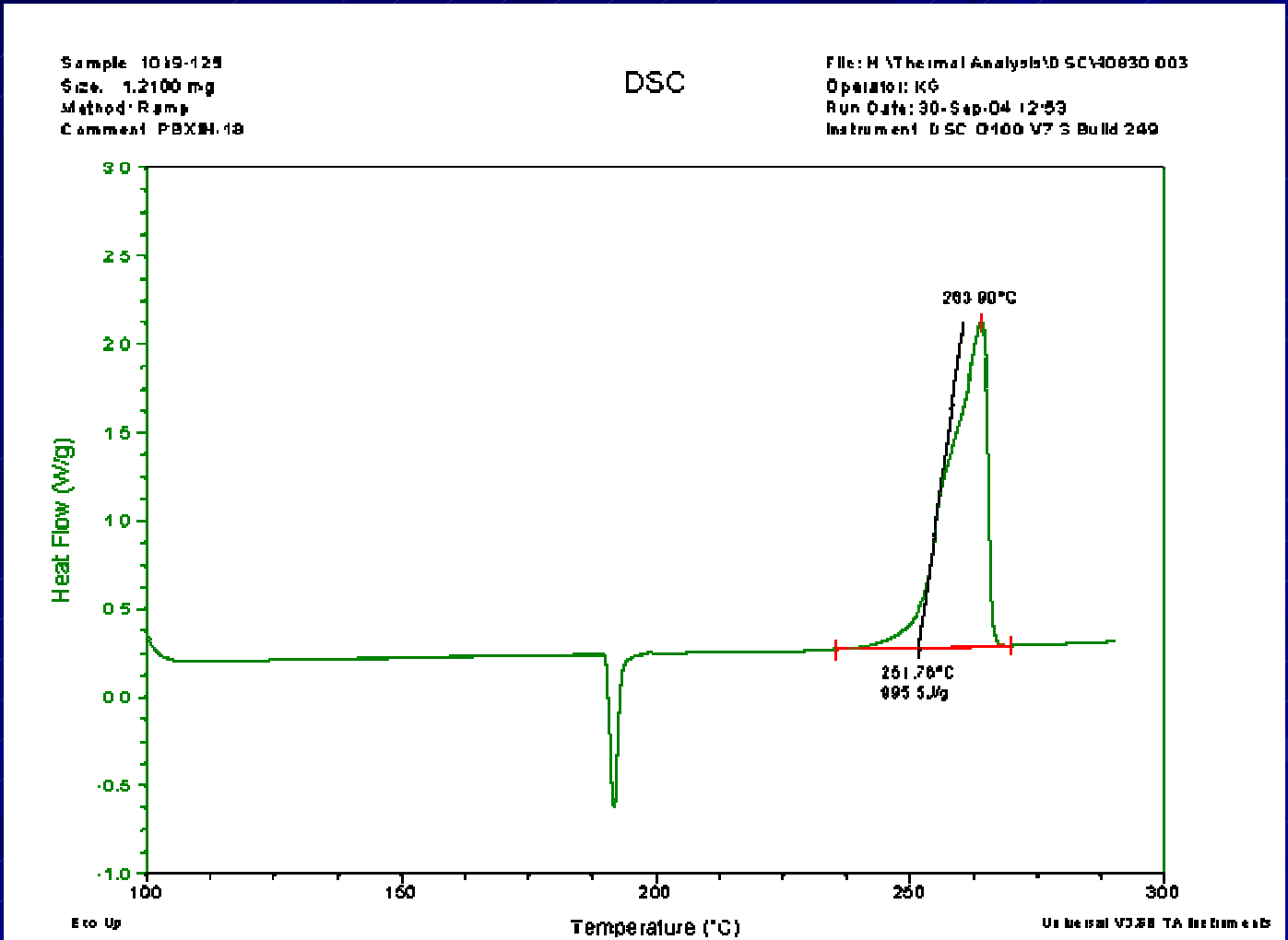
Differential Scanning Calorimetry of PBXIH-18

- Ramp Rate of 3ºC / min. (100-225 ºC) & 1ºC / min. (225-280 ºC)

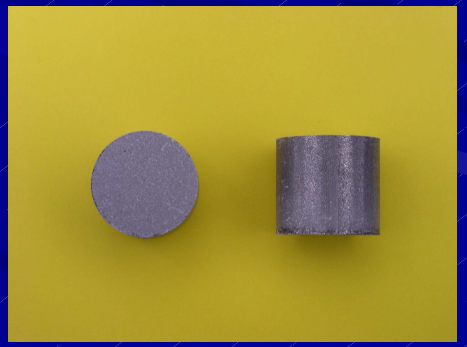


Findings from PBXIH-18 Process Development

- WR Fluid Effectively Recovered
  - Product generated using new and reclaimed WR Fluid were indistinguishable in properties
- HMX / DOA Premix
  - Data indicates impact sensitivity of PBXIH-18 was improved by the use of HMX / DOA Premix
- PBXIH-18 Exhibited Excellent Physical Characteristics
  - Granulation, Flow, Density, etc

PBXIH-18

Bulk Powder and Pressed Pellets



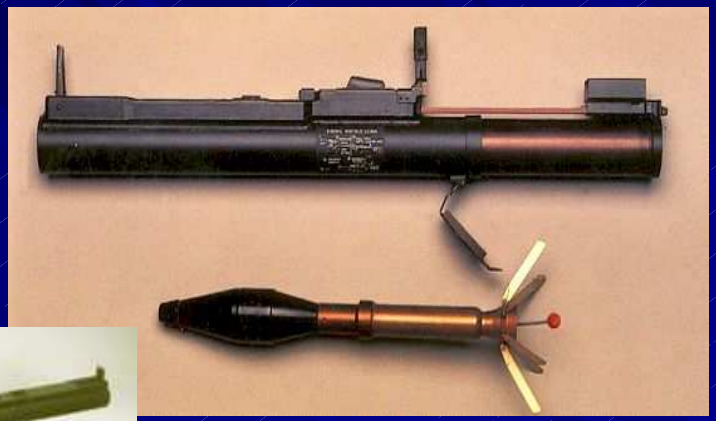
Production Operations

- PBXIH-18 Explosive
  - Scale-up: small production batch (≈ 300 pound)
  - Similar as process condition “E” as specified by Lab DOE
  - Manufactured April 2005
- Product Characteristics

Vacuum Still
(500-gallon Capacity)

					Granulation % Passing USSS					Impact, cm	
	Press Density (g/cc)	H2O %	VTS (ml/mg) 48 Hrs.	Coff. Of Friction		No. 6	No. 8	No. 40	No. 70	PBXIH-18	Std.
PBXIH-18-1	1.92	0.03	0.06	150	PBXIH-18-1	100	100	5	2	30.04	15

Qualification with PBXIH-18



SMAW

Shoulder-launched Multipurpose Assault Weapon

LAW

Light Anti-tank Weapon

Summary

- WR Fluid was Effective for Thermobaric PBX Processing using HSAAP Infrastructure
- Good Properties Demonstrated for PBXIH-18
- PBXIH-18
  - Process development complete
- Cost of Aluminized PBX Explosives
  - Dependent on recovery efficiency of WR Fluid