Process of Transferring New Energetic Materials from Concept to Production at Holston Army Ammunition Plant

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HSAAP TRANSITION TO PRODUCTION TIME LINE

Production Scale

<table>
<thead>
<tr>
<th>Year</th>
<th>Premixes</th>
<th>FEM RDX</th>
<th>DMDNB</th>
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Lab Development

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New Product Development

Quality Management Processes
- ISO 9001 2000
- Life Cycle Management
- Six Sigma

Process / Product Improvement
Evaluation
Full-Scale Production
Scale-Up Activities
Lab Scale Development
Technical Review
Management Review
Conceptual Process or Product
Featured Products

- PAX-21
- FEM RDX
- DNAN
- HMX & RDX Premixes
- PBXW-17
- DMDNB
- PAX 2A
- NTO
PAX - 21

- Comp-B Replacement IM Castable
  - 60mm Mortar (D&Z Kansas)
  - Others under evaluation

- Development ➔ Production: 10 Months
  - Utilized Existing Equipment and Process Knowledge
Concept ➔ Production: 8 Months

Mill Specifications:
- Capacity (50 – 500 LB / hour)
- Target product particle size (3-20 micron)

Programs:
- PAX-21
- PAX-194
- JAASM
- Gun and rocket propellants
- Commercial automobile air bags
DNAN

- Key Ingredient in PAX-21
- Material Problems
  - Sole source from China
  - Material does not meet purity specification
- 2 Stage Program:
  - 1.0 DNAN Purification Method ➔ 4 Months
  - 2.0 DNAN Synthesis ➔ Ongoing Program
HMX & RDX Premixes

- Concept ➔ Production: 6 Months
- “CXM Type” Products for Cast Cure Mixes
- Benefits
  - Improved safety at LAP plant
  - Reduced processing costs at LAP plant (no drying)
- Typical Coatings
  - IDP; HTPB; DOA
- Certified Viscosity of premix for PBX manufacture
  - Reduces risk at LAP plant
PBXW-17 (aka PBXN-11)

- Concept ➔ Production: 4 Months
- IM Pressed Explosive
- Traditional HSAAP Manufacturing Technology
- Programs
  - APOBS (Ensign Bickford A&D)
  - Mongoose (BAE SYSTEMS)
DMDNB

- Development ➔ Production: 16 Months
- Chemical Taggant for Plastic Explosives
- Was Produced Solely by Dow Chemical
  - Facility shut down Q4 / 2002
- Identified by the Army as a Critical Material
- Now Produced at HSAAP
PAX-2A

- Concept ➔ Production: 18 Months
- Polymer Coated HMX Explosive
- Leading IM Replacement for Comp A-5
- Traditional HSAAP Manufacturing Technology

10x Magnification
NTO

- Concept ➔ Production: Production Scale-up
  Ongoing
- IM RDX Replacement
- Novel Method for Triazolone Synthesis
  - Highly suitable for Agile Facility
- Currently Undergoing Evaluation by U.S. Air Force
- Synthesis & Recrystallization Work Being Sponsored by Eglin AFB
TO & NTO Crystals

TO (200x Magnification)

NTO (60x Magnification)
Challenges

- Resource Sharing Across Programs
- Rapid Learning Curve
- “Comfort Factor” of Introducing New Technologies / Processes
- Waste Stream Management i.e. Ammonium Perchlorate (AP), Nitroaromatics
Summary

- Proven Synthesis, Scale-Up and Production Methods
- Average Time Scale = 9 Months
- ISO 9001-2000 Certified Manufacturer