

## TerraStryke® TPH<sup>ENHANCED</sup>™

### Product Highlights

TPH<sup>ENHANCED</sup>™ is a cost-effective residual source mass remediation strategy

TPH<sup>ENHANCED</sup>™ Enhances biodegradation of petroleum contaminants by native microbes *anaerobically*

TPH<sup>ENHANCED</sup>™ provides a metabolic analog to Oxygen (O<sub>2</sub>)

TPH<sup>ENHANCED</sup>™ represents a **Green** strategy that minimizes the impact of remediation.

TPH<sup>ENHANCED</sup>™ **cost-effectively** eliminates aboveground energy consuming, emissions generating equipment.

TPH<sup>ENHANCED</sup>™ leverages existing Site conditions to realize low-cost, low-risk contaminant destruction.

TPH<sup>ENHANCED</sup>™ is ideal for remote site locations with limited access and energy availability.



## TerraStryke® TPH<sup>ENHANCED</sup>™ Residual Source Mass Remediation

### USAF Fire Training Center: Petroleum Hydrocarbons, Naphthalene, BTEX Former Chanute Air Force Base, Illinois USA

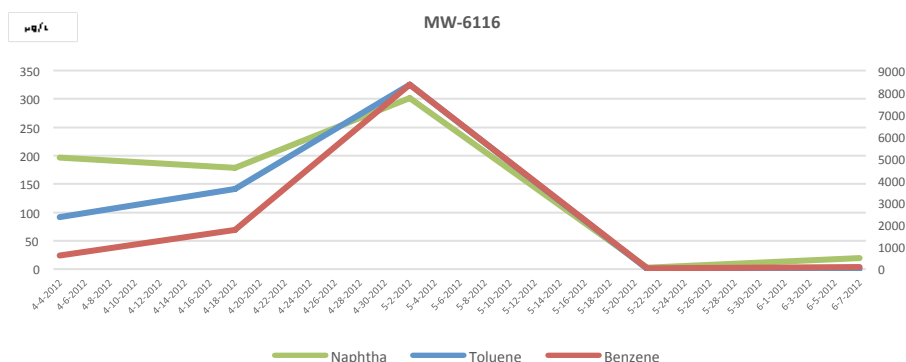
TerraStryke® Products LLC (TerraStryke®) develop and distribute biostimulation additives proven to cost-effectively enhance the destruction of dissolved phase, sorbed and/or residual source mass contaminants by native microbial populations.

TerraStryke® enriches site geochemistry and native heterotrophic microbes to provide cost-effective contaminant degradation with minimal support equipment and site impact.

This case study summarizes product efficacy under simple evaluation processes. The results lead to full-scale implementation of TPH<sup>ENHANCED</sup>™ and demonstrate expedited residual source mass solubilization and enhanced destruction of bioavailable contaminants, providing a low-cost, low-risk strategy to achieve long-term compliance goals.

**RESULTS:** After TPH<sup>ENHANCED</sup>™ deployment, native microbes enhanced the solubilization of residual source mass contaminants, represented by a greater-than 23-fold increase in dissolved phase total VOC concentrations (from 23.3 ug/L to 556 ug/L MW-6116). Five months later, total VOCs realized ≈ 75% reduction in bioavailable contaminants and >95% additive assimilation. Specifically, VOC concentrations within TPH<sup>ENHANCED</sup>™ amended groundwater realized:

- A near 30-fold increase in benzene, followed by **>71.8%** reduction
- A secondary 6-fold increase in benzene, followed by **>74.2%** reduction
- A near 10-fold increase in total VOCs followed by **>71.9%** reduction
- A secondary 9-fold increase in total VOCs followed by **>74.7%** reduction



**PROCESS:** Smear zone soils contaminated with VOCs and Petroleum Hydrocarbons (PHCs) were excavated and placed in two 35-gallon-poly drums. The remaining space was filled with a mixture of groundwater removed from excavation and TPH<sup>ENHANCED</sup>™ which; nourishes native microbes, enhancing the production of biosurfactants, increasing contaminant bioavailability, and long-term achievement of site remediation goals.



**TPHENHANCED™** is ideal for fixed, remote, and legacy site locations providing a low-cost low-impact process to address soil and/or groundwater environmental management concerns sustainably.

**BACKGROUND:** At the site described, prior to treatment, soils adjacent to the proposed treatment zones had been excavated to remove smear zone soils contaminated with residual (sorbed and stringer) contaminant source mass. Excavated soils were reportedly removed to immediately below the soil/water interface. Three distinct treatment areas resulted; each with an assumed 10-foot thick groundwater impact zone, and surface areas ranging from 3,000 square feet (s.f.), to 17,400 s.f. The treatment areas had within them one groundwater monitoring well each for the two smaller areas, and three monitoring wells within the larger area. Monitoring well MW-6116, located within the larger treatment area, generally downgradient from most the treated area.

#### **OPERATIONS:**

Additive deployment was performed using Direct Push Technology (DPT) with site costs approximating \$10-\$15 per ton. Soils within the treatment zones had not been excavated, and it was later discovered that smear zone TOC was 4-8 times that reported as baseline; this increase in source mass contaminants increased additive load demand and, extended compliance timelines; however, without complete residual source mass contaminant removal, compliance goals will be forfeited over time. The **TPHENHANCED™** process proved a cost-effective strategy to passive-aggressively enhance contaminant solubilization, bioavailability, and degradation.

*TerraStryke®* **TPHENHANCED™** provides native microbials an analog to Oxygen (O<sub>2</sub>), allowing for the cost-effective, passive-aggressive destruction of VOC/PHC contaminants, with less-cost and less-impact. The **TPHENHANCED™** process eliminates costly, long-term above-ground, energy-consuming and emissions-generating support equipment. **TPHENHANCED™** is proven effective in terms of cost and performance, allowing the realization of long-term compliance goals by working with Mother Nature, not against.

**To determine if our additive is appropriate for an environmental management concern at your site please consider our low-cost, low-risk pilot evaluation process described below**

#### **PRODUCT EVALUATION PROCESS:**

*TerraStryke®* has established a low-cost, low-risk Pilot Study program to determine additive efficacy under actual site biogeochemical conditions, eliminating the costly 'jar effect' and providing potential end-users a representative, yet conservative, 'Go-No-Go' evaluation. The Pilot Study confirms amendment efficacy and facilitates more accurate additive loading requirements. *TerraStryke®* on-site evaluation provides insight into full-scale remedial expectations allowing all Stakeholders a level of assurance with full-scale implementation, while avoiding costly mistakes.

#### **DEPLOYMENT PROCEDURES**

*TerraStryke®* evaluations are performed *in-situ*, under actual site biogeochemical conditions, using Passive Release Sock (PRS) deployment units. Additive filled PRS units fit within 2-inch diameter groundwater monitoring well(s) and remain suspended/undisturbed in the test well screened interval for prescribed period of time. Ideally the test well is proximate to source zone contaminants. At scheduled intervals, PRS units are replaced and performance groundwater monitoring and sampling is performed. Average evaluations require up to 4-5 deployment/replacement events.

#### **LENGTH OF EVALUATION**

*TerraStryke®* evaluations at petroleum hydrocarbon sites require up to 6-9 weeks to complete; whereas, chlorinated volatile organic compound (cVOC) sites require 6-9 months for completion. A minimum 50% Performance Goal is established for the evaluation to be considered a success and justify future discussions regarding full-scale additive deployment strategies. Upon the completion of each evaluation, *TerraStryke®* provides a Technical Memorandum discussing pertinent results relative to established Performance Goal(s), estimated costs, and remediation time-lines. Please note, PRS deployment units are for efficacy evaluation only and are not designed for use under full-scale treatment operations.



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