OPEN BURNING AND OPEN DETONATION OF ENERGETICS: ALTERNATIVE TECHNOLOGIES

U.S. EPA OSWER/ORCR/FUD/[illegible]/EDAT SUMMER RESEARCH

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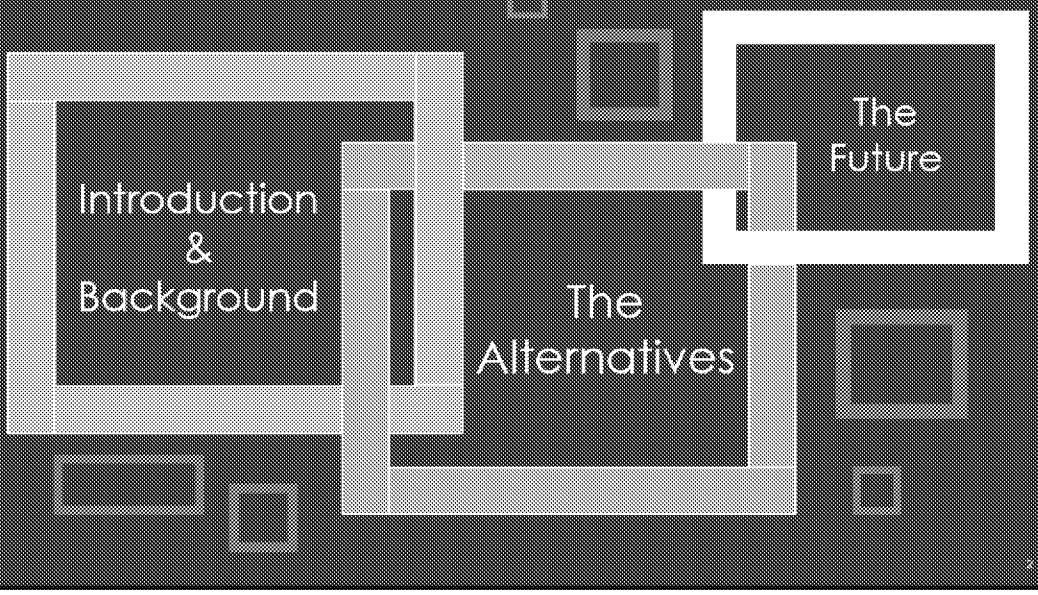
Agenda



Background: OB/OD

The OB/OD situation:

- Tons of munitions stockpiled all over the country
- OB/OD is the easiest solution
- Allowed under RCRA
- Not everyone is interested in the alternatives that are available

Why is OB/OD a problem?

- Dangerous
- Environmentally harmful
- Extremely expensive to clean up (often results in the creation of a Superfund site)

Background: The Project

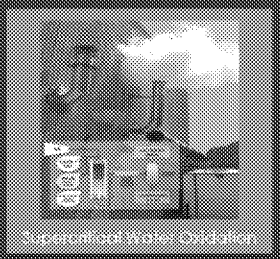
Briefing the Office Director

Alternative Technologies

Costs and Contamination

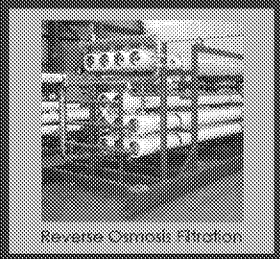
The Explosives Disposal Assessment Team (EDAT) is working to prove that OB/OD is harmful to human health and the environment, expensive to clean up, and that there are cleaner, safer alternative technologies available.

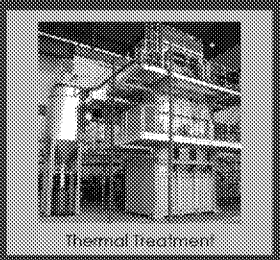
The Alternatives


Supercritical Water Oxidation

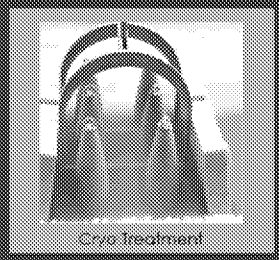
Water Jet Cutting

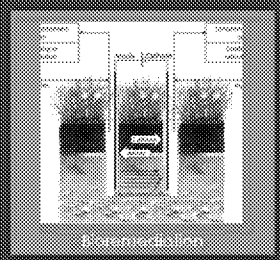
Conversion to Fertilizer


Reverse Osmosis Filtration


Thermal Treatment

Chemical Neutralization


Cryo Treatment


Bioremediation

Alternative: Supercritical Water Oxidation

Process

- Uses water at (374°C/705°F) and 3,206 psi
- Under these conditions, organic materials, oxidation reactants, and oxidation products are miscible in water
- Products = CO_2, H_2O, and salts with NO_x and SO_x at or below detection limits without any post-treatment

Application

- Consistently demonstrated to be extremely efficient
- Allows complete oxidation reactions to take place in relatively compact equipment and without mass transportation limitations
- Major SCWO program recently completed for the US Army at BGCAPP (KY)

Capabilities

General Atomics

Alternative: Water Jet Cutting

Process

- Pressurized water and industrial garnet abrasive used to cut through hardened steel
- Operation is housed in an enclosed ventilation booth to prevent worker exposure
- High explosives are washed out and piped to on site chemical conversion technology

Application

- Highly transportable mobile unit
- Has been fully tested and fielded for use by the military
- Gentle enough not to ignite high explosives
- GT system can process up to 1,600 rounds on 3 in/50 projectiles per shift
- Used on blasting caps – 2,000 lb bombs
- System used for US Navy explosive D projectiles
- Extremely versatile system

Companies

Goldtec
Jet edge Inc
Gradient Technology
Flow International Corporation
Caretta Technology Inc
Team Technologies

Alternative: Conversion to Fertilizer

Archtech

Company

Process

- Uses naturally occurring, coal-derived humic acid – a water soluble colloidal solution
- Facilitates a series of reactions to decompose highly toxic and hazardous chemicals
- Reactions are carried out in a reaction vessel operation at atmospheric pressure and temperature of 160°F – 180°F
- Reaction completed after 2-4 hours
- Product is neutralized and ready for application as fertilizer or safe disposal

Application

- Non polluting
- Recycles energetics into sellable fertilizer
- Lower cost than thermal
- Used at McAlester Army Ammunition Plan (OK)
- Demonstrated at Hawthorne Army Depot (NV)
- Fertilizer in compliance to EPA Universal Treatment Standards for Hazardous Wastes
- Breakthrough for complete deconstruction of ammonium perchlorate
- Building facilities at Crane Army Depot (IN) and Radford Ammo Plant (VA)
- Fertilizer applied in NJ
- Successfully tested on a variety of munitions

Alternative: Reverse Osmosis Filtration

Process

- Use of pressure to separate soluble ions from water though a semi-permeable material
- Usually a thin film composite material
- Typically membrane is arranged in a spiral configuration

Application

- Heavy industry and power generating sectors utilize Reverse Osmosis to produce high quality water
- Economical technology for soluble ion removal

Companies

Degremont Technologies/ SUEZ Environment

Alternative: Thermal Treatment

Companies

Sterlinggo
Dynasafe
General Atomics
Sandia National Laboratories
El Dorado Engineering
Heritage Disposal and Storage
International Explosives Ordnance Disposal ltd.
Lawrence Livermore National Laboratories
UBX International Inc.
NABCO

Application

- Tested/used by the military
- Usually equipped with pollution controls and air monitoring
- Cost are modest
- GA systems in Germany

Process

- Munitions are fed through a loading system
- Explosives are heated until they burn, deflagrate or detonate
- Variations between the different methods of thermal treatment

Static Detonation Chamber, Explosives Waste Incinerator, Transportable Flashing Furnace, Contaminated Waste Processor, Circulating-Bed Incinerator, Rotary Kiln

Alternative: Chemical Neutralization

GA Approach

- Used on CADs and PADs
- HPPP constructed at Tooele Army Depot
- Approx. 2 tons of demil weight processed per day

Companies

General Atomics

PLANTECO

PLANTECO Approach

- Demonstrated by DOD
- Can rapidly treat high concentrations of TNT, RDX, ADNTs, HMX, and Picric acid

GA Process

- Submerges energetics in warm NaOH to dissolve aluminum containment bodies
- Solution then hydrolyzes the energetics to benign, low-molecular-weight organic salts
- Non-hydrolyzable "tramp" materials are removed from the bath, rinsed, and sent to disposal after inspection
- GA's SCWO system disposes of the spent NaOH solution
- Comprehensive gaseous discharge analyses were performed to support a preliminary screening risk assessment (indicates that a PAS for the CAD HPPP gaseous discharge is not required)

PLANTECO Process

- Rapid in-situ chemical treatment
- Consists of selected bulk reductants that generate free radicals that react rapidly to completely degrade oxidized organics to innocuous end products along with precipitating/immobilizing metals

Alternative: Cryofracture and Cryocycle

Cryofracture Process

- Uses liquid nitrogen at -320°F to cool the munition (below its embrittlement temperature)
- Items are placed on munition-specific racks and submerged in bath of liquid nitrogen
- Cooling may vary from 10-30 minutes
- Munitions are then fractured in hydraulic press
- Can be pressed either individually or in specifically arranged groups (for smaller munitions)
- The munition debris is transferred to a thermal treatment system for final destruction of the energetics
- All material transfers are performed using either remotely controlled robotics or automated conveyor systems

Cryofracture Application

- GA has cryofractured 8-inch projectiles, M23 land mines, Area Denial Artillery Munition (ADAM) mines, 40 mm cartridge rounds, fuses, bursters, and hand grenades

Cryofracture Application

- Test system at Tooele Army Depot (UT)
- Facility at Yuma Proving Ground (AZ) and McAlester Army Ammunition Plant (OK)
- Transportable system at CAAA (IN)

Companies

General Atomics

Cryocycle Process

- Subjecting solid propellants to repeated thermal cycles between ambient and cryogenic temperatures
- During both freezing and warming phases of the process, fractures develop in the propellant gain material
- Fractures intersect through repeated cycling
- The bulk of the material is reduced to relatively uniform-sized rubble

Alternative: Bioremediation

Process

- Introduces process nutrients into biologically active zones (BAZ)
- Pumps recirculated groundwater through the BAZ
- Relies on hydraulic gradients or the permeability of the BAZ
- The heterogeneities in aquifers often hinder the introduction of the nutrients
- Areas with higher permeability result in preferential flow paths, leading to incomplete biological treatment
- The inability to uniformly introduce nutrients and other additives, such as surfactants and cometabolites, has hindered the successful implementation of in situ bioremediation
- Electrokinetics, Inc. is developing an electrokinetic remediation technology that stimulates and sustains in situ bioremediation for treatment of organics and heavy metals
- It involves applying to soil or groundwater a low-level direct current (DC) electrical potential difference or an electrical current using electrodes placed in an open or closed flow arrangement
- Groundwater or an externally supplied processing fluid is used as the conductive medium
- The low-level DC causes physiochemical and hydrological changes in both the waste and the conductive medium, thereby enabling uniform transport

Application

- Allows in situ treatment of contaminated subsurface deposits, sediments, and sludges
- Electrokinetics can be applied to any waste that can be treated by bioremediation
- Process additives and nutrients are added to the processing fluids to enhance bioremediation of organics
- Can be engineered to remove inorganics through electromigration and electroosmosis

Contractor

Electrokinetics Inc

The Future: Replacing OB/OD

- Contacting companies for data
- Identifying the most promising technologies/technologies that have been approved by other organizations
- Compiling the evidence
- Briefing the administration on the benefits of alternatives to OB/OD

Replacing OB/OD with alternatives

What I Learned

Better sense of where I want to go in the future

Getting to know the inner workings of EPA

How to operate independently within the framework of my project

Acknowledgements

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