

GRACE

Water

- 1) phyt
- 2) Biovia
- 3) GAC

79573

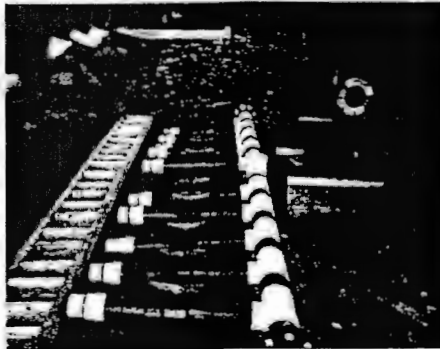
Soil

- 1) chem/bio | 2014
- 2) Ba ^{long} stability to 2000
- 3) disposal
- 6) excavate/sieve



DARAMEND[®]
*Bioremediation
 of Soils Containing
 Organic Explosives*

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160
 175 ± 50g
 (circled scribbles)

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onward F



10 68KU 101E3 8045/43 SOIL+DA



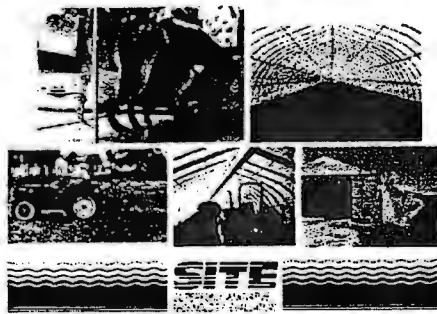
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EPA

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Daramend™ Bioremediation
Technology

Innovative Technology
Evaluation Report



U.S. EPA

SITE Report

EPA/540/R-95/536

Economic Analysis

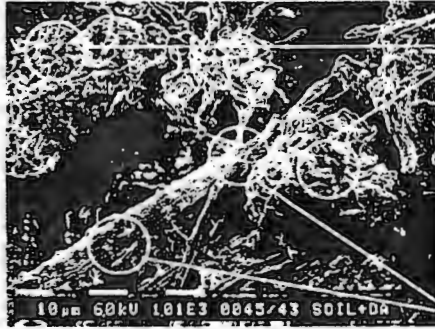
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"A full-scale cleanup of this site using this technology was estimated to cost between \$619,000 for an *in situ* plot with an attendant unit cost of \$92/m³ (\$70/yd³), and \$959,000 for an *ex situ* plot with an attendant unit cost of \$140/m³ (\$108/yd³), including the cost of residual disposal. The residual consisted of oversized particles screened out of the soil during pretreatment and deemed to be hazardous. Landfilling was assumed to be the preferred disposal option, although this may not be permissible for these types of wastes in some jurisdictions."

Quotation from U.S. EPA SITE Report (Section 3.2, p. 22)
EPA/540/R-95/536, July 1996

DARAMEND® in Soil

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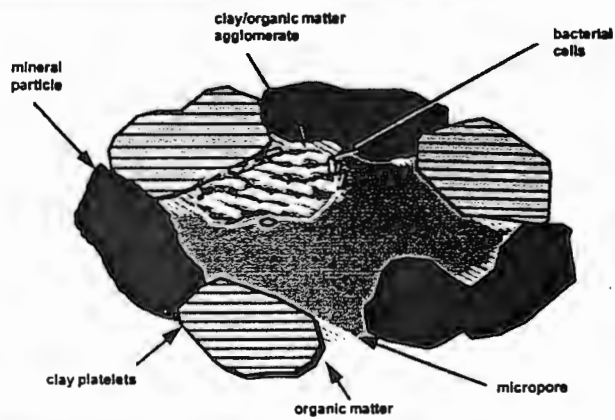
Contaminated Soil Aggregates

Contaminants desorb from soil surfaces, enter water film and diffuse to surface of DARAMEND® particle where biodegradation occurs.

Hydrated DARAMEND® particle colonized by native soil microorganisms (bacteria and fungi)

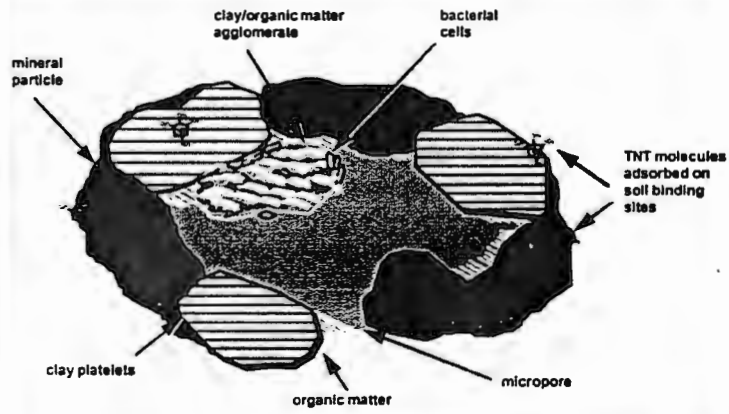
Soil microstructure with aquatic microsite

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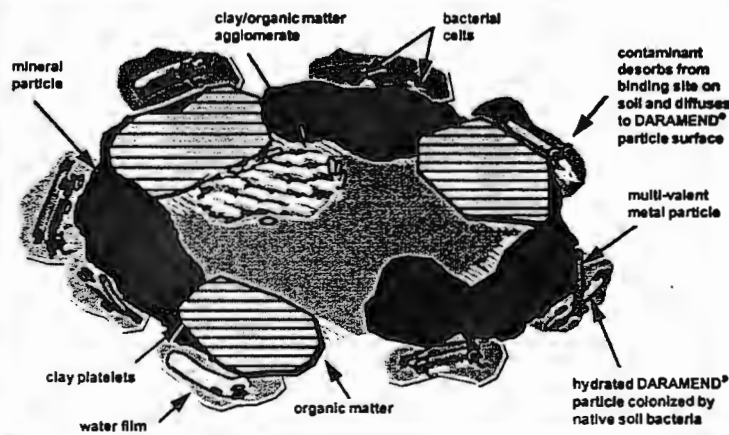
Organic explosive-impacted soil microstructure

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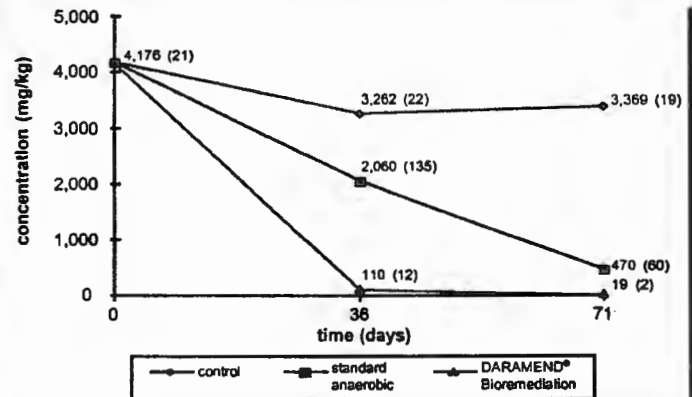
DARAMEND® Bioremediation

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Influence of DARAMEND[®] treatment on concentrations of TNT and total amino compounds¹ in U.S. Army soil

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1. Numbers in parentheses indicate total amino compounds by EPA 8330 Method

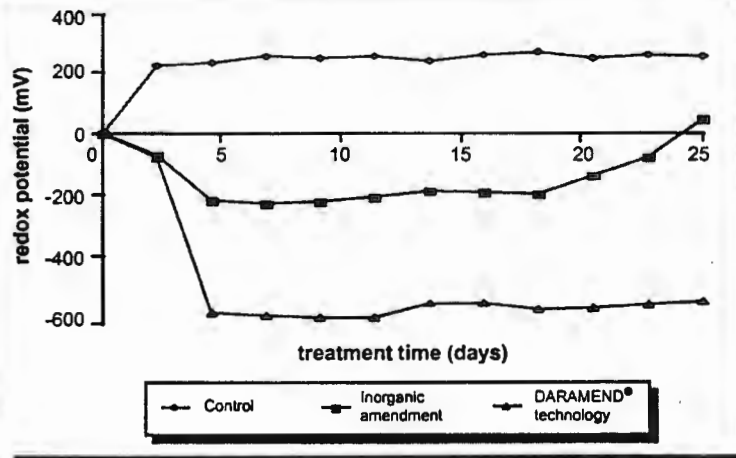
Influence of DARAMEND[®] treatment on explosive compound concentrations in U.S. Navy soil

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	Initial	Cycle 1 15 days	Cycle 2 29 days	Cycle 3 43 days	Cycle 4 57 days	Cycle 7 95 days
2,4,6-Trinitrotoluene	10.5	0.8	0.2	0.1	0.1	BLD
2-Amino-4,6-dinitrotoluene	4.1	0.7	0.3	0.2	0.2	BLD
HMX	1,074	301.3	80.0	43.1	28.3	10.5
RDX	54.4	0.1	BLD	BLD	BLD	BLD
Total Explosive Compounds	1,146	303.0	80.9	43.7	29.0	10.9

Influence of DARAMEND® technology on redox potential in soil during reductive phase

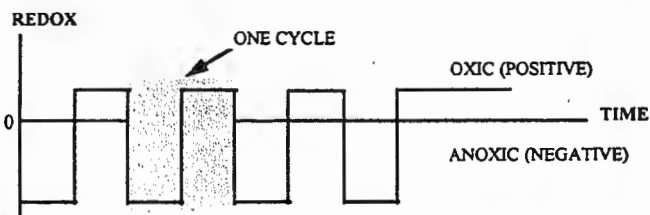
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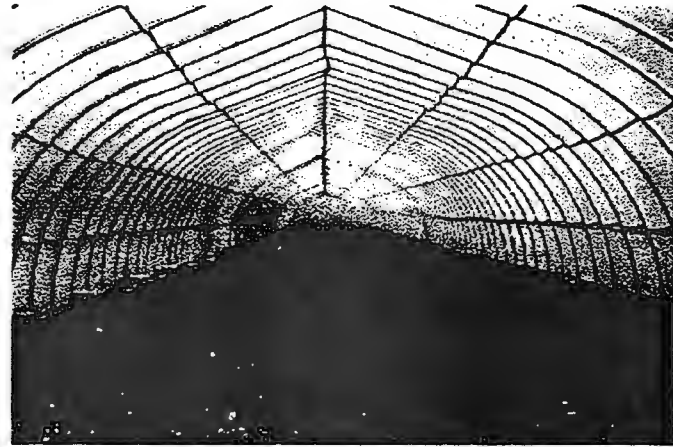
DARAMEND® Technology

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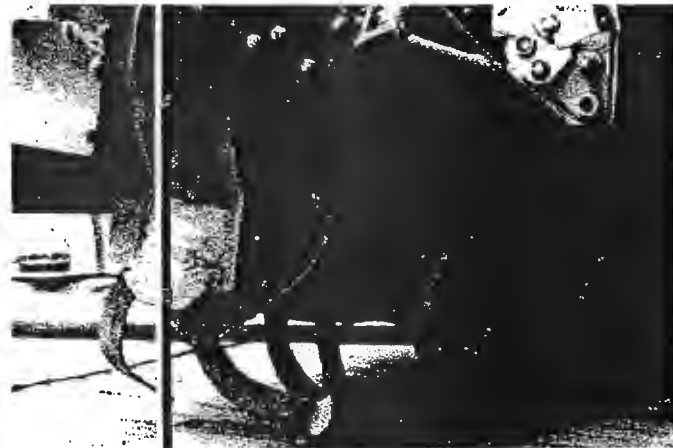
- ◆ Anoxic/oxic cycling with reductive and oxidative phases
- ◆ Requires optimization of conditions for each phase
- ◆ Patented technology (U.S. Patents #5,411,664; #5,480,579; #5,618,427)



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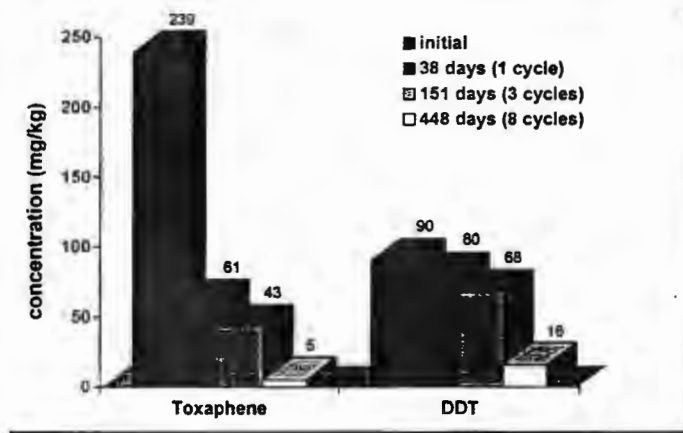


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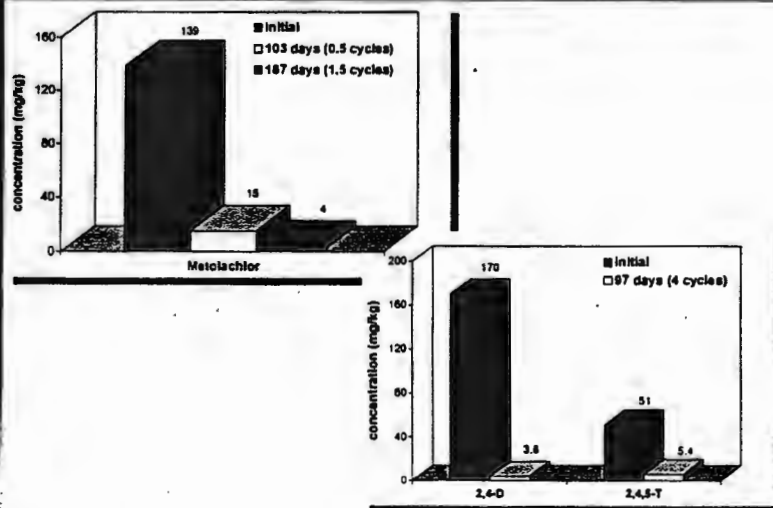
Influence of DARAMEND® technology on chlorinated pesticide concentrations in South Carolina soil

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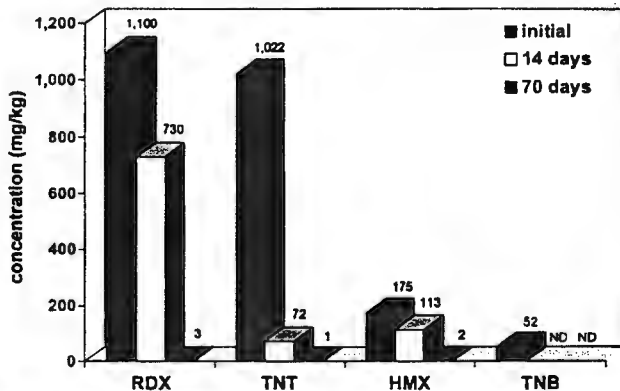
Influence of DARAMEND® technology on chlorinated herbicide concentrations in soil

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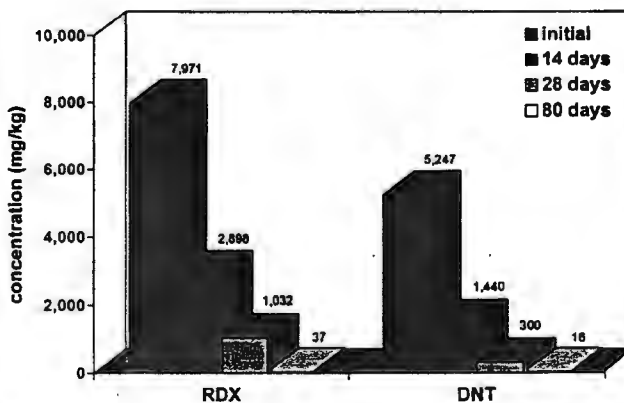
Influence of DARAMEND® technology on concentrations of organic explosives in soil from Hawthorne AD, Hawthorne, NV

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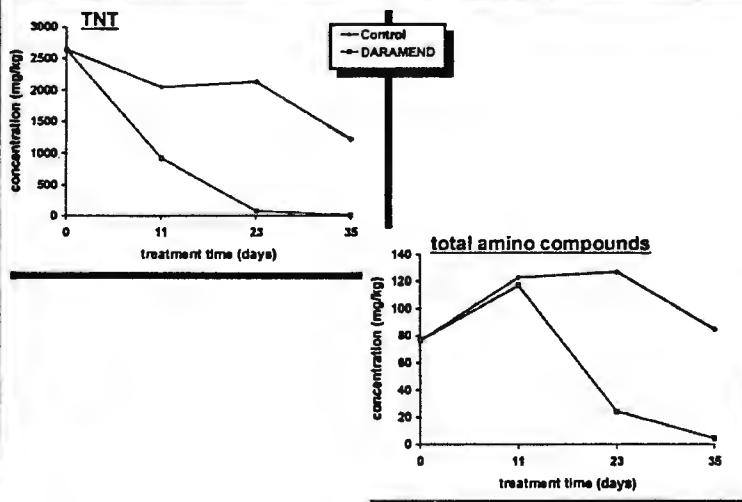
Influence of DARAMEND® technology on concentrations of organic explosives in soil from Joliet Army Ammunition Plant, Joliet, IL

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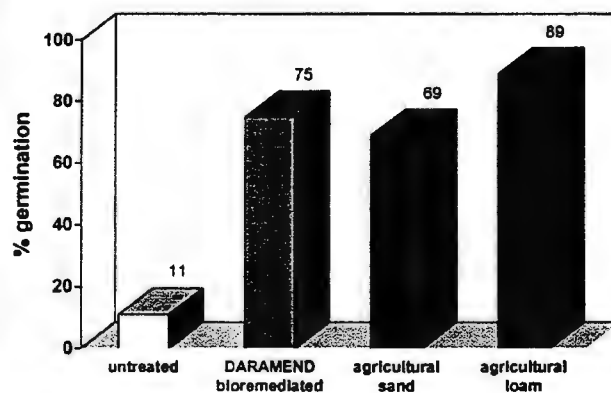
Influence of DARAMEND® technology on TNT and total amino compounds in soil from Raritan Army Arsenal, Edison, NJ

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Influence of DARAMEND® technology on tomato seed germination in organic explosive contaminated soil

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Influence of DARAMEND technology on concentrations of organic explosives in military soil following 28 days of anoxic treatment

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