



Establishment of a TATB Manufacturing Process for Triaminotrinitrobenzene (TATB) at Holston Army Ammunition Plant

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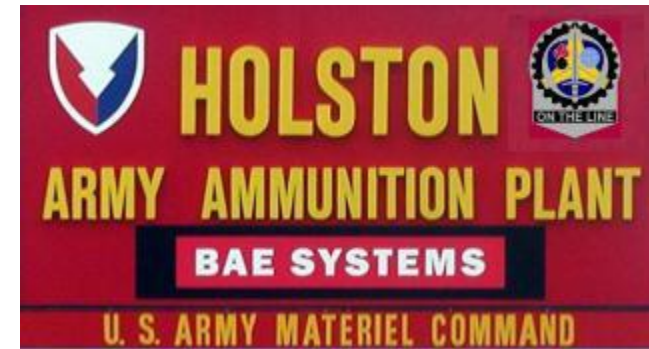
BAE System Ordnance Systems / HSAAP
US Navy, NAVAIR - China Lake
US Army, PD-Joint Services
US Navy, NSWC - Indian Head





Briefing Outline

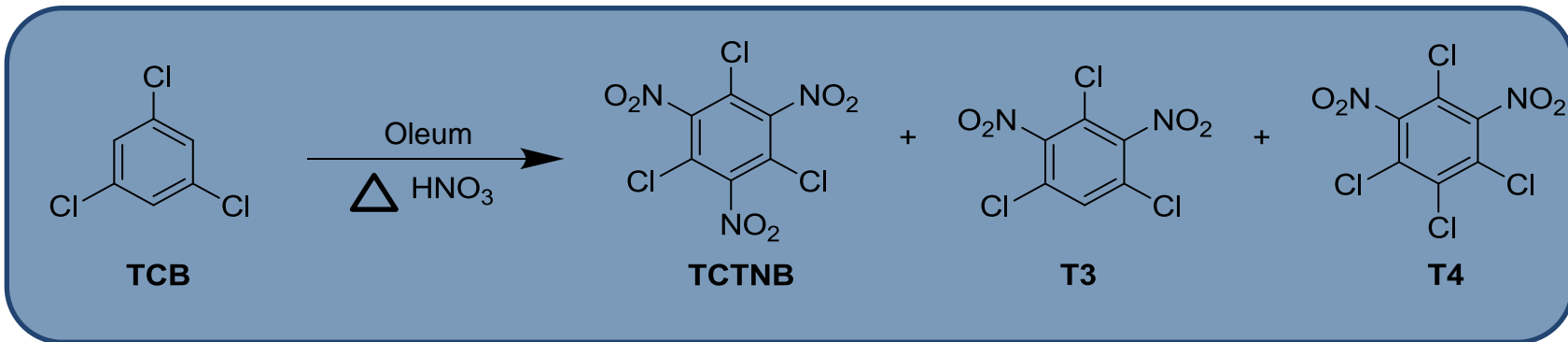
- Review of Benziger TATB Synthesis Process
- History on TATB Requirements & Manufacture
- TATB Program Overview
- Overview of TATB Facility at Holston AAP
- Qualification of TATB and PBX Formulations
- Conclusions
- Acknowledgements





Review Benziger Synthesis for TATB

First Step - Nitrate TCB to TCTNB

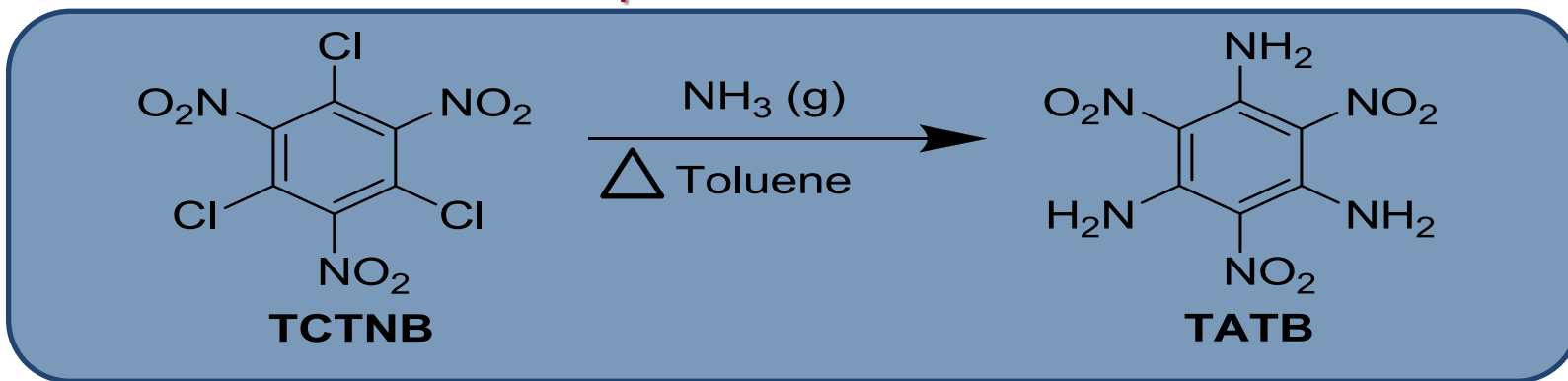


- 1,3,5-Trichlorobenzene (TCB) is used as the starting material for both Wet-aminated and Dry-aminated TATB
- TCB is nitrated in an Oleum / Nitric Acid solution to yield 1,3,5-Trichloro-2,4,6-trinitrobenzene (TCTNB)



Review Benziger Synthesis for TATB

Second Step - Aminate TCTNB to TATB



- TCTNB is aminated with ammonia gas to yield 1,3,5-triamino-2,4,6-trinitrobenzene (TATB)
- The Type of TATB Depends on Amination Conditions (i.e. whether water and / or an emulsifier is present in the reaction)
- TATB physical attributes influenced in amination step (i.e. particle size, crystalline surface characteristics, etc)



Why So Much Emphasis On TATB ?!?

- TATB is one of the least sensitive explosive materials available
- Critical ingredient in numerous IM Fuze systems within DOD
- Ex. applications for TATB formulations (PBXN-7 & PBXW-14):



General Purpose Bombs	2.75 HE Warhead
Penetrator Bombs	Quickstrike Mine
Tactical Tomahawk	60mm Mortar
SLAM ER	81mm Mortar
JSOW FTB	120mm Mortar



- DOE applications are both tactical and strategic





Recent TATB History

- **1993 - CONUS production of TATB ceased**
- **1999 - DOD began OCONUS TATB procurement from UK**
- **2005 - Last qualified TATB source ceased production**
- **2007 - DOD / DOE Joint Working Group established**
- **2008 - NNSA / DOE TATB Study Group established**
- **2010 - Lab and pilot demonstrations of Benziger TATB synthesis by BAE Systems & ATK**
- **2011 - TATB facilitization contract awarded at Holston AAP**
- **2013 (March) - TATB Facility fully commissioned**
- **2013 (May) - Manufacture of qualification batches for for TATB, PBXN-7, & PBXW-14 completed**



Benziger TATB: Truly a “Joint” Program

- Program participation by all DOD Services, multiple DOE Agencies, and Industry
- TATB Working Group Participants:

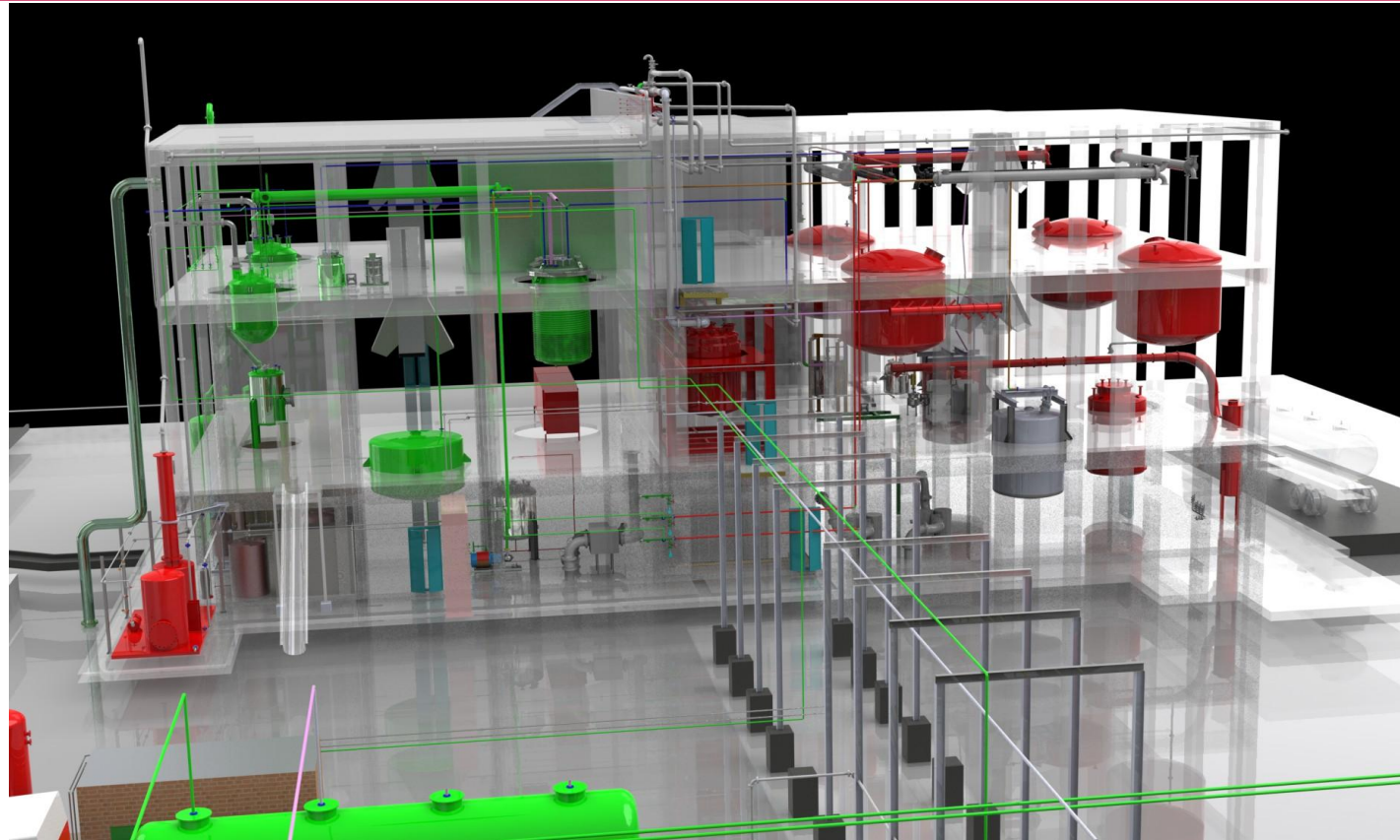


OUUSD (AT&L) / PSA / LW&M	Rock Island Contracting Com.
NAWC China Lake	679 th ARSS, Eglin AFB
NSWC Indian Head	DOE, HQ NNSA
NAWCAD Pax River	DOE, LANL
PD Joint Services	DOE, LLNL
PM CAS	DOE, Pantex
ARDEC	DLA, Strategic Materials
Joint Munitions Command	BAE Systems





Schematic of New TATB Facility



**Building G-10 Agile
Manufacturing Plant for
Energetic Materials
At Holston AAP**

Key:
Red – Legacy equipment
used for TATB processing

Green – New equipment
being installed for TATB

- **TATB Facility designed to use much of the existing infrastructure in Agile Plant**
- **Provided a cost effective manufacturing capability for Benziger TATB**
- **Enhances the capabilities of the Agile Facility for other Energetic / Critical Materials**



TATB Manufacturing Infrastructure and Process

- **TATB Process Includes:**
 - Nitration
 - Amination
 - Purification (Reflux & Washing)
 - Recovery (Filter & Filter Press)
 - Acid Handling (Oleum & SNA)
- **Process Equipment:**
 - Glass Lined Reactors
 - Pressure Vessels
 - Wash Tank / Filter Press
 - Toluene Storage Tank
 - Ammonia Delivery System
 - TCB (Heaters and Feed System)





TATB Manufacturing Infrastructure and Process (Continued)

- **Process Control**

- **Highly Automated**
- **> 330 I/O Points**
- **Safety PLC**



- **Facility Operation & Capacity:**

- **Fully integrated into HSAAP Agile Plant**
- **Projected capacity >20,000 lbs / month if needed**





TATB Product Qualification Batches

Product Qualification Batches

- Qualification batches produced in HSAAP Agile Plant
- Minimum requirement for 5 consecutive batches meeting specification



Nutsches of TATB

Applicable Specifications

- TATB Military Specification No. WS23158
- New Joint DOD / DOE Specification (MIL-DTL-32337)

<u>TATB Attributes</u>	<u>HSAAP TATB</u>
Particle Size (USSS Screen Nos. 15, 35, 60, 85, & 105)	PASSED
Crystal Morphology (SEM)	PASSED
Total & Inorganic Chlorine (%)	PASSED
Purity (%)	PASSED
Impurity Levels (%): T3, T4, & TCTNB	PASSED
DSC (°C, Peak Onset & Max)	PASSED
Ash Content (%)	PASSED
Vacuum Thermal Stability	PASSED
Impact, Friction, ESD	PASSED
Angle of Repose	PASSED
Infrared Spectroscopy	PASSED



PBXN-7 and PBXW-14 Product Qualification Batches

Product Qualification Batches

- Qualification batches produced in standard Holston AAP PBX Infrastructure (Building G-6)
- Min. requirement for 3 batches of both PBXN-7 and PBXW-14 fully meeting specification



**500-gallon
Vacuum Still
for PBX**

Applicable Specifications

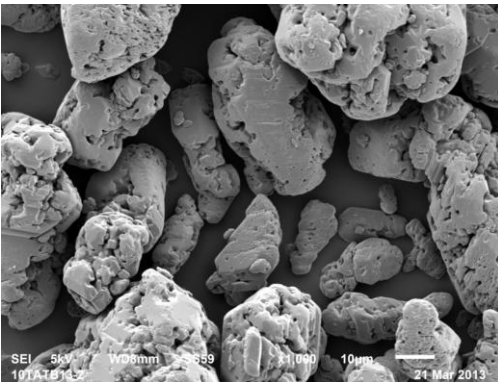
- **PBXN-7: MIL-DTL-82874D**
- **PBXW-14: MIL-DTL-32280**

<u>PBX Attributes</u>	<u>PBXN-7 & PBXW-14</u>
Composition	PASSED
Granulation (USSS Sieves): PBXN-7: Nos. 6, 14, 18, & 100 PBXW-14: Nos. 6, 12, 40, & 100	PASSED
Moisture (%)	PASSED
Purity (%)	PASSED
Bulk Density	PASSED
Pressed Density	PASSED
Vacuum Thermal Stability	PASSED
Workmanship	PASSED
Impact, Friction, ESD	PASSED
Shock Sensitivity (LSGT)	PASSED

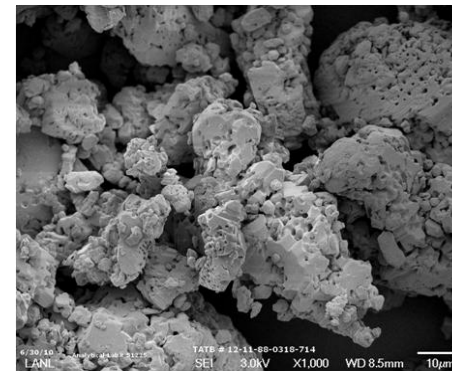


Testing & Qualification Summary for Benziger TATB and Formulations

- The Benziger TATB and the corresponding PBXN-7 & PBXW-14 formulations from Holston AAP are fully compliant with Mil-Specs
- The Benziger TATB Produced at Holston AAP is chemically and physically indistinguishable from legacy TATB product
- Government Laboratories participating in the qualification program:
 - DOD: NAWC China Lake, NSWC Indian Head, ARDEC
 - DOE: LLNL, LANL, PANTEX
- Full DOD qualification of the Holston Benziger TATB and PBXN-7 / PBXW-14 formulations is expected before the end of CY-2013



Holston AAP Dry Aminated TATB (1,000X)



Legacy Dry Aminated TATB (1,000x mag)



Summary

- **TATB Synthesis via Traditional Benziger Process has been Effectively Demonstrated on a Production Scale at Holston AAP**
- **The TATB Product is Fully Compliant with All Applicable DOD and DOE Specifications**
- **The TATB has been Formulated into PBXN-7 and PBXW-14 using Traditional PBX Coating Equipment at Holston AAP**
- **The PBXN-7 and the PBXW-14 is Fully Compliant with All Applicable DOD Specifications**
- **These Explosive Formulations are being Evaluated by Applicable DOD Labs & Full Qualification is Expected by the End of CY-2013**
- **The projected Capacity of the TATB Facility should be Capable of Meeting All Foreseeable Future Demand and the TATB Product Cost Should Be Lower than Historic Levels**



Acknowledgements

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- **US Army, ARDEC**
- **US Navy: NAVAIR Weapons Division, China Lake; NAVAIR Aircraft Division; Pax River; NSWC, Indian Head Division**
- **US Air Force, 679th Armament Systems Squadron, Eglin AFB**

