

Biodegradation for Treatment of POL-Contaminated Soil - Introducing a New Guidance Document

Environment, Energy & Sustainability Symposium

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U.S. Army Corps of Engineers

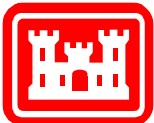
Construction Engineering Research Laboratory (CERL)

Champaign, IL

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U.S. Army Corps of Engineers

Headquarters



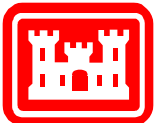
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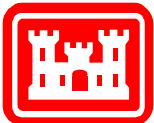
What Are PWTBs?

- **Public Works Technical Bulletins**
- **Sponsored by USACE HQ**
- **Variety of Subjects**
- **Available through Whole Building Design Guide**
- **Accessible at:**
- http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215
- **May have to use Alternate Path – CCB, Army/COE, then PWTB**



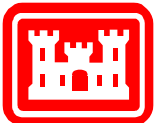
PWTB Contents

- **Biodegradation Technology Description**
- **Army Examples of Implementation**
- **Literature Review**
- **Regulatory Review**
- **Related Technologies**
- **References**



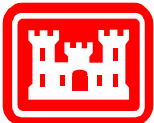
Bioremediation

- **Use of Microorganisms to Remove Pollutants**
- **Applicable to Variety of Pollutants**
- **Remedial Technology Using Microorganisms to Help Reduce Concentration of Petroleum Hydrocarbons in Soil**
- **Capability to Transform Contaminated Soil into Useful, Recyclable Material at Relatively Low Cost**
- **Complex Process**
 - **Nature and Amount of Pollutant**
 - **Actual Surrounding Environmental Conditions**
 - **Composition of Native Microbial Community**
- **Installation Sources**
- **Regulatory Environment More Stringent**
- **Optimization**
 - **System Parameters**
 - **Bioaugmentation**



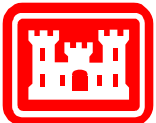
General

- **Hydrocarbons – Wide Range of Physical and Chemical Characteristics**
- **Microbiology – Types of Microorganisms**
- **Dominant Organisms or Groups of Organisms**
- **Changing Environments – Changing Populations**
- **Adaptation Wins**
- **Capacity to Use Hydrocarbons as Primary Source of Carbon and Energy**
- **Metabolic Pathways – Aerobic or Anaerobic**
- **Indigenous Organisms Present in Most Subsurface Systems**
- **Bioremediation - Ex-situ or In-situ**
 - **Ex-situ - Advantage – Control**
 - **Disadvantage – Expense and Disruption**



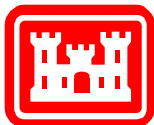
Fort Hood Experience

- **Demonstrated Bioremediation with and without Bioaugmentation**
- **POL-Contaminated Sludges and Soil**
- **Constructed Permanent Biosite**
- **Capacity to Treat 1,600 cu yards, Store 250 Cu yards**
- **Six- month Cycle**
- **Goal <1,500 ppm of TPH**
- **Use as Intermediate Cover at Sanitary Landfill**
- **Demonstrated Environmental Parameter Optimization Adequate**
- **Use of Additives Unnecessary**



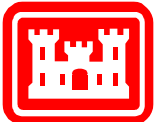
Bio-site

- **Designed In-house**
- **6-inch Reinforced Concrete Pad, Seams and Joints Sealed, Sand Base, 80-mil Impermeable Liner, Leach Field**
- **8-foot Fence**
- **Separate Staging Area**
- **0.5 Percent Grade to Drain**
- **Reclaimed Water Available for Sprinkling**
- **Grit Collection Chamber for Suction Truck Slurry**
- **Operating Equipment**
- **Operations Building**



General Operating Procedures

- **Incoming Soil to Staging Area**
- **Initial Samples for Testing**
- **Transfer to Treatment Pad**
 - **Spread and Layered**
 - **Nutrients Added and Tilled**
 - **Watering and Tilling as Needed**
- **Sampling Schedule**
 - **Constituents**
 - **Frequency**
- **Soil Disposition**
- **Documentation**
- **Windrows Also Demonstrated**



Fort Riley

- **Similar Site to Fort Hood's**
- **Meet State-required Cleanup Levels**
- **Used as Fill for Construction Projects or Mixed with Compost**
- **Kansas Uses “Risk based” Action Levels**
 - **Different Categories of Risk**





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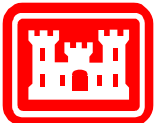


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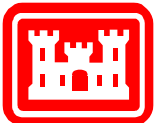
State Regulations

- **States Vary Widely**
 - **Responsible Agencies Vary**
- **Often BTEX, TPH, PAHs**
- **Usually Regulate Via Action Limits, Allowable Uses and Varying Concentrations**
- **Vary by Environmental Medium**
- **“Risk-based” Soil Cleanup Difficult - Many Factors Taken Into Account**
 - **Contaminant, Exposure Pathways, Material End-Use**
- **Several States Discussed in PWTB**



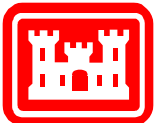
Texas Example

- TCEQ
- Risk-Based
- Tier 1 Default Cleanup Standards
- Tier 2 Site-Specific Calculation
- Contaminant of Concern, Different PCLs
- Protective Concentration Limit (mg/kg)
 - Tier 1 Industrial Soil
 - Benzene 110
 - Toluene 33,000
 - Ethyl benzene 10,000
 - Xylene 1,100



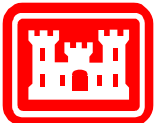
Environmental Modification for Bioremediation

- **Environmental Limitations Include Excessively High Waste Concentrations, Lack of Oxygen, Unfavorable pH, Lack of Mineral Nutrients, Lack of Moisture and Unfavorable Temperature**
- **Bioaugmentation**
 - **Seeding with Pollutant-degrading Bacteria**
 - **Rationale – Xenobiotics**
- **Great Majority of Cases - Inoculations Neither Necessary Nor Useful;**
 - **Exceptions - Biodegrading Microorganisms are Poor Competitors**
 - **Or When Co-metabolizing Takes Place**
- **Massive Accidental Spill of Toxic Chemical in Previously Unexposed Environment**
- **Always Provide Reasonable Growth Conditions, May Need Substrate in Some Cases**



Biopiles

- **Similar Full-scale Technology –**
- **Excavated Soils are Mixed with Soil Amendments, Place on a Treatment Area and Bioremediated Using Forced Aeration or Turning Windrows**
- **Treatment Bed, Aeration System, Irrigation/Nutrient System, Leachate Collection System**
- **Control Moisture, Heat, Nutrients, Oxygen and pH**
- **Sometimes Plastic Covered**
- **Treat TPH Less Than 50,000 mg/kg**

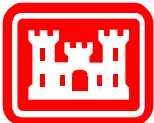


Questions?

Contact information or for additional information or resources

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