

59170

Phytoremediation of High Explosives at Pantex and Los Alamos Facilities

Victor F. Medina, Ph.D.

Dept. of Civil Engineering

Washington State University, Tri-Cities

In Collaboration With

USEPA/NERL-ERD

Athens, GA

SPS

[Handwritten signature]

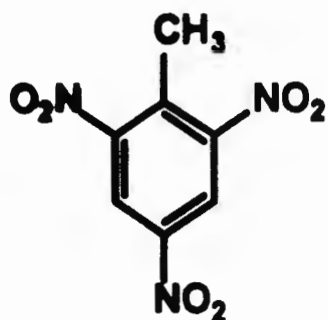
59170



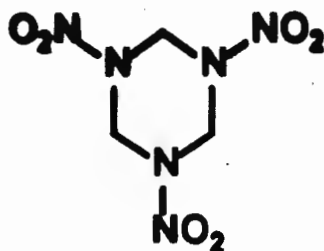
3545

*McCutcheon briefing
March 1998
Santa Fe NM*

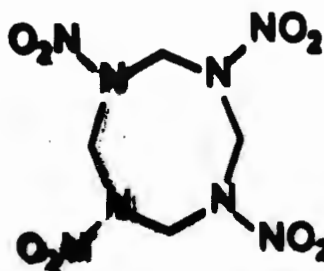
Structures of High Explosives



2,4,6-Trinitrotoluene
TNT

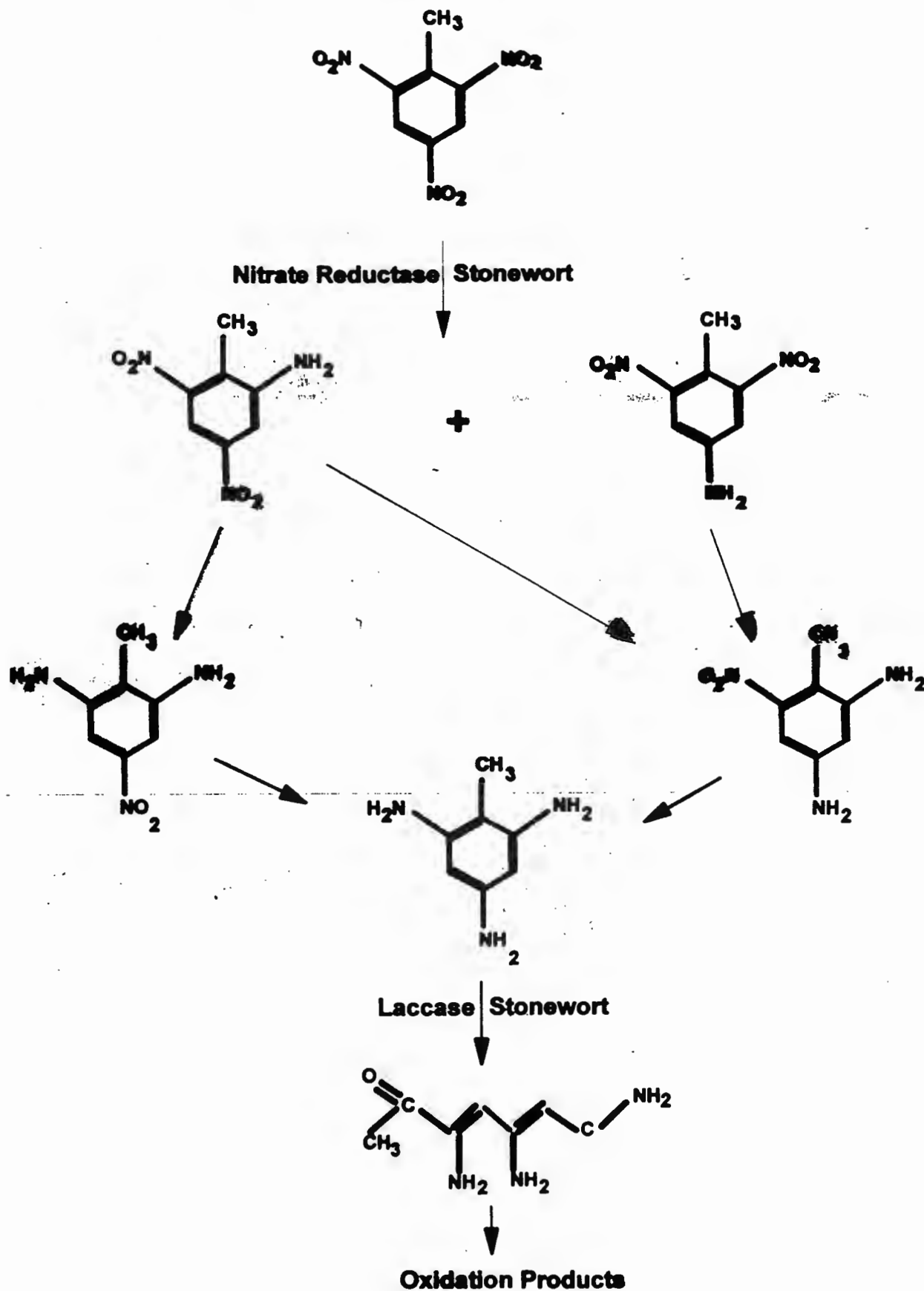


Hexahydro-1,2,5-trinitro-1,3,5-triazine
RDX



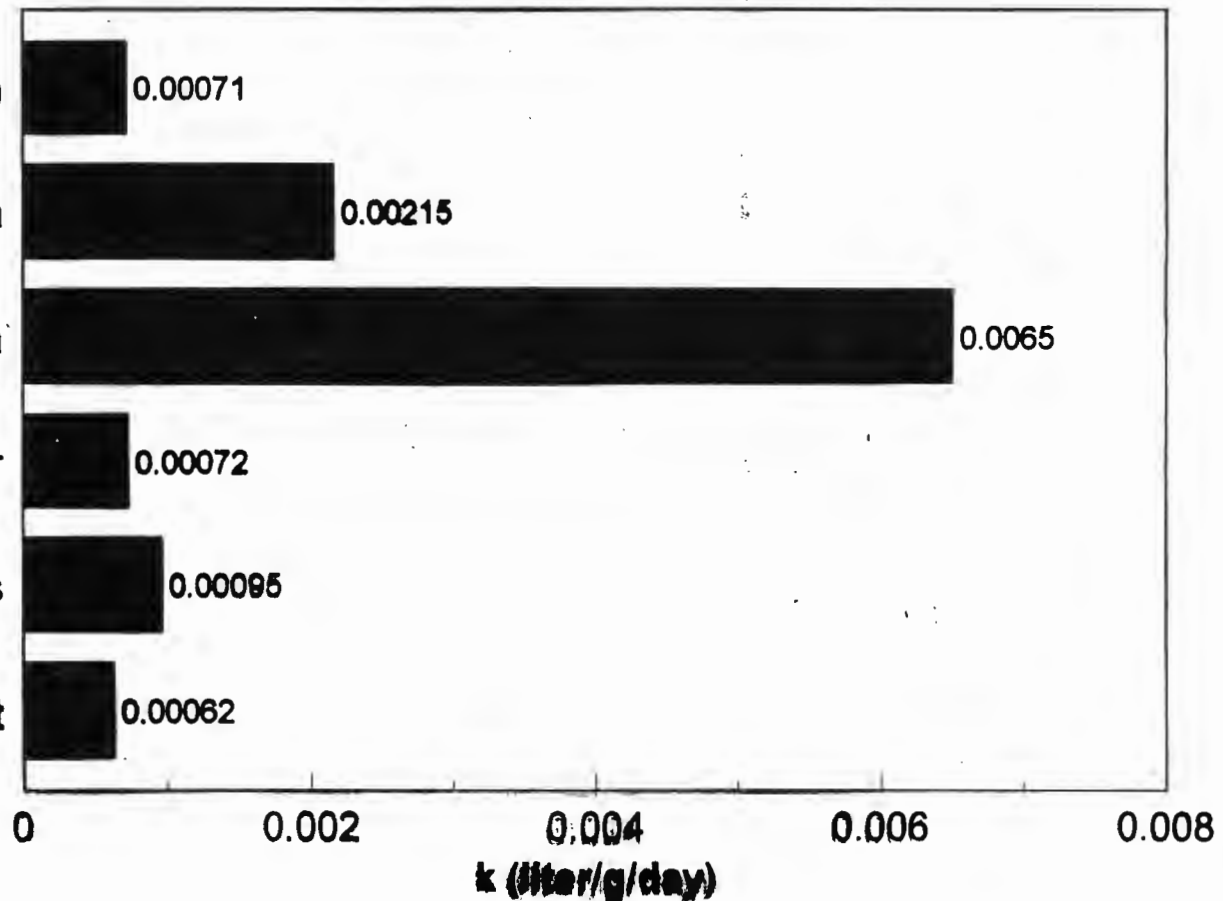
Octahydro-1,2,5,7-tetranitro-1,3,5,7-tetraazocine
HMX

The Proposed Reaction Sequence of TNT Degradation with Aquatic Weed Stonewort



First Order Kinetic Rate Constants for Treatment of RDX (Adjusted for Plant Density)

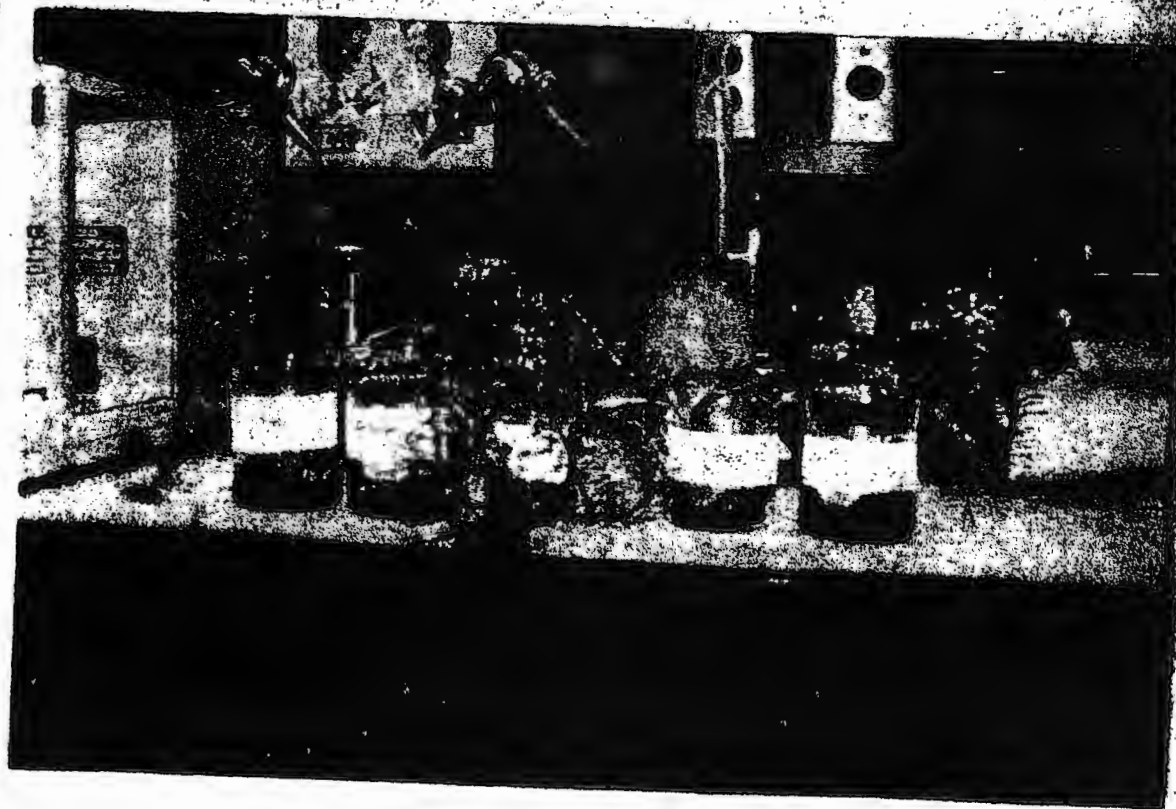
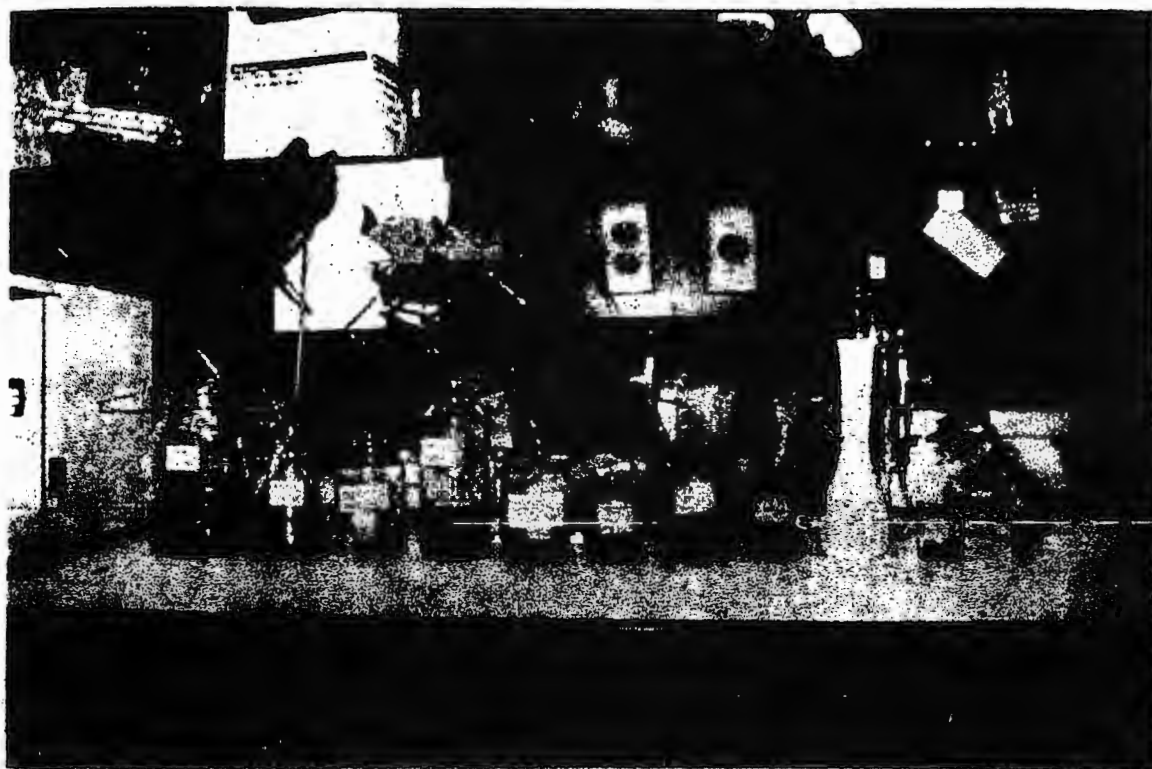
*MNX
RDX - detected
7MX*



*Milan
not
successful for RDX
in enhanced
wetlands*

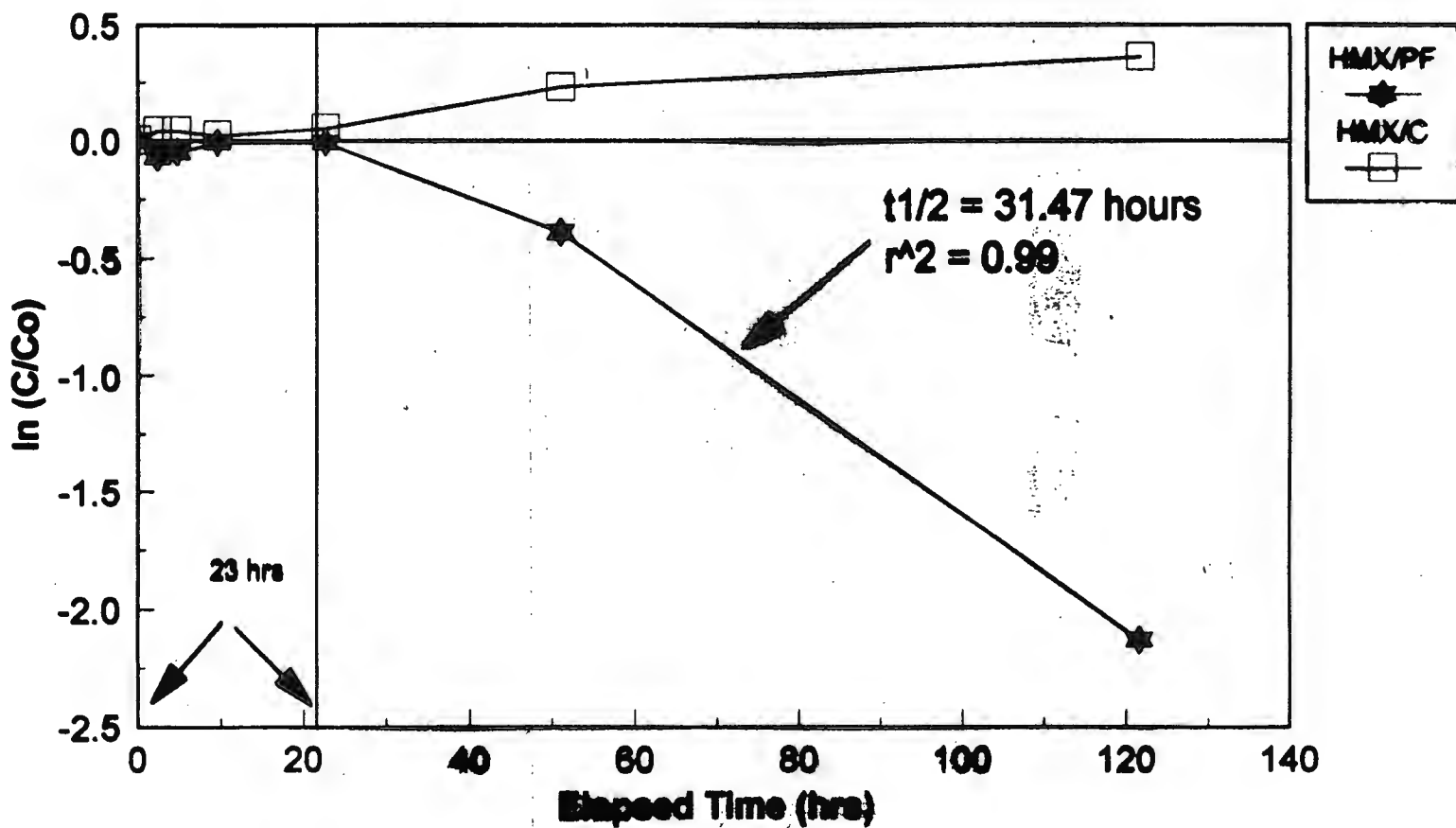
*Winters a
problem*

Photographs of Batch Experiments



HMX Study

Treatment of 2 ppm with Parrot Feather
Plant Density = 200 g/liter

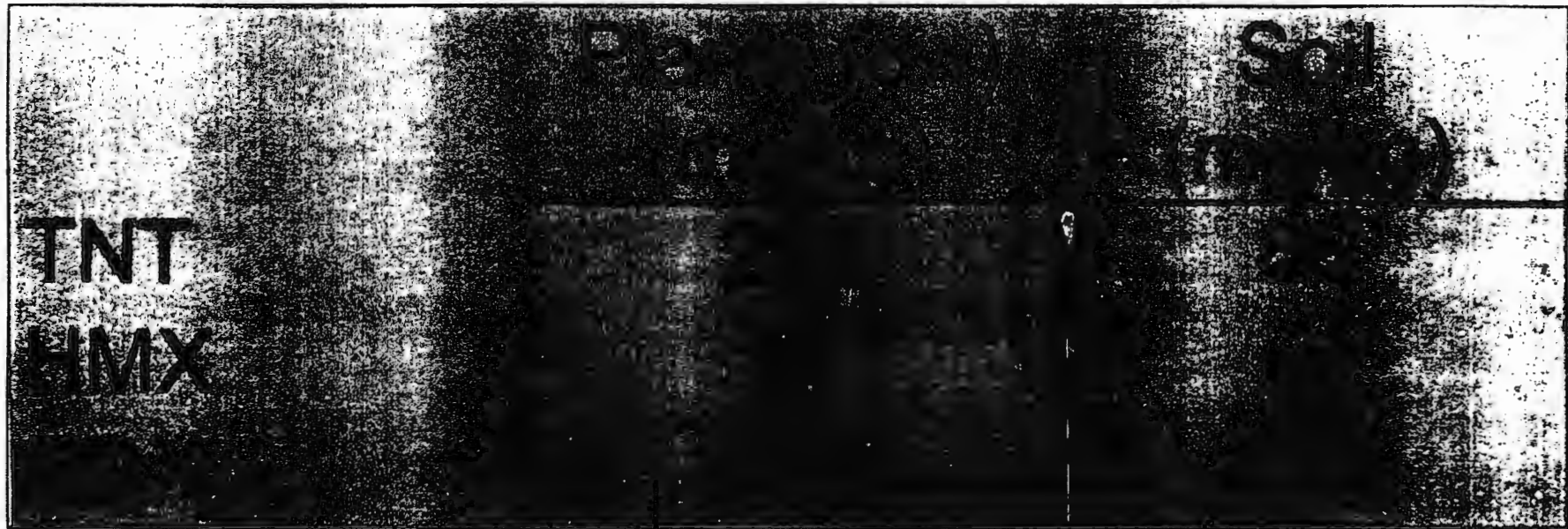


Yucca Plant Project

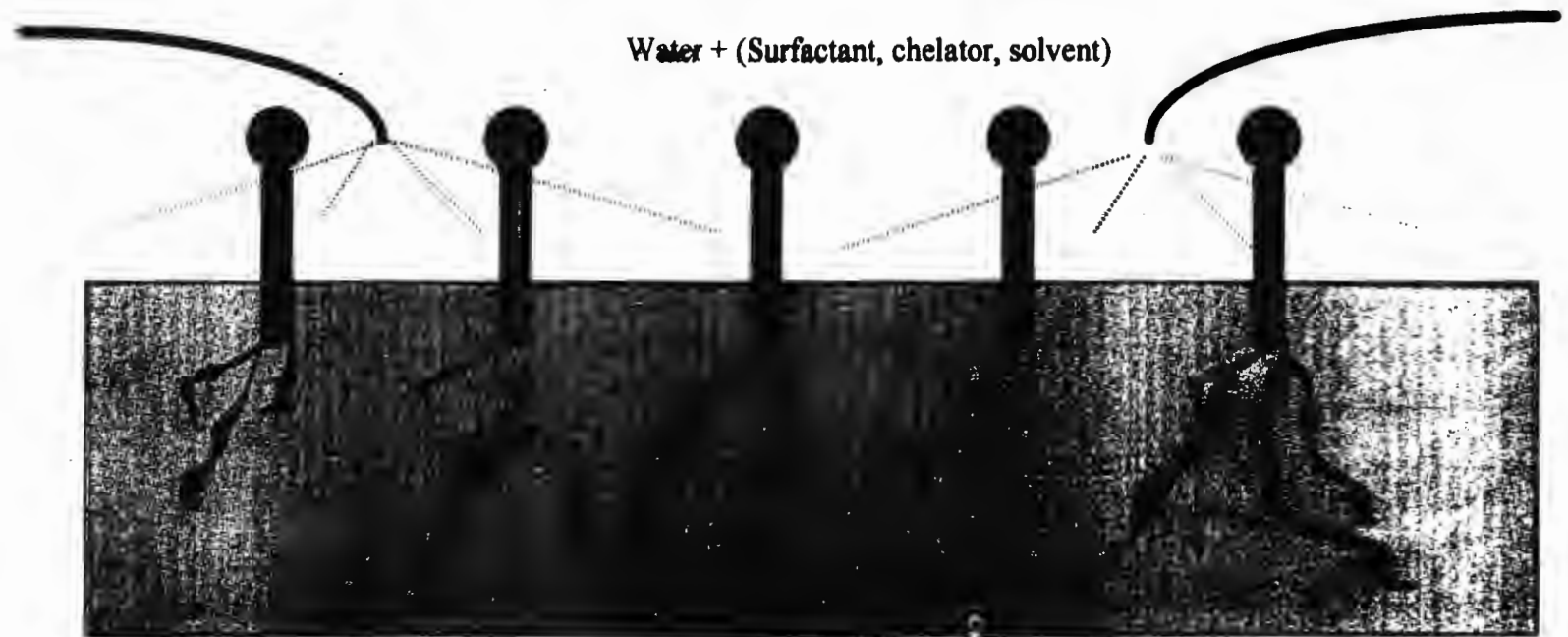
- Crane Naval Weapons Center, Crane, IN
- Yucca plants found growing in demolition pits heavily contaminated with TNT & RDX
- Yucca plants were found to accumulate high levels of TNT & RDX



Preliminary Data from Yucca Plant Study



Soil Leaching and Degradation



1. The site is actively watered to increase the movement of the contaminants from the soil into the root system
2. Phytodegradable organic compounds are broken down by the enzymatic processes of the plant.
3. Non degradable organics and inorganic compounds accumulate in the plant, and the plants can be harvested.
4. Surfactants, Chelators &/or solvents may be used to increase the solubility of the munitions and thus increase the rate of uptake.

Los Alamos National Laboratory

Key Points

- ▶ Investigate natural attenuation of RDX
- ▶ Accumulation of Ba

Phase 1. Greenhouse Studies

- ▶ Macroalgae in springs
- ▶ Pine & other terrestrial vegetation

Phase 2. Field Study

- ▶ Natural Attenuation & Transport Study in Canyon Sediments/Surface Waters

Pantex

- ▶ **Soil**

- ▶ Upper 5-6 ft of soil near buildings & utilities
- ▶ Prairie grass/smaller shrubs

- ▶ **Drainage ditches**

- ▶ Playa plants & sediments

Pantex

Phase 1. Plant Screening for RDX, HMX Disappearance

- ▶ Grasses/HMX clean-up
- ▶ Other native grasses/scrub for soil clean-up
- ▶ Playa/wetland plants

Pantex

Phase 2. Greenhouse Studies for Soil & Sediment Cleanup

- ▶ Using contaminated soil & sediment from site
- ▶ 4-5 grasses/shrubs & 2-3 wetland plants
- ▶ 3 months duration
- ▶ Phytotoxicity determination
- ▶ Accumulation vs complete degradation

Pantex

Phase 3. Pilot Field Study (Next Spring)

- ▶ **6 months**
- ▶ **Investigation of site-wide scale-up**

Conceptualized Schematic of Pantex Phytoremediation Field Demonstration

