



Pilot Study Guidance Document for TPH Remediation Plant Products Co. Ltd. Innovative *In-Situ* Formulations

The following is Plant Products Co. Ltd. (PPCL) guidance document for the implementation of a Remedial Pilot Study. Each Study is designed to generate Site-Specific data necessary to evaluate the suitability of the bioremedial additive **TPH^{ENHANCED}** to remediate petroleum hydrocarbon compounds (PHC) and appropriate additive loading requirements. The Pilot Study program allows each prospective Client a low-risk, low-cost opportunity to evaluate **TPH^{ENHANCED}** under actual site biogeochemical conditions.

Background

- **TPH^{ENHANCED}** is a proprietary and patent-pending *in-situ* amendment formulated to leverage anaerobic processes to passively aggressively destroy the organic contaminants of concern.
- **TPH^{ENHANCED}** works with Mother Nature to enhance Site conditions and expedite contaminant destruction without the use of above-ground, fixed, energy-consuming, support apparatuses.
- **TPH^{ENHANCED}** stimulates endemic microbial population(s) and expedites contaminant destruction.

The primary purpose of each Study is to provide a 'Go, No-Go' evaluation process under the actual groundwater geochemistry in which full-site remediation is anticipated. Each study provides the Client, Regulatory Agency, and Remedial Practitioner a level of assurance for success; creating minimal, if any, overall impact to Site conditions. The Pilot Study is performed *in-situ* using a proprietary Passive Release Sock (PRS) technology to eliminate the "jar effect" associated with laboratory-scale studies.

PPCL Remedial Pilot Studies provide a conservative measure of our products efficacy under actual Site conditions, to ensure the establishment of low-cost and innovative solutions which meet the immediate remedial goals and budgetary limitations.

Length of Pilot Study

Depending upon the type and concentration of hydrocarbon contaminant present, the geochemistry of the aquifer, and the presence/absence of pooled contaminant, Pilot Studies performed at sites with phreatic zone soil/groundwater contaminated with TPH/PHCs generally require 6 to 8 weeks to complete using **TPH^{ENHANCED}**.



Results of Study

Each Remedial Pilot Study will establish a Performance Goal Criteria of 50% removal or greater of the primary PHC/TPH concentrations. Upon the studies completion, PPCL shall provide a Technical Memorandum discussing the pertinent results relative to the established Performance Goal Criteria. In the event the Pilot Study results in the pursuit of full-scale remediation, PPCL shall also provide a conceptual remedial design and an order of magnitude full-scale remediation cost estimate based on our reduction of data generated during the Pilot Study.

Materials

Additive samples are delivered using PRS deployment units. PRS units are designed for direct placement in existing groundwater monitoring wells, providing slow formulation release, while enhancing contact residency time within a vertical column contaminant zone groundwater.

PRS deployment units are:

1. Approximately 5-feet long with an outer diameter smaller than the inner diameter of the receiving well;
2. Constructed using filter-fabric with the bottom end sealed; and
3. Equipped with grommets at each end.

PRS deployment units are shipped with:

1. Deployment rings used to secure each PRS to the respective well casing;
2. Cable ties to link PRS deployment units together for longer screen intervals; and
3. Material Safety Data Sheet (MSDS).

PPCL will provide the necessary number of PRS deployment units within 21-days of receipt of an authorizing Purchase Order, or signed Proposal document.

Procedures

Remedial amendment contact with phreatic zone soil/groundwater is accomplished by deploying a PRS within the screened, saturated zone, of an existing 2-inch O.D. groundwater monitoring well. One PRS deployment unit is required for every 5-feet of screened interval.

PRS deployment units containing **TPH^{ENHANCED}** support the release of solid-phase additive over an approximate 2-week period; therefore, a physical examination of the PRS unit is required every 2-3 weeks to maintain additive supply throughout the length of the Pilot Study program. If observation indicates that the additive has been consumed, the PRS unit is to be replaced.

Groundwater Monitoring and Analytical Testing

Of critical importance to a successful Pilot Study is accurate data collection; and to that point, as part of any PPCL sponsored Pilot Study, the Client must commit to the collection and analytical testing of baseline and periodic post-deployment performance groundwater samples.



It is from the results of the baseline and performance groundwater sample analysis that product efficacy and full-scale remediation designs are based. Table One summarizes the groundwater monitoring and analytical testing parameters required in addition to those necessary to document target contaminant concentrations.

Table One

Parameter	Methodology	Container & Preservative	Notes
Methane	EPA Method 3C GC Screen	Glass 40-ml VOA	HCl Preserved
Nitrate, Nitrites	EPA Method 6010b	Plastic 250 ml	48-hr Holding Time
Sulfate	EPA Method 375.4	Plastic 250 ml	No Preservative
Dissolved Manganese & Iron	ICP EPA Method 6010b	Plastic 500 ml	None, Lab Filtered
Total Organic Carbon (TOC)	TOC SM-5310B	Glass	H ₂ SO ₄ Preserved
pH	Field Monitored	NA	No Purge
Conductivity	Field Monitored	NA	No Purge
Dissolved Oxygen (DO)	Field Monitored	NA	No Purge
Oxidation-Reduction Potential (ORP)	Field Monitored	NA	No Purge

Groundwater monitoring and sample collection is to be performed *prior* to PRS deployment (baseline) and *each* time the PRS deployment unit is examined. Due to the limited area of influence of each PRS, *all* groundwater monitoring and sampling *must* be performed using *non-purge* techniques. Purging of the monitoring may remove the majority of groundwater and microbial population affected by PRS deployment, adversely affecting rates of contaminant destruction and potentially skewing performance results.

Basis of Billings

The cost of each Pilot Study is **\$2,500.00**. PPCL will provide the materials and product support necessary to successfully complete a single-well Pilot Study; and the Client shall agree to independently publish the results of the Pilot Study.

Please NOTE: *the cost of a single-well Pilot Study shall be waived in the event the results of the study fail to meet the project-specific Performance Criteria, full-scale remediation using TPH^{ENHANCED} is performed or, the published paper is accepted for presentation at a mutually acceptable industry related event.*