



2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Enhancing Range Sustainability Through Innovative Technology Application

**Mike Warminsky, P.E.
AMEC Earth & Environmental
23-27 February 2003**



2003 AFCEE Technology Transfer Workshop

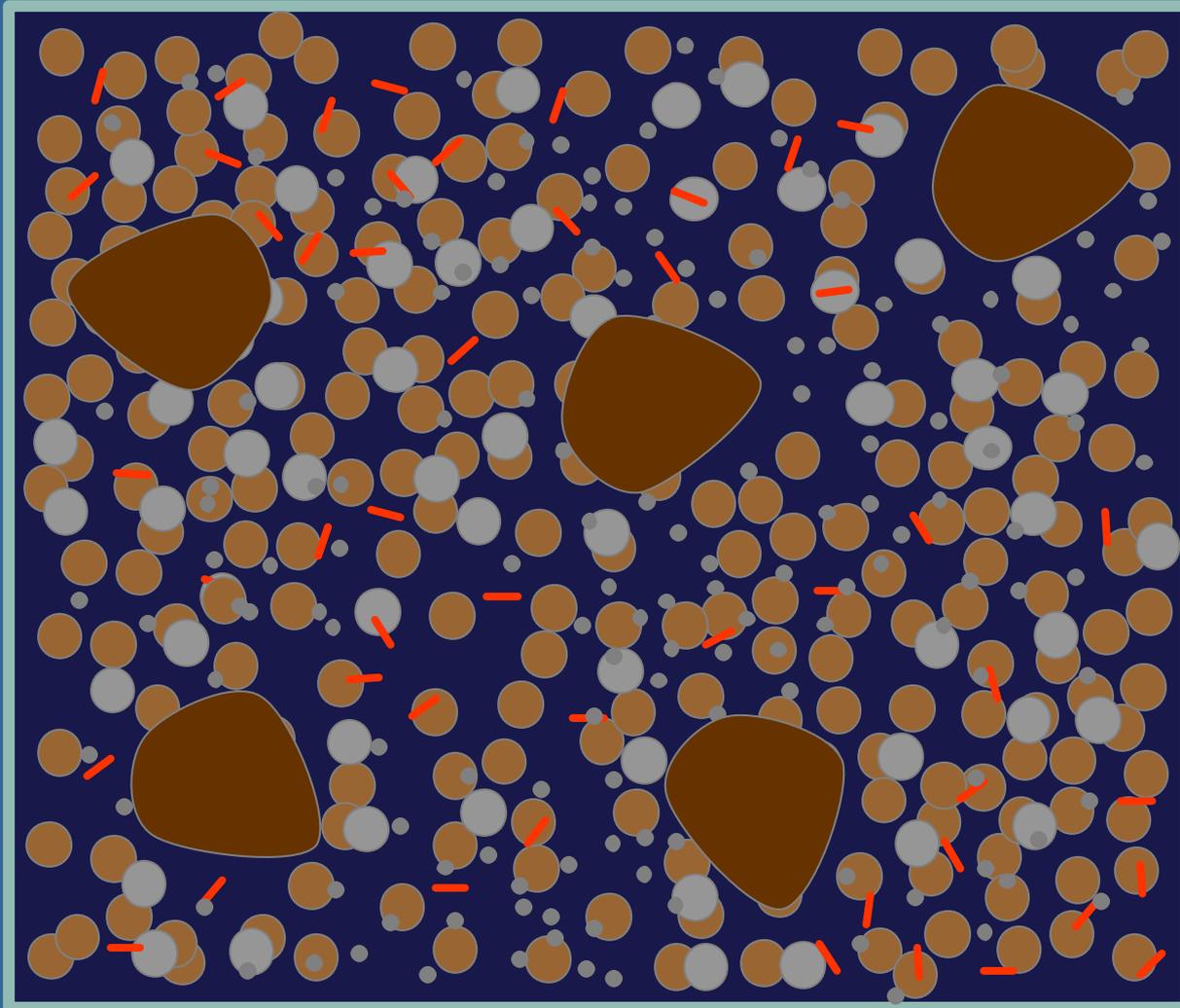
San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Sustainability Issues:

- Deposition of Metals
- Management of Residues
- Technology Application to Bring Best Value

Treatment Issues: *The Soil Matrix*



● Coarse Soil

● Boulders

● Soil Fines

● Particulate
Contaminants

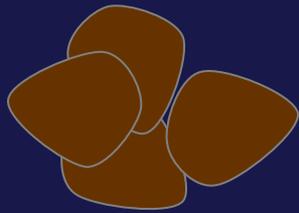
/- Humates



Onsite Soil Remediation Approach

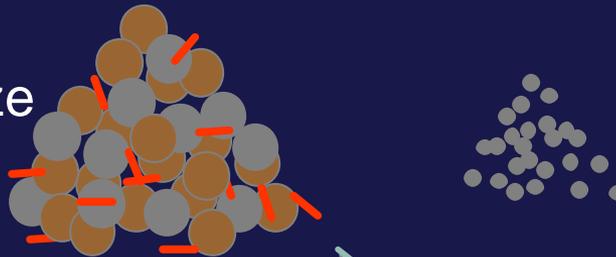
- Evaluate soil from each site separately (matrix and contaminants)
- Treatability studies to develop and optimize treatment process
- Build in flexibility to accommodate changing conditions
- Combine technologies into treatment-train approach to achieve best value

How Does Soil Washing Work?

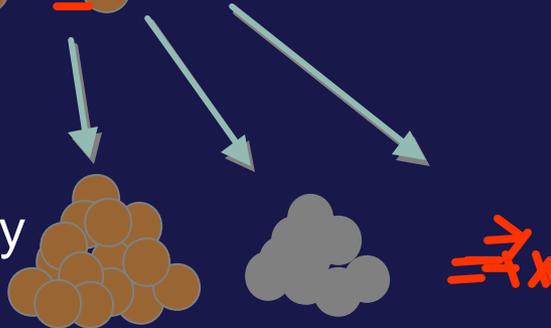


Washes Oversized

Separates by Size



Separates by Density



● Coarse Soil

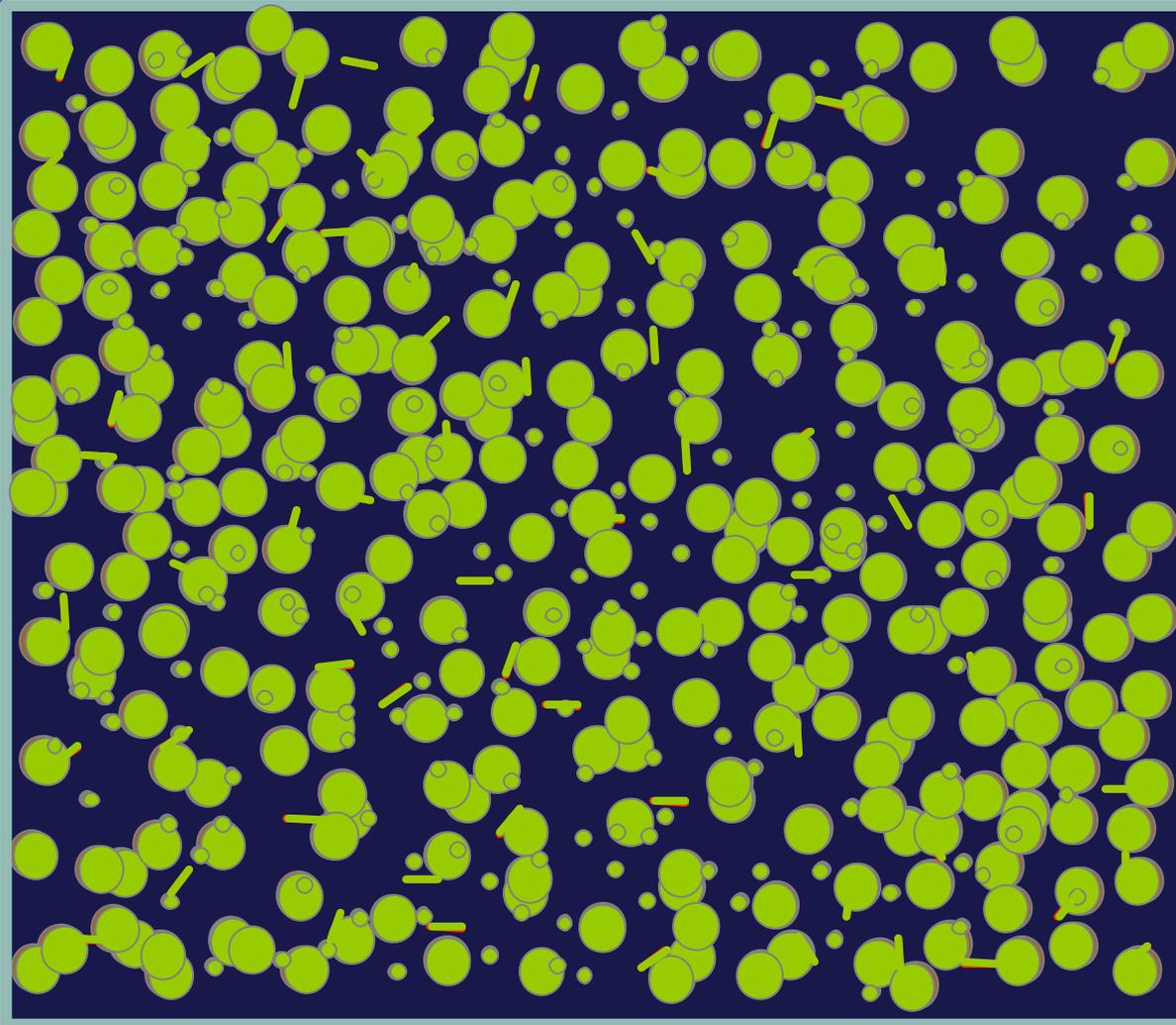
● Boulders

● Soil Fines

● Particulate Contaminants

— Humates

How Do Encapco Emulsions Work?



● Coarse Soil

● Soil Fines

● Particulate
Contaminants

／ Humates

*CHEMICAL
FIXATION*

*MICRO-
ENCAPSULATION*



Focus on Materials Handling

- Feed Soil is “Raw Material”
- Treated soil is “Product”
- Inventory management and control critical
- Trade-off number/turnaround \$ for analytical vs. storage capacity
- Must balance “Raw Materials” in vs. “Product” out with excavation/transportation/restoration



Manage as a Large Scale Construction Project

- Scope/Schedule/Cost Tracking project critical
- Coordination between multiple operations/subcontractors required
- Orchestrate seamless delivery through coordination of parallel/sequential tasks



Encapco History

Encapco began in 1994 as a division of the DeSilva Gates Construction Company, a San Francisco Bay Area general contractor. Dedicated to recycling rather than stabilization and disposal, Encapco sought methods to convert a contaminated soil liability into a useful asset. That philosophical approach led to the issuance of a U.S. Patent on the Encapco process using emulsions to chemically immobilize heavy metals which are then reusable as structural fill materials.

Project Experience Includes:

- Caltrans Highway/Park and Ride Lot Project.
- Fort Hunter Liggett Stabilization/Paving Project.
- Successfully completed treatability studies on SAFR soils, including Fort Benjamin Harrison, MCA/GCC 29 Palms, Alameda Naval Air Station and Yuma Proving Grounds.



What is the Encapco technology?

- Use of specially-modified emulsions for soil treatment
- Chelating and/or precipitating agents are added into asphalt or tall oil pitch emulsions to provide chemical bonding within a hydrophobic matrix with increased soil strength, lower permeability
- Past test results show effectiveness on heavy metals and refractory organics (mixed wastes)
- Treated soil can qualify as RCRA waste recycling under federal and state laws



Federal Regulatory Criteria

“Use in a Manner Constituting Disposal” RCRA Recycling Exemption

- Product produced for the general public's use
- Recyclable materials have undergone a chemical reaction so as to become inseparable by physical means
- The product meets LDR treatment standards



Recycling Project Goals

- Stabilize soil, gross particulates and ionics in a low permeability matrix that significantly inhibits further oxidation and eliminates dust generation health risk
- Reduce soluble levels of contaminants to regulatory criteria
- Produce a viable recycled construction product



Emulsion Composition

<u>Material</u>	<u>Volume</u>
• Tall Oil Pitch or Asphalt	50%
• Emulsifier - Non-ionic	2%
• H ₂ O	42%
• Acid - Proprietary	6%
Emulsion pH	2
Material Volume Added	< 3%



Process Overview - Design

- AASHTO soil classification
- Analytical baseline analysis
- Estimate starting soil mix design
- Strength testing and structural design
- Treatability analysis
- Final mix design verification
- Product structural design



Process Overview - Implementation

- Screen and separate oversize material from soil
- Pre-treatment (e.g., soil washing), if necessary
- Re-test soil to ensure material consistency with the sample
- Prepare and manage onsite quality control and safety plans
- Set up onsite pug mill(s) and produce proprietary Emulsified Treated Material (ETM) at rates up to 300 tons per hour per pug mill
- Perform post-treatment QA/QC testing



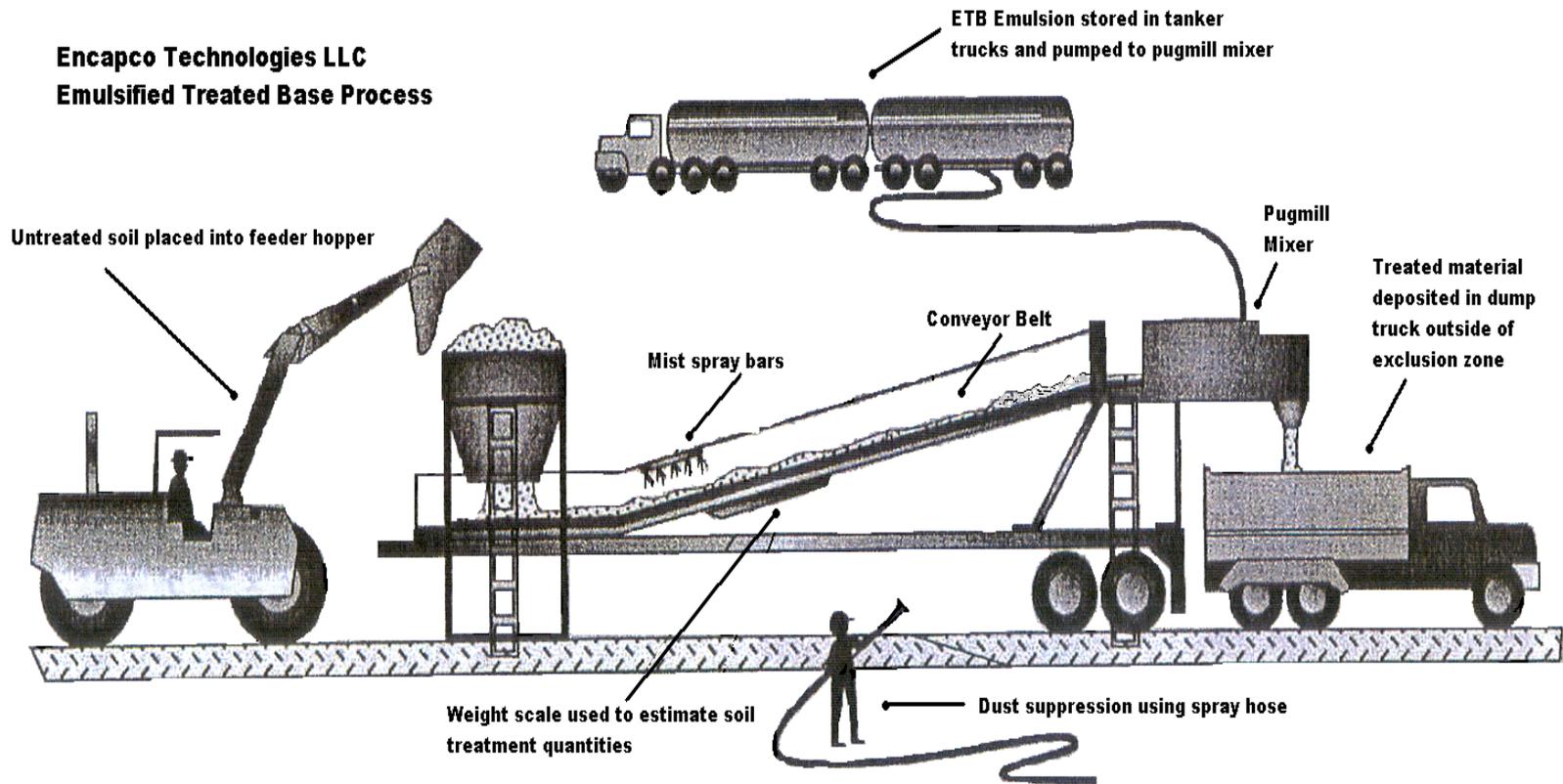
2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Material Processing Overview

**Encapco Technologies LLC
Emulsified Treated Base Process**





2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Previous Test Results PCB Results

Aroclor 1242			Aroclor 1260		
PCBs	PCB-STLC	PCB-TCLP	PCBs	PCB-STLC	PCB-TCLP
EPA 3545/8082	EPA 8082-STLC	EPA 1311/8082	EPA 3545/8082	EPA 8082-STLC	EPA 1311/8082
mg/kg	mg/l	mg/l	mg/kg	mg/l	mg/l

Sample ID

PCB from Pile (Unspiked)	<0.05	--	--	0.25	--	--
PCB from Pile (Baseline)	740	0.49	0.062	310	0.18	<0.025
4% 1:1 C PCB	800	0.16	0.02	360	0.089	<0.01
4% 1:1 S PCB	700	0.034	0.021	330	<0.01	<0.01
8% 1:1 C PCB	220	0.071	0.012	99	0.035	<0.005
8% 1:1 S PCB	760	0.21	0.014	380	0.099	<0.005

Notes:

4% 1:1 C PCB = Topein C (Asphalt emulsion)

4% 1:1 S PCB = Topein S (Tall pitch oil emulsion)

All PCBs not included in the table were not detected above the laboratory detection limit.

-- = Not analyzed.



2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Previous Test Results Lead and Cadmium (TTLC)

Contaminated Site	Hazard	TCLP (ppm)				
		Untreated	Treated with			
		Base Material	Tall Oil Emulsion	4% Lime Only	Tall Oil w/ 4% Lime	Asphalt Emulsion
Dupont - Delaware	Lead	1300	23	350	ND	
US Army - 29 Palms	Lead	300			ND	
US Army - Ft. Ben Harrison	Lead	23	ND			
USAF - Mather AFB	Lead	15				ND
USAF - McDill AFB	Lead	600			ND	
Speakman Foundry - Del.	Lead	13				ND
Vulture Mine - AZ	Lead	90	ND			
Midvale Slag - UT	Lead	130				0.5
	Cadmium	92				ND



2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Previous Test Results Depleted Uranium (DU)

	Saturation Period	Alpha Spectroscopy			Mass Spectroscopy
		U233(pC/L)	U235(pC/L)	U238(pC/L)	DU (ppm)
Spiked Soil Sample	Dry				(a) 160,000
Untreated Control Soil	7 Days	2,290	0	16,600	61
	27 Days	2,030	245	12,600	29
	47 Days	774	45	4,100	8
Total Solubilized DU				38,684	98
Soil Treated with Tall Oil Pitch Emulsion	7 Days	130	39	97	<0.05
	27 Days	22	27	45	<0.05
	47 Days	46	0	0	<0.05
Total Solubilized DU				406	0

NOTE: (a) (ppm) measured in dry soil. All other (ppm) measurements reflect DU solubilized in water phase.



2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship



DEPARTMENT OF THE ARMY
UNITED STATES ARMY TANK - AUTOMOTIVE AND ARMAMENTS COMMAND
ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER
PICATINNY ARSENAL, NEW JERSEY 07806-5000

U.S. Army Heavy Metals Office

13 JAN 2000

Mr. William M. Jones, President
Encapco
P.O. Box 2223
11555 Dublin Blvd.
Dublin, California 94568

Dear Mr. Jones:

The U.S. Army Heavy Metals Office has reviewed the September 1999 Report on the use of organic-based emulsions to reduce the solubility of Depleted Uranium (DU) in soils. That report was prepared for U.S. Army TACOM-ARDEC under Contract DAAE 30-99-M-0167.

The report presents the results of leachability, strength and permeability testing using background soils from the Yuma Arizona Proving Grounds spiked with DU corrosion products. The soils were tested both untreated and after treatment with a range of specialty organic-based emulsion products.

The test results indicate that treatment with pitch-based emulsions can reduce DU leachability by over 99%, as measured both by mass spectroscopy and alpha spectroscopy. The structural strength of the treated soil and its resistance to water infiltration were each improved by a factor of 10.

The unqualified success of these results suggests that a simple, cost effective range maintenance application process using these emulsions can potentially avoid future DU issues at a number of Army facilities around the country, particularly at the Yuma, Arizona and Aberdeen, Maryland Proving Grounds. Such a solution would further serve to protect military personnel and the environment without interfering with the continued use of these range facilities for the nation's military readiness.

I am excited by the significance of these test results. I look forward to working with you on Phase I of our SBIR contract and to proceed as soon as reasonably possible to full-scale demonstration testing of these emulsions.

Sincerely,

Thomas A. McWilliams
Chief, U.S. Army
Heavy Metals Office

The test results indicate that treatment with pitch-based emulsions can reduce DU leachability by over 99%, as measured both by mass spectroscopy and alpha spectroscopy. The structural strength of the treated soil and its resistance to water infiltration were each improved by a factor of 10.



Current Navy Demonstration Project

- Approximately \$3.0 million contract to demonstrate emulsion stabilization technology on a range of contaminant and site conditions
- Approximately half of the contract is dedicated to high concentration metals, refractory organics, and mixed wastes
- Half of the contract is dedicated to demonstrate the technology on radioactive sites



Current Navy Demonstration Project

- Successful treatability testing on PCBs in soils
- Field projects initiated at Crane, IN; Mechanicsburg, PA; and Portsmouth, ME
- Test protocols under development and field budgets approved for stabilization of DU at Yuma; Th at Kirtland AFB; and Pu and Am at NTS and Rocky Flats
- Inter-agency technical team working collaboratively



2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

What next?

- Initial laboratory treatability testing on soils from the former McClellan AFB
- Treatability studies on soils from SAFR at Fort Lewis
- Treatability studies on soils from SAFR at former Fort Ord



2003 AFCEE Technology Transfer Workshop

San Antonio, Texas

Promoting Readiness through Environmental Stewardship

Questions & Answers