Proven & Effective Green Sustainable-

M6 Propellant Disposal

For Camp Minden, Louisiana

March 4, 2015

Presented to EPA Dialogue Committee
Dr. Daman Walia, President, ARCTECH
Jonathan Sperka, Technical Director
Ordnance Holdings, Inc. (OHI)

Overview

- **ARCTECH** and **Ordnance Holdings Inc**. (OHI) with assistance from a respected local contractor will deliver a proven, safe, green, non-thermal solution on a timely basis, within the budget parameters
- ARCTECH has two decades experience safely remediating M6 and other propellants and high explosives, and chemical weapons in multiple jurisdictions
- The solution has several years of data from multiple sources with acceptance in several states.
- The process is exempt from RCRA permitting under the 1997 Munitions Rule as it is considered a recycling process. LADEQ has adapted the Munitions Rule. Since No RCRA permit it required, there will be no delay in implementing the technology at Camp Minden.
- **Proven Technology**: Actodemil is a Non-Thermal Humic Acid Catalyzed Hydrolysis-Neutralization Solution, which can be scaled up.
- Two safe alternatives for final product will be proposed.

ARCTECH - Pioneering Green Sustainable Solutions – Military Unique Materials

- Established in 1988 as a technology spin-off from Atlantic Research Corporation - Selected as one of the top six U.S. bio-processing firms -1989 – Long History of Working with Military Unique Munitions
- 1980's –Pioneered Composting Technology for Clean Up of Explosive Contaminated Grounds
- Early 1990's - Developed and commercialized Humic Acid product for use in addressing environmental problems
- 1990's - Validated Actodemil® for safe destruction of propellants and explosives for the DOD, U.S. Army, and international militaries (e.g., Turkey, Israel, Egypt, Australia)
- Also Selected from ACWA Completion for Non Thermal Destruction of Chemical Weapons
- Continuous development of advanced green commercial and industrial technologies and products

ARCTECH Teamed with OHI Experienced Explosives Safety / UXO Contractor

- OHI Staff includes engineers, scientists, GIS analysts, and UXO technicians, and explosives safety analysts / experts
- Staff includes former Master level military Explosive Ordnance Disposal (EOD) personnel who will have Sr. safety and quality oversight roles
- OHI's UXO / Explosives related clients include (sample listing):
  - Naval EOD Technology Division (NAVEODTECHDIV)
  - Naval Facilities Engineering Command (NAVFAC)
  - Joint IED Defeat Office (JIEDDO)
  - U.S. Army Corps of Engineers (USACE)
- OHI has experience operating under DDESB approved Explosive Safety Plans - current project example – Fort Story, VA – UXO / Energetic Material Support

Actodemil® Proven Patented Technology

- ARCTECH Patent No. 5,538,530 – “Method for Safely Disposing of Propellant and Explosive Materials and for Preparing Fertilizer Compositions”
- US PTO Allowed Application Patent on December 23,2014
- Proven technology - Application Test Sites (test data available):
  - McAlester Army Ammunition Plant
  - Hawthorne Army Depot
  - Crane Army Depot
  - Radford Army Ammunition Plant
  - U.S. Forces Korea
  - Haikestep (near Cairo) – Egyptian Army Demil Facility
  - Turkey (Military Explosives Enterprise)

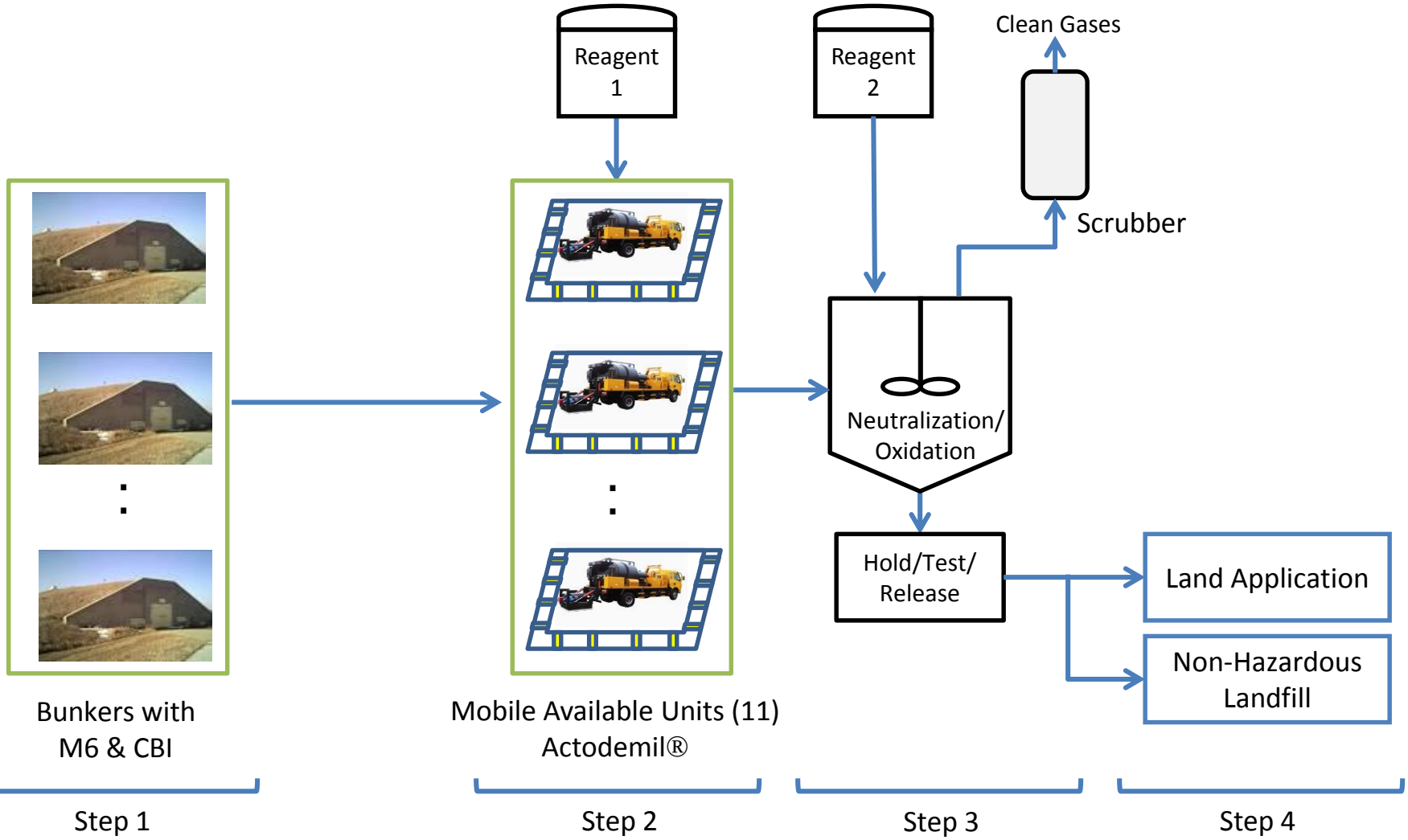
Technology Scalability Proven

- Bench scale unit
  - Portable
  - Processes ≤ 2-5 lbs of material

- 50, 1,00, and 2,000 pound per batch units developed and fielded

2,000 pound unit fabricated for U.S Army project - 1995

Rapid Deployment Approach of Actodemil® for Safe Disposition of M6 Camp Minden Propellants for 80,000 lbs per Day



Actodemil® Approach Allows Rapid Deployment and Timely Disposition of 15 Million lbs of M6 & CBI

Phase I - Notice of Award
Implementation Plan
Obtain Required Permits
Assessment of M6 and Repackage
Prepare Site for Acdodemil® Facility

Phase II - Notice to Prceed
Actodemil® Unit 1 Shakedown/M6 20 WDays

Phase III - Actodemil® Production Runs (80% AF) 240 WDays

One year

Phase IV - Final Site Closeout 30 WDays

Independent Lab Analysis by NEL Laboratories Confirmed Actodemil® of M6 Resulted in Eliminating Explosives and Toxic Chemicals of Concern

Parameter	Result, mg/kg	US EPA UTS Limit, mg/kg
Nitrocellulose*	169 (99%+ Reduction)	
2,4-Dinitrotoluene (DNT)	ND	140
2,6-Dinitrotoluene (DNT)	ND	28
2,4-Dimethylphenol	ND	14
2-Methylphenol (o-Cresol)	ND	5.6
4-Methylphenol (p-Cresol)	ND	5.6
4-Chloro-3-methyl phenol (p-Chloro-m-Cresol)	ND	14
4,6-Dinitro-2-methyl phenol	ND	

NEL Analyzed for Explosives, 8 RCRA Metals and 134 Toxic Organics.

*Analyzed by GPL Labs (Analytical method: IAAP)

- UTS: Universal Treatment Standards limits for Recycled Wastes for Land Use. CFR Title 40, 2012

Attached: Independent Lab Analysis Report and US EPA UTS Limits

Actodemil Product Proven Non-Mutagenic by the AMES Test at an Independent Lab --- ILS North Carolina

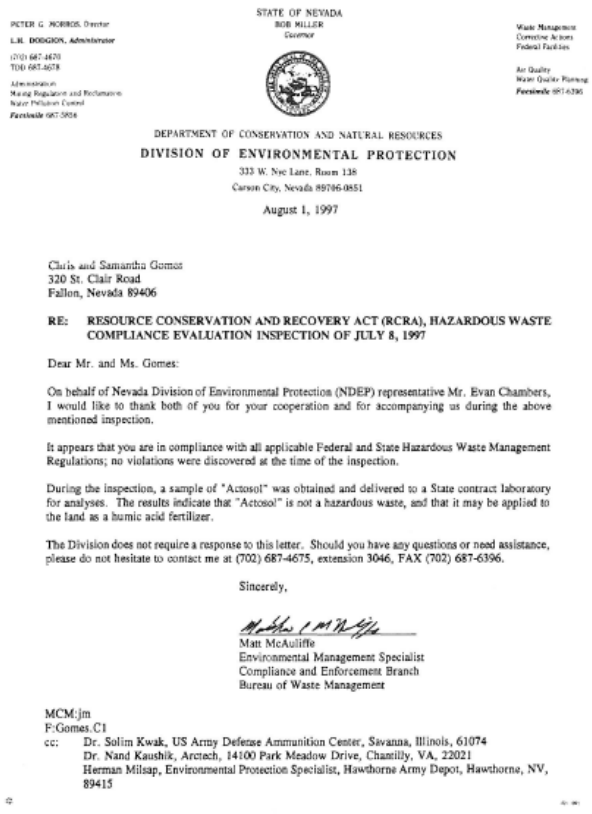
- The Ames test is used world-wide as a screen tool to determine the mutagenic potential of compounds or chemicals in several test strains of *Salmonella Typhimurium*.

- Ames assay data showed a mutagenic index *(MI)* between 0.83 to 1.31 which is below the standard *MI* of 1.6 as indicative of mutagenic potential.

Nevada EPA Concluded About Actodemil®

“not a hazardous waste, and that it may be applied to the land as a humic acid fertilizer”

“commends ARCTECH's efforts to develop fertilizers from this otherwise discarded material”



STATE OF NEVADA
BOB MILLER
Governor

PETER G. MORROS, Director
L.H. DODGION, Administrator

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
333 W. Nye Lane, Room 138
Carson City, Nevada 89706-0851

August 1, 1997

Chris and Samantha Gomes
320 St. Clair Road
Fallon, Nevada 89406

RE: RESOURCE CONSERVATION AND RECOVERY ACT (RCRA), HAZARDOUS WASTE COMPLIANCE EVALUATION INSPECTION OF JULY 8, 1997

Dear Mr. and Ms. Gomes:

On behalf of Nevada Division of Environmental Protection (NDEP) representative Mr. Evan Chambers, I would like to thank both of you for your cooperation and for accompanying us during the above mentioned inspection.

It appears that you are in compliance with all applicable Federal and State Hazardous Waste Management Regulations; no violations were discovered at the time of the inspection.

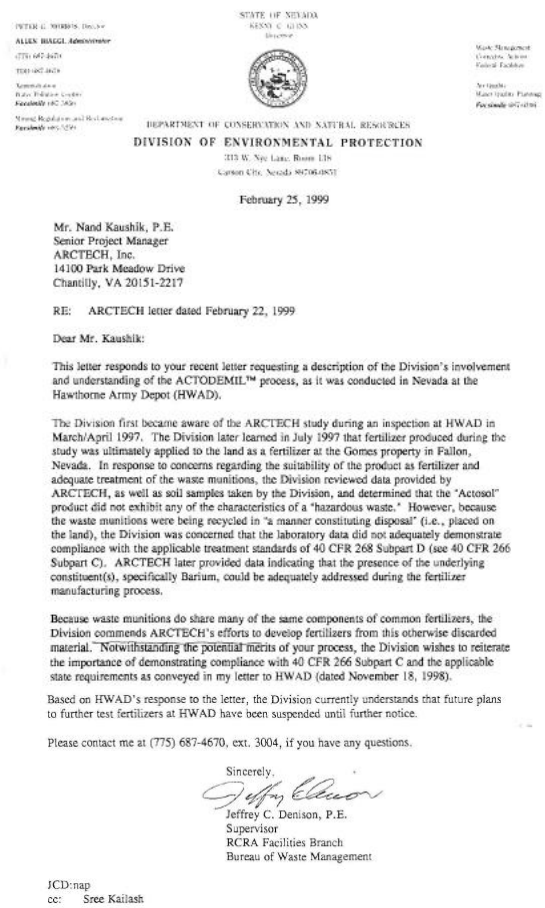
During the inspection, a sample of "Actosol" was obtained and delivered to a State contract laboratory for analyses. The results indicate that "Actosol" is not a hazardous waste, and that it may be applied to the land as a humic acid fertilizer.

The Division does not require a response to this letter. Should you have any questions or need assistance, please do not hesitate to contact me at (702) 687-4675, extension 3046, FAX (702) 687-6396.

Sincerely,

Matt McAuliffe
Environmental Management Specialist
Compliance and Enforcement Branch
Bureau of Waste Management

MCM:jm
F:Gomes.C1
cc: Dr. Solim Kwak, US Army Defense Ammunition Center, Savanna, Illinois, 61074
Dr. Nand Kaushik, Arctech, 14100 Park Meadow Drive, Chantilly, VA, 22021
Herman Milsap, Environmental Protection Specialist, Hawthorne Army Depot, Hawthorne, NV, 89415



STATE OF NEVADA

ALLEN BIAGGI, Administrator

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION

February 25, 1999

Mr. Nand Kaushik, P.E.
Senior Project Manager
ARCTECH, Inc.
14100 Park Meadow Drive
Chantilly, VA 20151-2217

RE: ARCTECH letter dated February 22, 1999

Dear Mr. Kaushik:

This letter responds to your recent letter requesting a description of the Division's involvement and understanding of the ACTODEMIL™ process, as it was conducted in Nevada at the Hawthorne Army Depot (HWAD).

The Division first became aware of the ARCTECH study during an inspection at HWAD in March/April 1997. The Division later learned in July 1997 that fertilizer produced during the study was ultimately applied to the land as a fertilizer at the Gomes property in Fallon, Nevada. In response to concerns regarding the suitability of the product as fertilizer and adequate treatment of the waste munitions, the Division reviewed data provided by ARCTECH, as well as soil samples taken by the Division, and determined that the "Actosol" product did not exhibit any of the characteristics of a "hazardous waste." However, because the waste munitions were being recycled in "a manner constituting disposal" (i.e., placed on the land), the Division was concerned that the laboratory data did not adequately demonstrate compliance with the applicable treatment standards of 40 CFR 268 Subpart D (see 40 CFR 266 Subpart C). ARCTECH later provided data indicating that the presence of the underlying constituent(s), specifically Barium, could be adequately addressed during the fertilizer manufacturing process.

Because waste munitions do share many of the same components of common fertilizers, the Division commends ARCTECH's efforts to develop fertilizers from this otherwise discarded material. Notwithstanding the potential merits of your process, the Division wishes to reiterate the importance of demonstrating compliance with 40 CFR 266 Subpart C and the applicable state requirements as conveyed in my letter to HWAD (dated November 18, 1998).

Based on HWAD's response to the letter, the Division currently understands that future plans to further test fertilizers at HWAD have been suspended until further notice.

Please contact me at (775) 687-4670, ext. 3004, if you have any questions.

Sincerely,

Jeffrey C. Denison, P.E.
Supervisor
RCRA Facilities Branch
Bureau of Waste Management

JCD:nap
cc: Sree Kailash

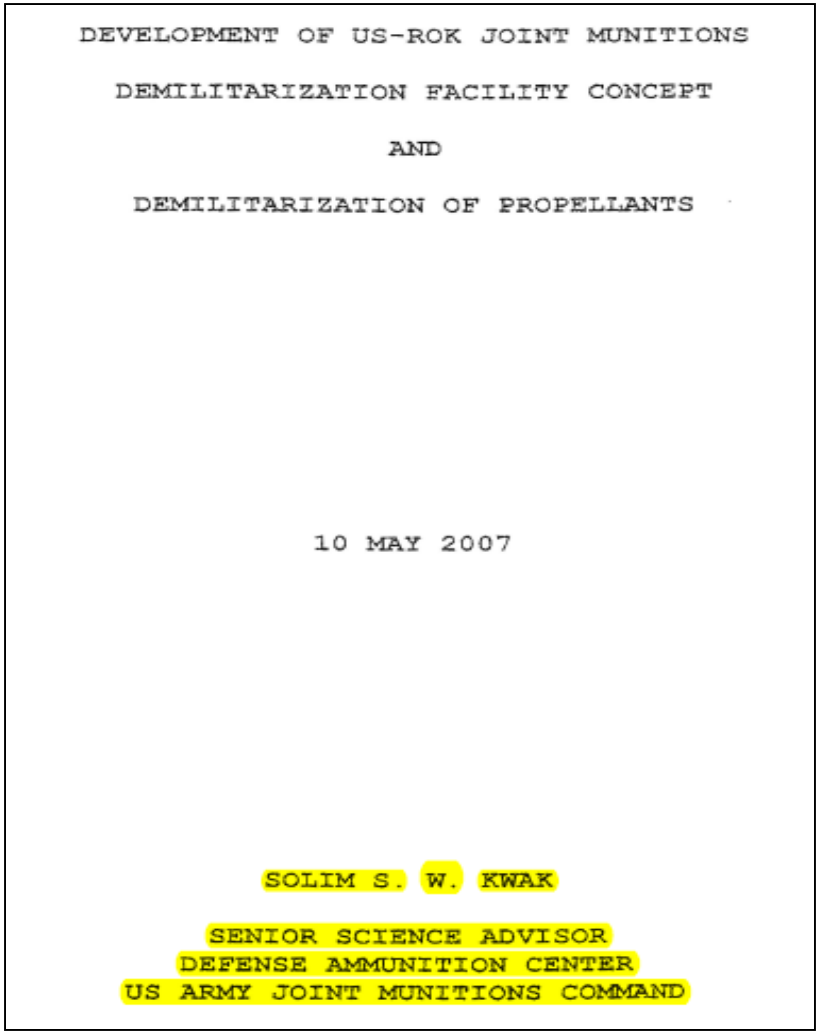
Explosive Safety Related – Policy & Guidance

- DoD 4145.26M – “DoD Contractors’ Safety Manual for Ammo and Explosives”
- DDESB 6055.9-M – “DoD Ammunition and Explosives Safety Standards: General Explosives Safety Information and Requirements”
- Army Regulation 385-64 – “U.S. Army Explosives Safety Program
- USACE – EM 385-1-97 – “Explosives Safety and Health Requirements Manual”
- USEPA 1997 Military Munitions Rule Adopted By LA DEQ

{ …..the Agency has determined the recycling of propellants or explosives into fertilizer may be a permissible activity under RCRA…….the use of an unused explosive or propellant as an ingredient to produce commercial fertilizer would be exempt from regulation under RCRA….. }

Excerpts from U.S. EPA Military Munitions Rule
40CFR Section 266.202
April 1997

U.S Army Senior Science Advisor of Demil Technologies Concluded Actodemil® to be the Environmentally Safest Based on Assessment of Various Demil Technologies



DEVELOPMENT OF US-ROK JOINT MUNITIONS

DEMILITARIZATION FACILITY CONCEPT

AND

DEMILITARIZATION OF PROPELLANTS

10 MAY 2007

SOLIM S. W. KWAK

SENIOR SCIENCE ADVISOR
DEFENSE AMMUNITION CENTER
US ARMY JOINT MUNITIONS COMMAND

"Under the alkaline reaction condition of the humic acid hydrolysis for propellants, the smaller carboxylate molecules are produced as a first step. These carboxylate groups react with phenolic and other hydroxyl groups in humic acid and are incorporated into the humic acid molecule as esters. Cyanate and urea are mineralized and adsorbed in the humic acid. If DNT is present, a simple straight alkaline hydrolysis will not completely destroy it. In the presence of humic acid, amines are incorporated as amides by reacting with the carboxylate groups in the humic acid."

- **Thus, humic acid enriched hydrolysis will not produce any toxic byproducts.**

University of Nevada Tests Proved Fertilizer Made From Recycled Single, Double and Triple Propellants:

- **Was not phytotoxic to alfalfa plants.**
- **Increased plant biomass after 1 & 2 months harvests after seed emergence when compared to the control**
- **Increased Chlorophyll concentrations in alfalfa plants.**

1:40 1:80 1:160 Control

Mixed single, double & triple base product applied to pots in the indicated dilution. The control is Hoagland Solution.

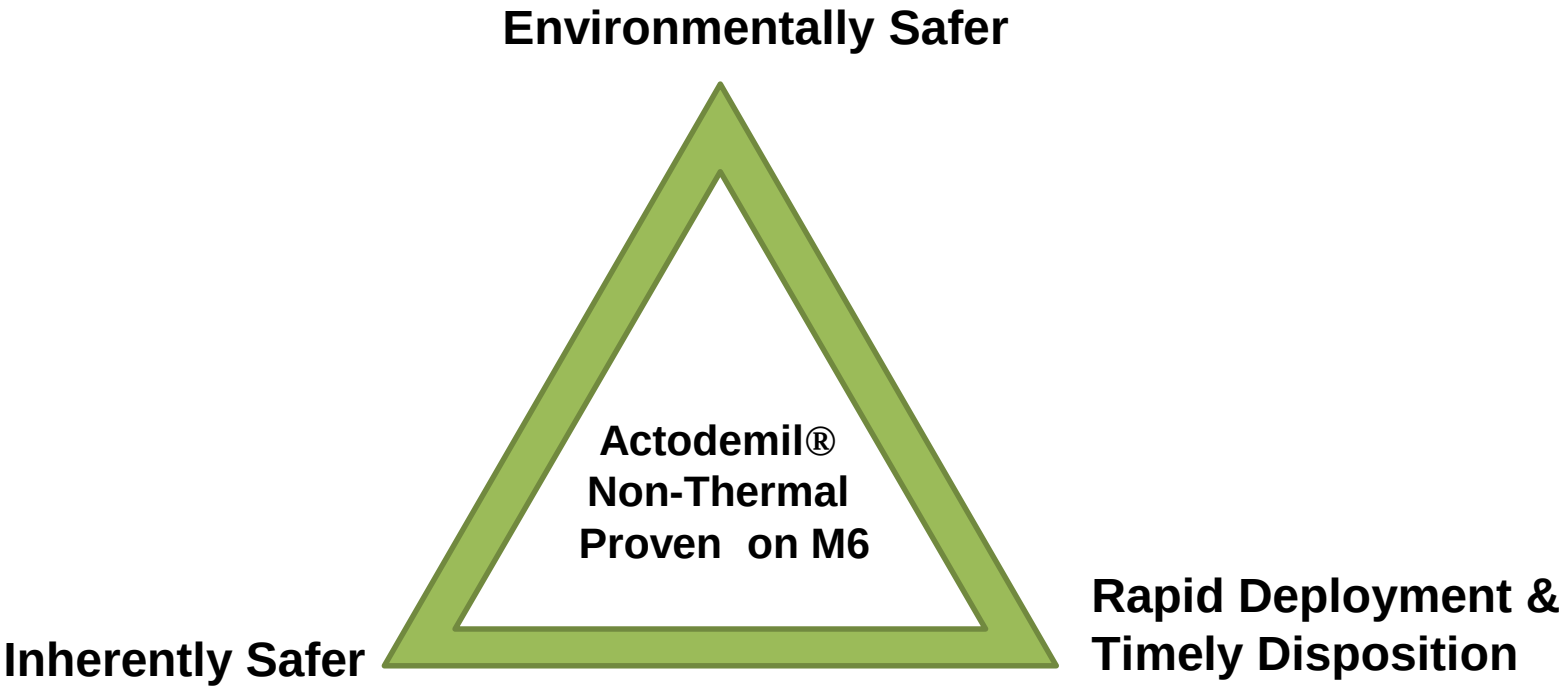
Farms and Ranches in Oklahoma Proved Benefits of 8,000 Gallons of Fertilizer Made From 10 Tons of Propellants Processed With Actodemil at 2,000 Lb Batch Production Runs

- That the recycled product was beneficial as a booster fertilizers with no Phytotoxicity when applied on Timothy and Bermuda grasses.
- Enhancement of the growth of Timothy and Bermuda grasses with visible green color.

Farms and Ranches

- Gary Coffee Farm and Ranch, Coalgate, Oklahoma
- John Bain Farm and Ranch, Stuart, Oklahoma
- Donnie Shores Horse Ranch, Coalgate, Oklahoma
- Gary and Ralph Turpin Farm and Ranch, Stuart, Oklahoma
- Timmy Rogers Farms, Stuart, Oklahoma
- Bart Peterson Greenhouses and Ranch, Stuart, Oklahoma
- Lisa Boggs Ranch and farms, Ada, Oklahoma

Actodemil® Three Prong Approach for Meeting Camp Minden Mission and Public Aspiration



Follows Backup Slides and Attachment:

- **Independent Lab Analysis Report**
- **US EPA UTS Limits**

Final Product – Non Energetic, Safe and Non-Hazardous

Proven characteristics

- Not reactive
- Friction & impact tests shows no energetic response
- Complies with USEPA Universal Treatment Standards
- Complies with USEPA Munitions Rule
- Not phytotoxic to plants
- Noncarcinogenic (Ames tested)

US Army Satisfied with ARCTECH Technology and its Operations by ARCTECH for Eliminating Toxic Waste Water at Chemical Weapons Demil Facility at Johnston Island in Pacific

Aug-20-2003 10:59am From-PMCSD JACADS FIELD OFFICE73 18089211973 T-113 P.002/003 F-142

DEPARTMENT OF THE ARMY
US ARMY CHEMICAL MATERIALS AGENCY (PROVISIONAL)
JOHNSTON ATOLL CHEMICAL AGENT DISPOSAL SYSTEM
PO BOX 156
APO AP 96558-0008

SFAE-CD-CO-J (50q) 19 August 2003
JACADS Project Office (CD-CO-J-2021)

MEMORANDUM FOR Record

SUBJECT: ARCTECH's HUMASORB® Technology--Successful Application at Johnston Atoll Chemical Agent Disposal System (JACADS)

1. The U.S. Army is currently is the process of destroying the obsolete U.S. stockpile of chemical weapons using an reverse assembly followed by incineration process. This is underway at locations in the continental United States and was completed on Johnston Atoll in the Pacific in November 2000. Incineration was the technology selected for this disposal at five of the nine stockpile locations. Various chemical agents and munition parts are processed in furnaces designed to handle liquid agent, explosive components and metal/miscellaneous parts. The gas stream from these furnaces is treated in a pollution abatement system (PAS) designed to capture metals and other contaminates prior to being released from a stack. In the PAS, the gas stream is washed down with a caustic solution, which result in the formation of a brine solution.

2. The waste brines produced during the destruction of chemical weapons contain a number of toxic metals which are typically processed through a Brine Reduction Area (BRA) that evaporates the solution to generate dry solid salt, which then has to be disposed off as a hazardous waste. However, the brine-processing rate is often limited when toxic metals are present above the RCRA permitted feed limits. This decrease in throughput leads to increase in operational costs and project schedule delays. The deployment of a waste brine treatment system for removal of metals can offer significant economical and operational advantages for risk mitigation.

3. The Program Manager for Chemical Demilitarization (PMCD) contracted with ARCTECH in 2001 to design, build and install a HUMASORB® system at Johnston island (JI) for treatment of brines generated from the JACADS PAS. A mobile HUMASORB® system had already been successfully tested in 1999 at JI to remove metals from Spent Decontamination Solution (SDS).

ARCTECH completed the task of design, fabrication and installation of the HUMASORB® system in 2002 and successfully treated approximately 160,000-180,000 gallons of brines in 2002 and 2003. ARCTECH personnel modified the process in the field as needed to treat brines with varying characteristics. HUMASORB® system deployment at JI for brine treatment led to the following advantages:

Aug-20-2003 10:57am From-PMCSD JACADS FIELD OFFICE73 18089211973 T-933 P.003/003 F-142

JACADS Project Office (CD-CO-J-2021)
SUBJECT: ARCTECH's HUMASORB® Technology--Successful Application at Johnston Atoll Chemical Agent Disposal System (JACADS)

a. HUMASORB® treated brines reduced the metals concentration to below the permit limits in a significant portion of the test containers.
b. Brine treatment by the HUMASORB® system allowed for faster processing of the brine in the BRA from 20% of capacity to 90% of capacity.
c. The solids generated from the HUMASORB® process were non-hazardous.

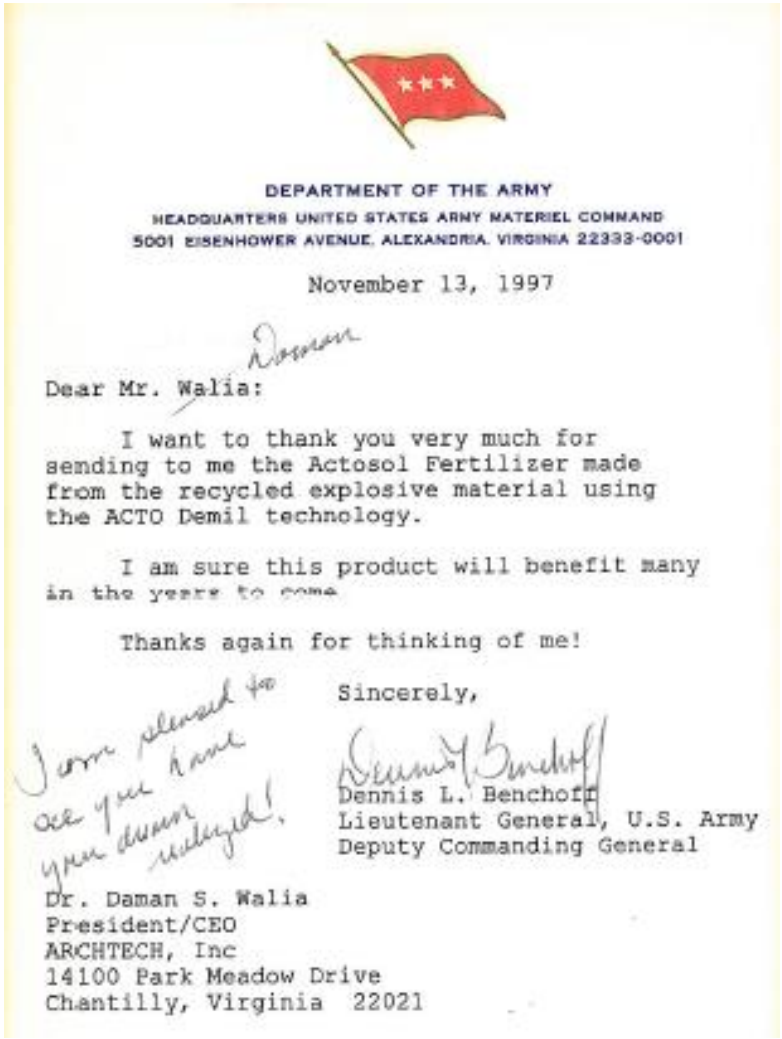
4. PMCD is very satisfied with ARCTECH and the performance of the HUMASORB® system at JI. HUMASORB® system performed as promised and ARCTECH met all the obligations of the contract and performed the project on-time and as per schedule. ARCTECH personnel demonstrated professionalism and flexibility throughout the project from inception to finish to meet the needs of PMCD. Please contact me if you have further questions concerning this project.

5. Questions on this matter should be referred to Mr. Charles Papish, (808) 421-0011 x 3975.

GARY W. MCCLOSKEY
JACADS Site Project Manager

Copy Furnished:
R. Malone, SAIC

The US Army Joint Munitions Commander General Benchoff Wrote "Actodemil® will benefit many in the Years to Come"



DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY MATERIEL COMMAND
5001 EISENHOWER AVENUE, ALEXANDRIA, VIRGINIA 22333-0001

November 13, 1997

Dear Mr. Walia:

I want to thank you very much for sending to me the Actosol Fertilizer made from the recycled explosive material using the ACTO Demil technology.

I am sure this product will benefit many in the years to come.

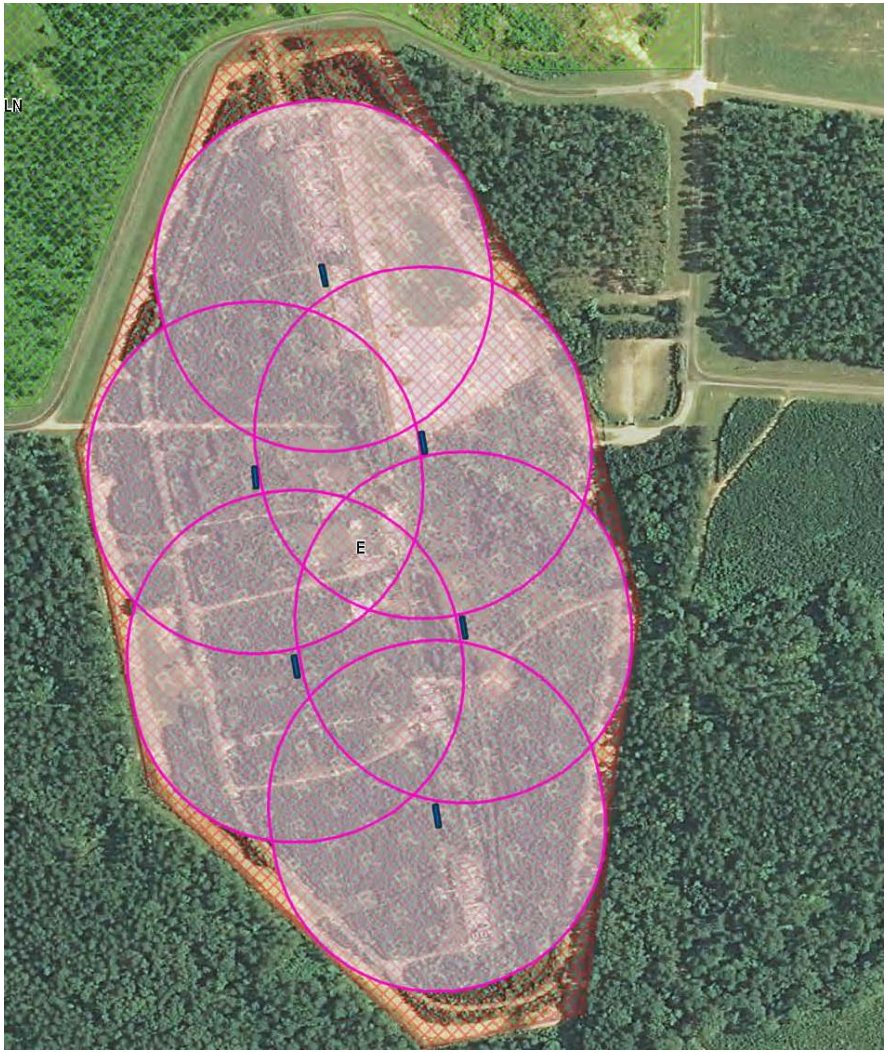
Thanks again for thinking of me!

Sincerely,

Dennis L. Benchoff
Lieutenant General, U.S. Army
Deputy Commanding General

Dr. Daman S. Walia
President/CEO
ARCHTECH, Inc
14100 Park Meadow Drive
Chantilly, Virginia 22021

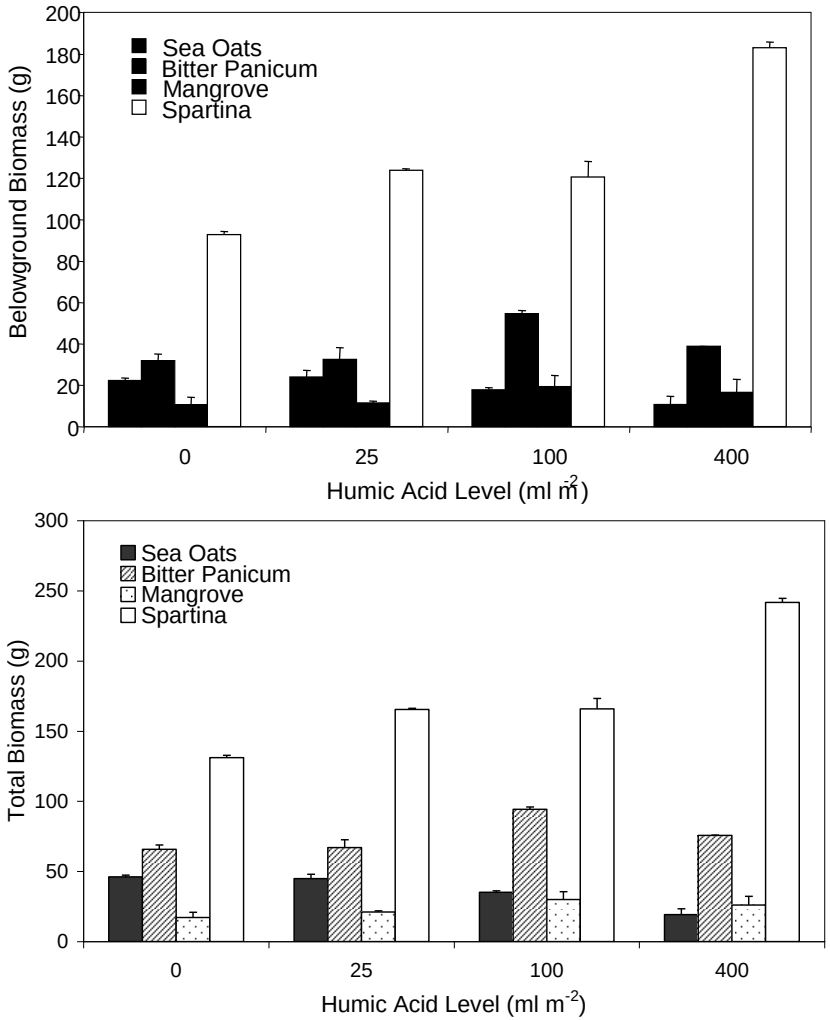
Processing Area



- Area E for processing station placement
- Placement driven by explosives safety arcs
- Post processing (strep 1 of Actodemil = no more hazard – EZ goes to 0)
- Minimal improvements (temporary pads, electrical, temporary access road)
- May be able to use rail system on Minden for storage (tanker trucks)

actosol® Humic Acid Application Increased Roots, Top Biomass, and Vigorous Growth of Dune Grasses for Restoration of Louisiana Coastal Lands. (Tests by Prof. Mark Hester of University of Louisiana)

Vigorous growth of bitter panicum (*Panicum amarum*) when a fertilization regime was coupled with a Humic Acid application of 100 ml per m^{-2}. Note extensive amount of vegetative spread (tillering) and flowering within only 5 months after planting (photo taken September 2004).



The effect of humic acid (applied as Actosol 3% humic acid solution) on biomass production by two widespread dune grass species (sea oats and bitter panicum) and salt marsh species (black mangrove and smooth cordgrass). *Spartina alterniflora* (smooth cordgrass) biomass production was substantially increased by addition of humic acid, especially the 400 ml m^{-2} level. Mangrove and Bitter Panicum both demonstrated greater biomass production at the 100 ml m^{-2} humic acid level. It is anticipated that Sea Oats will demonstrate elevated productivity at some more moderate level of humic acid (<25 ml m^{-2}).