
Actodemil® Technology System for Eco-friendly Destruction & Recycling of Explosives into Fertilizer

Technology Presentation

August 14, 2022

**ARCTECH, Inc.
P.O.Box 382, Centreville, Virginia 20122 USA**

ARCTECH Corporate Profile

- **Established in 1988 as Spin-Off Company**
 - **From a Major US Aerospace Company**

Developing & Deploying Biotechnology Solutions since Mid 70's



- **Market Profile: Develop Innovative Solutions from Concept to Implementation for the Energy, Environmental, and Agricultural markets**
- **Manufacturing Plant**
 - **South Boston, Virginia**
- **Commercial Products Applications in the US, Egypt, China, India, Australia, Gulf Countries, and South Korea**
- **Selected as One of the Top Six Bio-Processing Firms in the United States**
 - **By Ernst & Young**
- **Founding Member of *Humic Products Trade Association (HPTA)* in 2011**

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 soils**
- **1980-90's** **Successfully Developed and Commercialized humic acid product for use in addressing a variety of environmental problems**
- **2000 -** **Successfully validated Actodemil® for safe destruction of propellants and explosives, Remediation of Contaminated Explosive Contaminated Soils for U.S Army . Industry and Overseas/ ITAR Approved.**
- **Today** **Implementing Actodemil® System for safe destruction and decontamination of munitions for U.S. Army and other international clients**

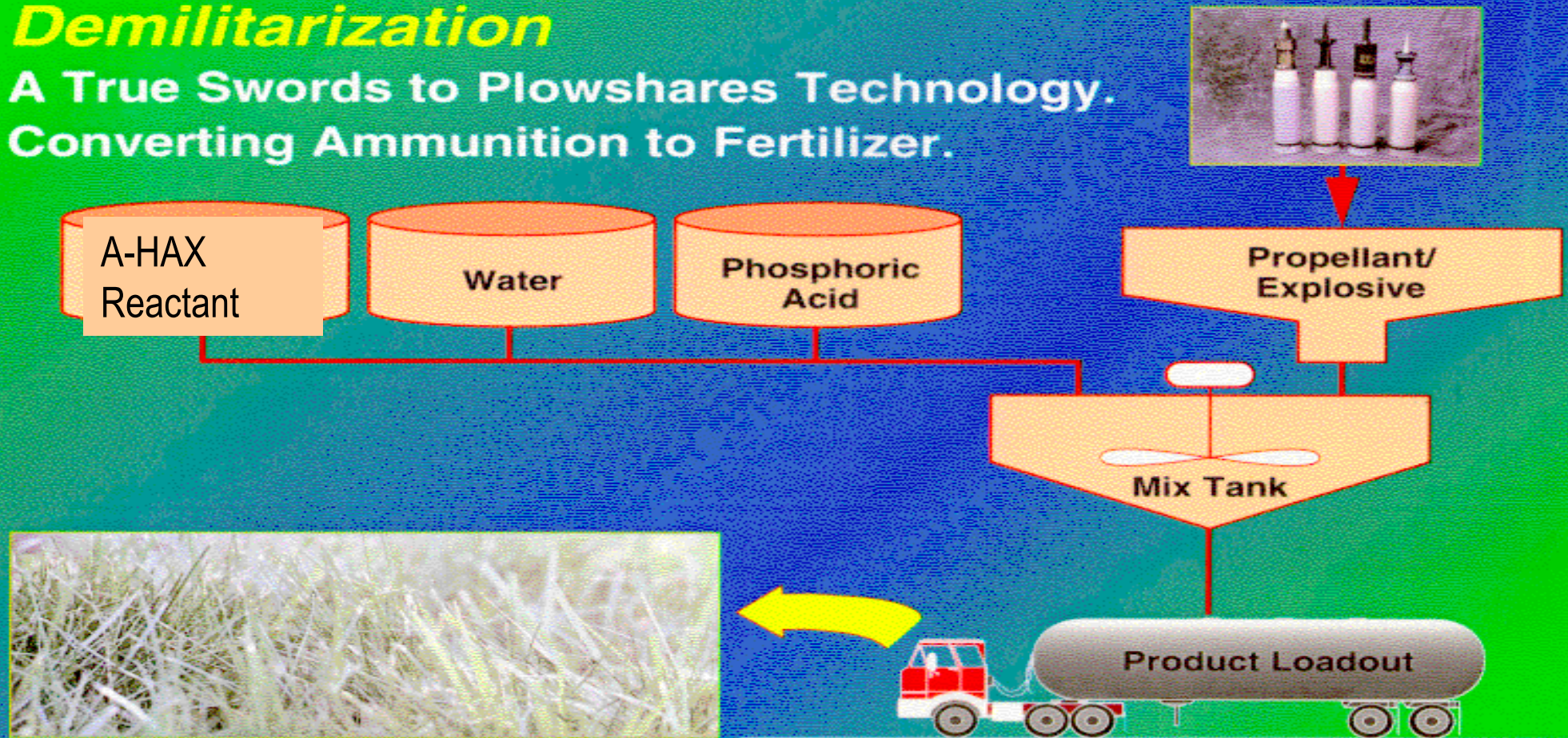
Actodemil® Technology

A Safe, Environmentally Protective, Easily Implementable And Cost Effective Approach For Recycling Of Propellants, Energetics, and Explosive Wastes into Non-Reactive and Non-Hazardous Product.

THE ACTODEMIL™ TECHNOLOGY

Demilitarization

A True Swords to Plowshares Technology.
Converting Ammunition to Fertilizer.



ARCTECH, Inc.

THE ARCTECH ACTODEMIL™ TECHNOLOGY

ENERGETICS REACTION: $R-O-NO_2 + [HA^+ OH^-] \rightarrow R-OH + [HA^+ NO_3^-]$

$R-O-NO_2 + [HA^+ OH^-] \rightarrow R-O-OH + [HA^+ NO_2^-]$

United States Patent [19]
Heaton et al.

Patent Number: 5,538,530
Date of Patent: Jul. 23, 1996

[54] METHOD FOR SAFELY DISPOSING OF PROPELLANT AND EXPLOSIVE MATERIALS AND FOR PREPARING FERTILIZER COMPOSITIONS

[75] Inventors: Harley L. Heaton, Manassas; Daman S. Walla, Woodbridge; Joseph J. Sluski, Leesburg, all of Va.

[73] Assignee: Arctech Inc., Chantilly, Va.

[21] Appl. No.: 451,542
[22] Filed: May 26, 1995

[51] Int. Cl.⁶ C05F 11/02
[52] U.S. Cl. 7024; 7158; 7163; 7190; 149/124
[58] Field of Search 711, 58, 59, 63, 7124, 903; 149/124

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James E. Allen et al., Nitrocellulose Finest Separation and Treatment, Working Proceedings, School of Civil Engineering, pp. 56-64, Nov. 4-5, 1993.

Primary Examiner: Ferris Landet
Attorney, Agent, or Firm: Brody and Neisark

[57] ABSTRACT
A one step process is provided which desulfurizes explosives and propellants and recycles the evolved nitrogen therefrom while concurrently modifying the remaining carbonaceous materials into humic acid suitable for plant fertilizer applications. Explosives and propellants are hydrolyzed with a solution of ACTOSOL[®] humic acid extract. The humic acid extract fixes the free nitrogen evolved, preventing its loss as ammonia or NO_x gases. The ACTOSOL[®] fixed nitrogen is then available directly to plants as slow-release nitrogen, and can directly replace nitrogen derived from urea or other sources in plant fertilizers. The carbonaceous material remaining from the desulfurization process is non-explosive and is taken up in the humic acid matrix. This material is immediately available to plants as a carbon source. The humic acid matrix chelates any metal ions released from the explosive or propellant as a consequence of the desulfurization process, and makes these metal ions available to plants as micronutrients.

16 Claims, No Drawings

United States Patent [19]
Srivastava et al.

Patent Number: 5,670,345
Date of Patent: Sep. 23, 1997

[54] BIOLOGICAL PRODUCTION OF HUMIC ACID AND CLEAN FUELS FROM COAL

[75] Inventors: Kalash Chandra Srivastava, Centerville; Daman S. Walla, Woodbridge, both of Va.

[73] Assignee: Arctech, Inc., Chantilly, Va.

[21] Appl. No.: 483,261
[22] Filed: Jun. 7, 1995

[51] Int. Cl.⁶ C12N 1/20; C12P 17/18; C12P 7/04; C12P 19/00
[52] U.S. Cl. 435/75; 435/42; 435/119; 435/142; 435/143; 435/156; 435/167; 435/252.1; 435/281
[58] Field of Search 435/75, 42, 142, 143, 156, 167, 101, 119

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5,404,155 6/1995 Volkwein
5,496,244 1/1996 Paszczewski et al.

Primary Examiner: Herbert J. Lilling
Attorney, Agent, or Firm: Brody and Neisark

[57] ABSTRACT
Coal is treated aerobically or anaerobically to produce humic acid, volatile fatty acids, lower alcohols, and/or methane using a consortium of bacteria designated Mito-1 or KSARC55. This process can also be used to convert aromatic compounds, such as phenols and derivatives thereof, to methane and carbon dioxide.

10 Claims, 7 Drawing Sheets

USPTO Allowed on December 23, 2014 an Application Patent #14/446,862

Actodemil® Technology Tested on Variety of Materials

Actodemil™ TECHNOLOGY SUCCESSFULLY TESTED ON:

Energetics

Large-Bore Gun Propellants

- 3"/50, 6"/47, M6 (NC based)
- 105 MM (NC/NG based)
- 106 MM - M30, M30A1(NC/NG/NQ)

Rocket Propellant

- 2.75" AA (NC/NG based)

Other Explosives - HMX, RDX, TNT,
DNT, Lead Azide, PETN, and AP

Chemical Agents

Nerve Agents

GB, VX

Blistering Agents

HD, HT, H

Biological Agents

E. coli

Actodemil® Technology Production Unit at McAAP



Rear View and Utilities Inputs



Another View of Actodemil® Production Unit at McAAP



Cooling System



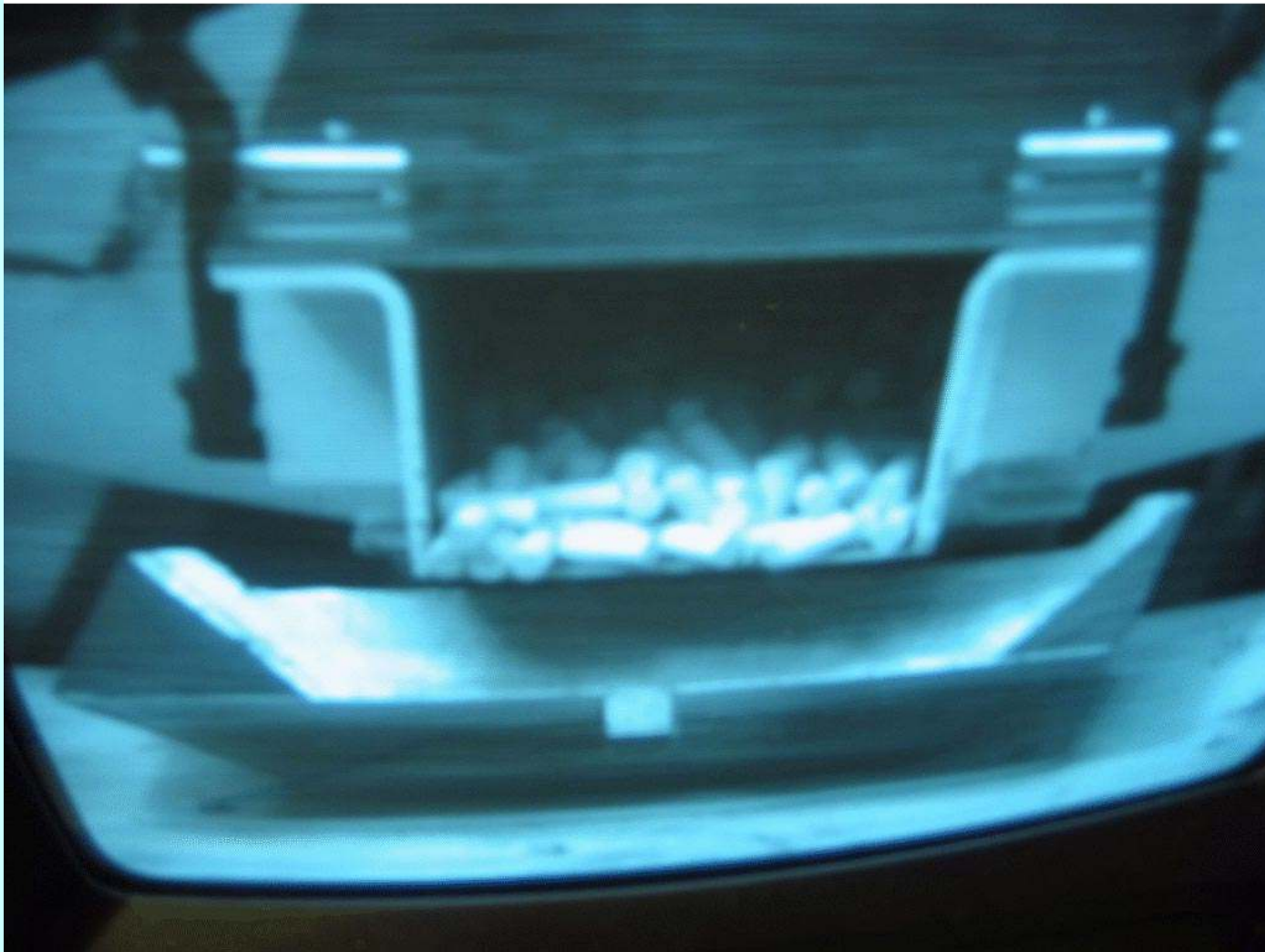
Scrubber System



ANOTHER VIEW OF HOPPER AND FEED SYSTEM



PICTURE OF PROPELLENT BEING FED INTO REACTOR



Major Conclusions from Actodemil® Technology Demonstration Tests

- All Tested Propellant/Energetic Chemicals (NC, NG, NQ, DNT, etc) Completely and Irreversibly Destroyed
- Applicable to Single, Double, and Triple Base Propellants, High Explosives, Chemical Agents, Primary Explosives, Energetic manufacturing wastes
- Process is Safe and Heat Release is Controllable
- Propellant Conversion Complete in 1-2 Hours at 180-190°F
- Final Fertilizer sold to various Users around McAlester, OK

Major Conclusions from Actodemil® Technology Demonstration Tests

Final Product Regulatory Compliant

- Complies with TCLP requirements
- Is not Reactive (as Defined by RCRA regulations)
- Complies with UTS Requirements
- Friction, Impact Tests showed no Energetic Response
- Complies with U.S. EPA's Munitions Rule Requirements
- Is Not Mutagenic as Determined by Ames Assay Test

Final Product Useful for Plants

Is not Phytotoxic to Plants
Enhances Plant Growth and Yield

Results of Recently Completed Validation Test

Analytical Parameter	Concentration (ppm)	Regulatory limit (ppm)
<u>Residual Explosive Compounds</u>		
Nitrocellulose:	Destruction Efficiency – 99.9%	
2,4-DNT:	Destruction Efficiency – 100%	
<u>TCLP Analyses</u>		
TCLP Metals	BQL	
TCLP Volatiles	BQL	
TCLP Semi-volatiles	BQL	
<u>Cyanide Reactivity</u>	Not Detected	250
<u>UTS Parameters</u>		
<u>Volatiles</u>		
Acetonitrile	11	38
Toluene	1.4	10
<u>Semi-volatiles</u>	None Detected	

List of Universities and Farm Users of Fertilizer Product from Actodemil® Technology Demonstration Tests

Universities

- Virginia Tech
- Univ. of Las Vegas
- Univ. of Minnesota
- Several Universities in S. Korea

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® Technology Supported by EPA regulators and the Public

.....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

GOING GREEN AT THE DOD. Defense Department Scientists Agree Army Depot uses obsolete Demil Technology. Actodemil® Technology fulfills the biblical prophecy of tuning swords into plowshares

- Reno News
May 29, 2001

STATE OF NEVADA
KENNY C. GUINN
Governor



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

February 25, 1999

Dear Mr. Kaushik:

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 Gotes 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).

Regulatory Framework For Process

- **MUNITIONS RULE**

Munitions Rule Permits Recycling of Propellants to fertilizer provided that:

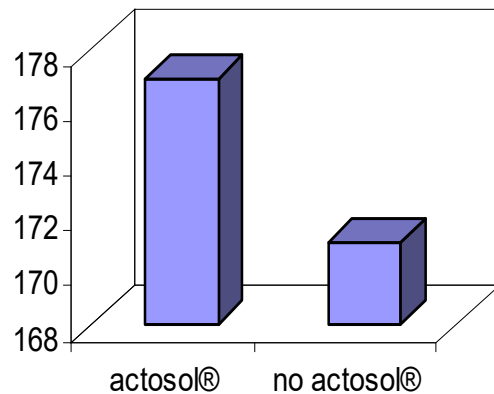
- **End Product Meets UTS requirements**

- **Exempt from RCRA Permit**

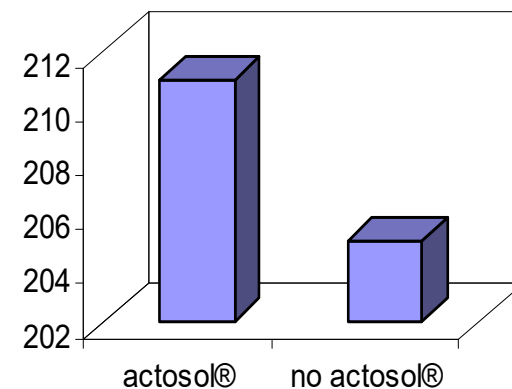
Actosol® Product from NC Fines Increases Corn Yield

- 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.

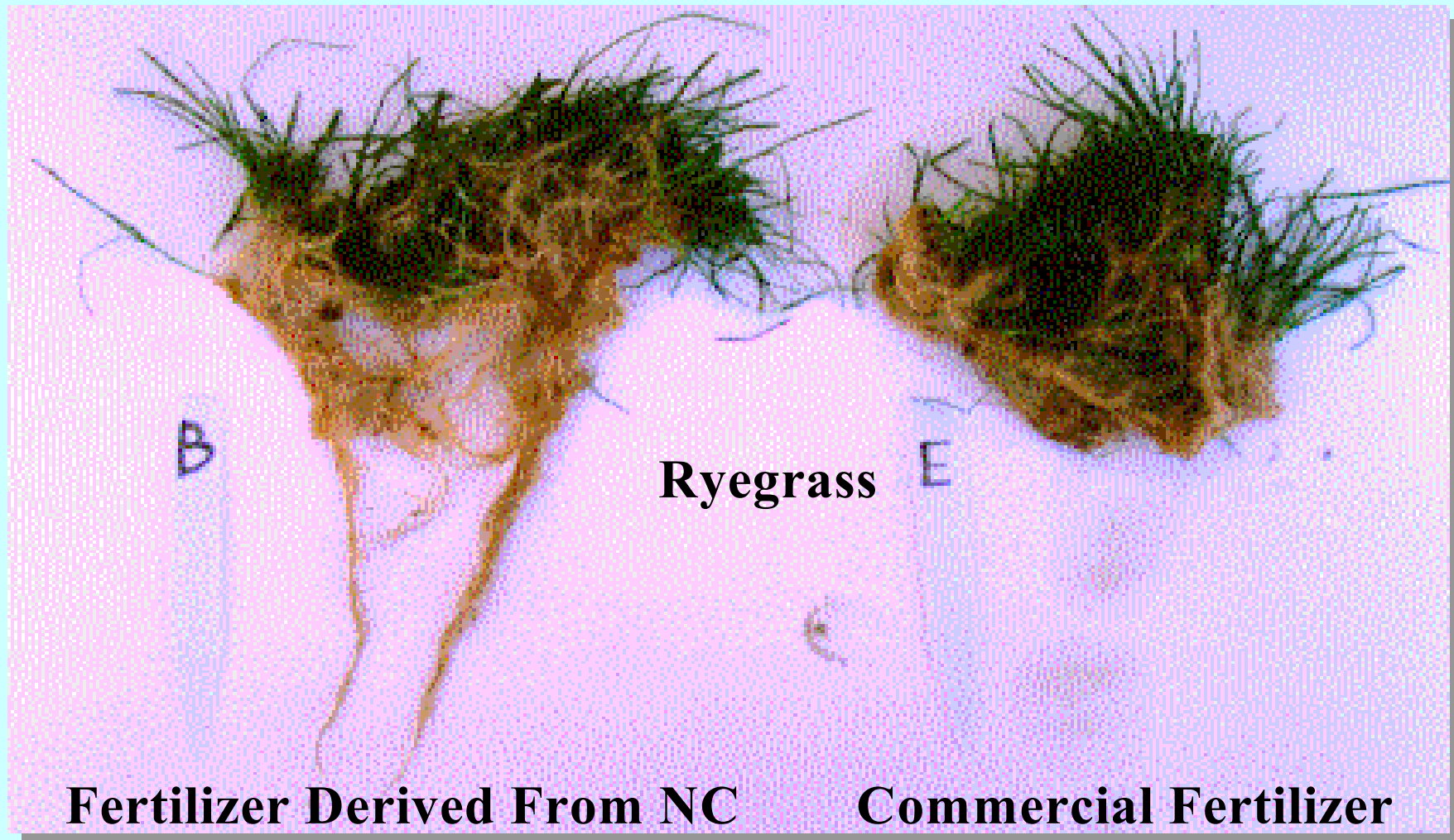
Sam Santini Farms



Roger Woolf Farms



PRODUCT IS BENEFICIAL FOR TURF GRASS GROWTH



SUCSESSES OF ACTOSOL® HUMIC ACID FERTILIZER



Amazingly, the growth rate of the alfalfa and wheatgrass was significantly better – thicker, taller and a much darker green color - in the plot where the Actosol-Z™ was added, even though only about 25% of the prescribed 100 ppm concentration of Actosol-Z® was actually applied. This is also evident in the photos below, where the agricultural consultant is shown collecting alfalfa and wheatgrass samples for analysis.



actoso[®] Humic Acid Being Applied Successfully In Various Applications

UNITED STATES

- Landscaping
- Erosion Control
- Landfill Closure
- Golf Courses
- Sod Farms
- Nurseries-Tomatoes
- Sand Dunes
- Floriculture
- Agriculture
- Horticulture

GULF COUNTRIES

- Rhodes Grass
- Water Melon
- Cucumber
- Alfalfa
- Orange Groves
- Grapes
- Onion
- Date Trees

MAURITIUS

- Sugar Cane
- Horticulture

S. KOREA

- Golf Courses
- Greenhouses



SUMMARY

- **Actodemil® is an established technology.**
- **The technology is effective for neutralization of a variety of propellants, explosives and other energetics**
- **The technology has already been tested on a variety of propellant wastes at RfAAP**
- **The process can also be used for decontamination of explosives-contaminated scrap metal and other solid wastes**
- **The process can produce a fertilizer that can be sold to produce revenues that can offset treatment costs.**
- **Actodemil® Technology Provides the Following Important Benefits:**
 - **More Safer** (reaction at atmospheric pressure and temperature not exceeding 200° F)
 - **More Easily Implementable** (permitting issues minimal)
 - **Higher Protection of Environment** (no wastes generated, gas emissions insignificant)
 - **More Cost Effective**