Actodemil® Technology for Recycling of Propellants and Energetic Wastes
Radford Army Ammunition Plant, Radford, Virginia

Actodemil® Technology Transitioning to Other Applications

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ARCTECH, Inc. 14100 Park Meadow Drive, Chantilly, Virginia 20151; (703) 222-0280
Established 1988 as spin-off company from Atlantic Research Corp.

Headquarters and Laboratory Facilities – Chantilly, Virginia

Manufacturing Facilities – South Boston, Virginia

Market Profile: Development and Implementation of Innovative Solutions for Energy, Environment and Agriculture markets

Selected as one of the six top bioprocessing firms in the United States (Arthur Young, 1989)

Selected by DOD as a participant in the Pilot Mentor-Protégé Program with BDM Federal (1993-1996)
ARCTECH Proven Experience in Offering Economical Solutions for Safe Destruction of Military Munitions

- **1970-80’s** Successfully developed and facilitated implementation of composting technology for bioremediation of explosive contaminated U.S. Army sites
- **1990’s** Successfully validated Actodemil® for safe destruction of explosives and chemical agents for U.S. Army
- **Today** Implementing Actodemil® System for safe destruction and decontamination of munitions for U.S. Army and other international clients
Why Actodemil® Technology for Recycling of Energetics

- Established technology for recycling Propellants and energetics
- Rapidly deployable approach for safe recycling of energetics
- No waste byproducts or toxic emissions
- Creates value-added fertilizer which will supplement conventional fertilizer instead of competing with it.
- Organic fertilizer enhances soils and agricultural activity
- Organic fertilizer will meet requirements for land application
- More cost effective than thermal treatment technologies
- ARCTECH has previous experience in designing engineering systems for exothermic reactions and implementing them
- ARCTECH has proven experience in marketing and selling fertilizer
Demilitarization
A True Swords to Plowshares Technology.
Converting Ammunition to Fertilizer.

ACTOSOL® Humic Acid Water Phosphoric Acid

Propellant/ Explosive Mix Tank

Product Loadout

ARCTECH, Inc.
Regulatory Framework For Process

- **MUNITIONS RULE**
  Munitions Rule Permits Recycling of Propellants to fertilizer provided that:
  - End Product Meets TCLP requirements
  - End Product Meets UTS requirements
  - End Product is Not Reactive

- Exempt from RCRA (RCRA Operating Permit Not required)
Actosol® Product from NC Fines Increases Corn Yield

- NC fines recycled to yield a 5-5-15 NPK actosol® product.
- Actosol® product tested on growth of corn at two farms in New Jersey.
- Actosol® product applied at 2 gal/acre.
- Increase in yield - 6 bushels an acre at each farm.
Actosol® Product Is Beneficial For Turf Grass Growth

Ryegrass

Fertilizer Derived From NC Commercial Fertilizer
• Actodemil® Technology Unit for the U.S. Army Defense Ammunition Center (DAC), McAlester Army Ammunition Plant (McAAP).

• Actodemil® Technology for Transitioning to U.S. Forces in Korea

• A New full-scale Actodemil® technology for U.S. Army Crane Ammunition Activity.

• Actodemil® technology for recycling of Propellant and Energetic Wastes at Radford Army Ammunition Plant, Radford, Virginia
Actodemil® Technology Production Unit at McAAP

Actodemil® Technology
ANOTHER VIEW OF HOPPER AND FEED SYSTEM
Another View of Actodemil® Production Unit at McAAP

Actodemil® Technology

Preserving tomorrow's world... today
Cooling System

Actodemil® Technology

Preserving tomorrow's world... today
Scrubber System

Actodemil® Technology

Preserving tomorrow’s world... today
Full-Scale Facility at Crane Army Ammunition Activity

- Process Capacity – 1 ton/day
- Capable of processing various single, double, and triple base propellants but none with metal combustion rate modifiers
- Full automation
- Capable of being monitored and operated from a remote location via computer
- Training to be provided to CAAA personnel
- Technology system components to be installed at existing building/facility at CAAA and integrated with existing utilities
- Capable of successfully neutralizing propellants to produce fertilizer that complies with regulatory requirements.
• RfAAP Mission: Provide our Warfighters with ‘World class propellants and powders

• Manufacture products in a safe and environmentally sound manner

• RfAAP is only active munitions-grade NC facility in N. America

• RfAAP now also manufactures TNT

• Number of waste streams produced from manufacturing operations

• Current practice is to open burn and/or incinerate

NEEDED: An alternative to the current thermal methods for treatment.

SOLUTION: Actodemil® technology for Recycling Propellant Wastes to a Organic Humic-Rich fertilizer
Planned Activities at Radford AAP

FY 05 Activities
1. Develop Site-specific data for Design of system at RfAAP
2. Develop design of Actodemil® technology system unit and facility
3. Develop documentation such as Hazard Analysis, Environmental Compliance Requirements, Safety Plan, SOPs, etc.

FY 06 and 07 Activities
1. Additional Engineering Design for implementation of system
2. Assembly and Implementation of system at RfAAP
3. System shakedown and optimization testing
4. Conduct operator Training
5. Handover technology system to ATK – April 1, 2008
Project Objectives

• Establish that the Actodemil® technology can safely and completely recycle the energetic waste materials produced at RfAAP.

• Establish that the resultant product complies with regulatory requirements for land application and can be used as a viable fertilizer.

• Provide information on process parameters, economics and process scale-up to develop a design of a full-scale Actodemil® facility at RfAAP.
**Success Criteria for Tests**

- Chemical analyses for explosive compounds expected in the wastes to be treated such as NC, NG, NQ, 2,4-DNT etc. to confirm that the destruction of these compounds exceeds 99%.

- Analytical tests to show that the product passes the Toxic Characteristic Leaching Procedure (TCLP), and UTS requirements.

- Laboratory analyses to show that the product is not cyanide reactive as defined under RCRA requirements.
Six Batch Tests Conducted so far

1. NRE (propellant mixes)
2. RF 1315
3. PAP 7993
4. RPD 380
5. RP-910
6. M30A1

Two more batch tests remain with MK-90 and contaminated solid wastes (e.g. gloves)
Actodemil® Technology for Treatment of Various Energetic Waste Streams, RfAAP, Radford, Virginia
General Test Procedures

- Initial check to ensure proper operation of all equipment and instrumentation
- Readying of a-HAX reactant solution.
- Manual addition of energetic waste material to the reactor tank
- Addition of the reactant solution to the tank and initiation of the test.
- Sampling and monitoring activities during the test.
- Following completion of tests addition of phosphoric acid for neutralization
- Addition of anti-foam agent (if necessary) to control foam during neutralization
- Transfer of final reactant product to storage drums, and
- Rinsing, decontamination of tank and piping, and prepare for next batch test
• Samples of Liquid Product Collected at:
  - 2-hour interval
  - 4-hour interval
  - 8-hour interval (end of test)

• Gas samples collected and analyzed onsite using Drager tubes
  - NO\textsubscript{x}
  - CO
  - NH\textsubscript{3}

• Continuous monitoring for temperature
Summary of Analyses Conducted

- Hydroxide ion concentration (OH-) conducted onsite

- Residual Explosive Compounds Conducted by GPL Labs, Frederick Maryland.

- Environmental Parameters analysis (TCLP, UTS parameters,, and cyanide reactivity) conducted by GPL Labs, Frederick, Maryland.

- Total Nitrogen, Total Phosphorus, and Total Potassium analysis conducted by independent lab – Thornton Labs, Florida
• Lab Analyses of Liquid Product from all tests showed no evidence of energetic compounds

• Fertilizer product is not reactive, and

• Fertilizer product meets TCLP and UTS requirements

ALL SUCCESS CRITERIA MET