

Spill Response Mode: A Universal Mid-Infrared Soil TPH Calibration Method for Small Scale Remediation Activities

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Introduction

- Total Petroleum Hydrocarbon (TPH) contamination of soils is a major environmental issue.
- Determination of the extent and magnitude of TPH contamination is both lengthy and costly.
- RemScan is a time and cost saving in-field measurement tool for TPH contaminated soil that has traditionally required Site Specific calibration.
- To address this issue Ziltek has developed Spill Response mode, a TPH calibration that can be deployed immediately.
- Spill Response has been validated in conjunction with environmental remediation experts for TPH spills.

Spill Response Mode

Model Training Scheme

- Spill Response mode training data collected from spill zones globally.
- 8172 samples and growing steadily to incorporate more soil types.
- Machine learning generated calibration model.

Model Operation

- Soil samples scanned by RemScan.
- Baseline offset applied (zeroing).
- Calibration model to predict TPH concentration.

On-Site Requirements

• Site Setup:

- Quickly collect measurements of clean soils to establish baseline offsets.
- Offsets for site soil types stored in internal database.

Sample Measurements:

- Measure soil contamination directly on the soil surface.
- Wet samples (>5% free moisture) can be dried rapidly in Portable Drying Unit (<20 minutes).
- Dried samples measured directly on Portable Drying Unit Sample Slides.
- RemScan operation does not hinder any other on-site works.
- Results available in real-time.

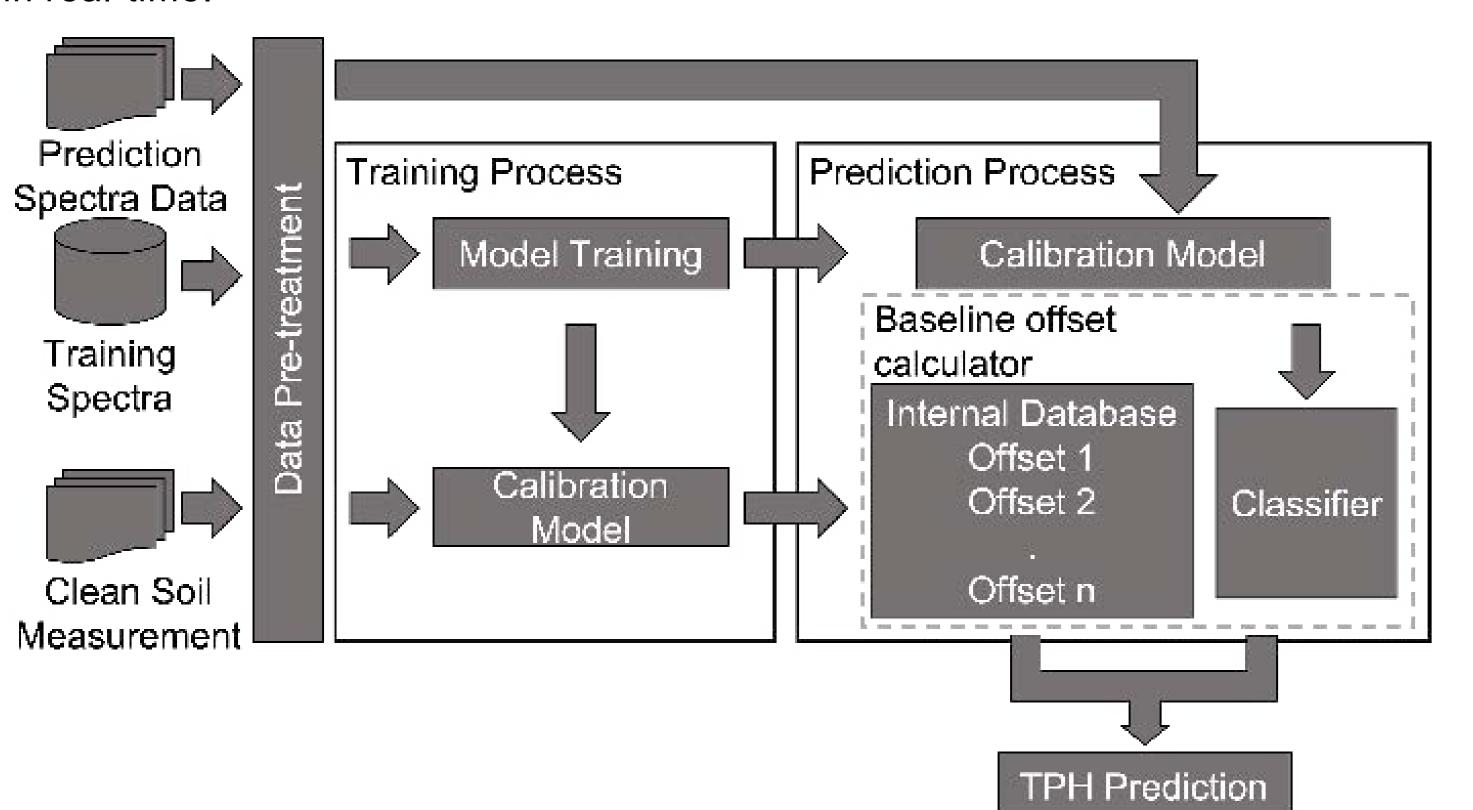


Figure 2: Spill Response Mode Process Flowchart

Case Study 1

Brick Manufacturing Site

Contaminant: Waste Oil (Mixed Hydrocarbons)

Site and Methods

Case Study 2

Site and Methods

reached.

Results

analysis.

- Hopper linked to a storage tank by conduit suspected of leaking waste oil.
- Clay soil saturated with rain, 45° slope.
- Samples collected from beneath the hopper outlet, throughout the pipe's route, and directly downhill from the hopper outlet.
- Portable Drying Unit used on-site to dry samples to <5% free moisture in <20 minutes.
- Samples split for RemScan and laboratory (ALS) GC analysis.
- Samples measured five times each and then averaged.

Results

Sand Content (%)

Figure 1: Distribution of Training Data Soil Types

- No false positives or negatives relative to 1,000 mg/kg TPH threshold.
- Confirmed the hopper outlet was leaking oil onto the slope below.
- Determined the extent of the spill.

Former Concrete Factory

Contaminant: Transformer Oil

Integrity of oil tank found to be compromised.

Confirmed and localized transformer oil leak.

Transformer removed to enable depth measurements.

- RemScan Spill Response measurements and laboratory values for TPH are in general agreement.
- Spill Response mode provided actionable results in 3 hours versus 3 days for laboratory GC analysis.

• Electricity transformer removal and assessment of surrounding soil for TPH contamination.

• Soil excavated under the transformer, samples collected every metre until groundwater

• Portable Drying Unit used on-site to dry samples to <5% free moisture in <20 minutes.

Spill Response mode provided actionable results in 3 hours versus 3 days for laboratory GC

Measurements acquired at different depths align with remediation experts' evaluation.

Verified Spill Response mode works well for contaminants other than diesel.

Agreement between RemScan predictions and laboratory GC analysis outcomes.

Remediation experts on-site to perform clean up and transformer removal.

Samples collected directly underneath and around the transformer.

Samples split in half for RemScan and laboratory GC analysis.

No false positives or negatives relative to 1,000 mg/kg TPH threshold.

Table 1:Lab Results and RemScan Predictions

Sample Name	Laboratory Measured TPH (mg/kg)	RemScan Predictions TPH (mg/kg)
Baseline	0	0
Test 1	180	599
Test 2	570	847
Test 3	4,040	8,861
Test 4	4,900	18,747
Area Run-off	5,730	7,100
Test 5	16,300	19,441



Figure 3: Mixed Hydrocarbon Spill Site

Table 2: Lab Results and RemScan Predictions

Sample Name	Laboratory Measured TPH (mg/kg)	RemScan Predictions TPH (mg/kg)
Baseline	0	0
Test 1	130	182
Test 2	4,200	6,618
Test 3	6,500	2,580
Test 4	7,200	6,172
Test 5	12,000	9,977
Test 6	14,000	4,824
Test 7	45,000	26,277



Figure 4: Electricity Transformer Spill Site

Conclusions

Spill Response Mode Construction

- Ziltek has developed Spill Response mode for RemScan, a universal calibration for TPH spill response scenarios.
- Clean soils on-site used to produce baseline data.
- Site specific baseline data used to correct TPH predictions for local conditions.

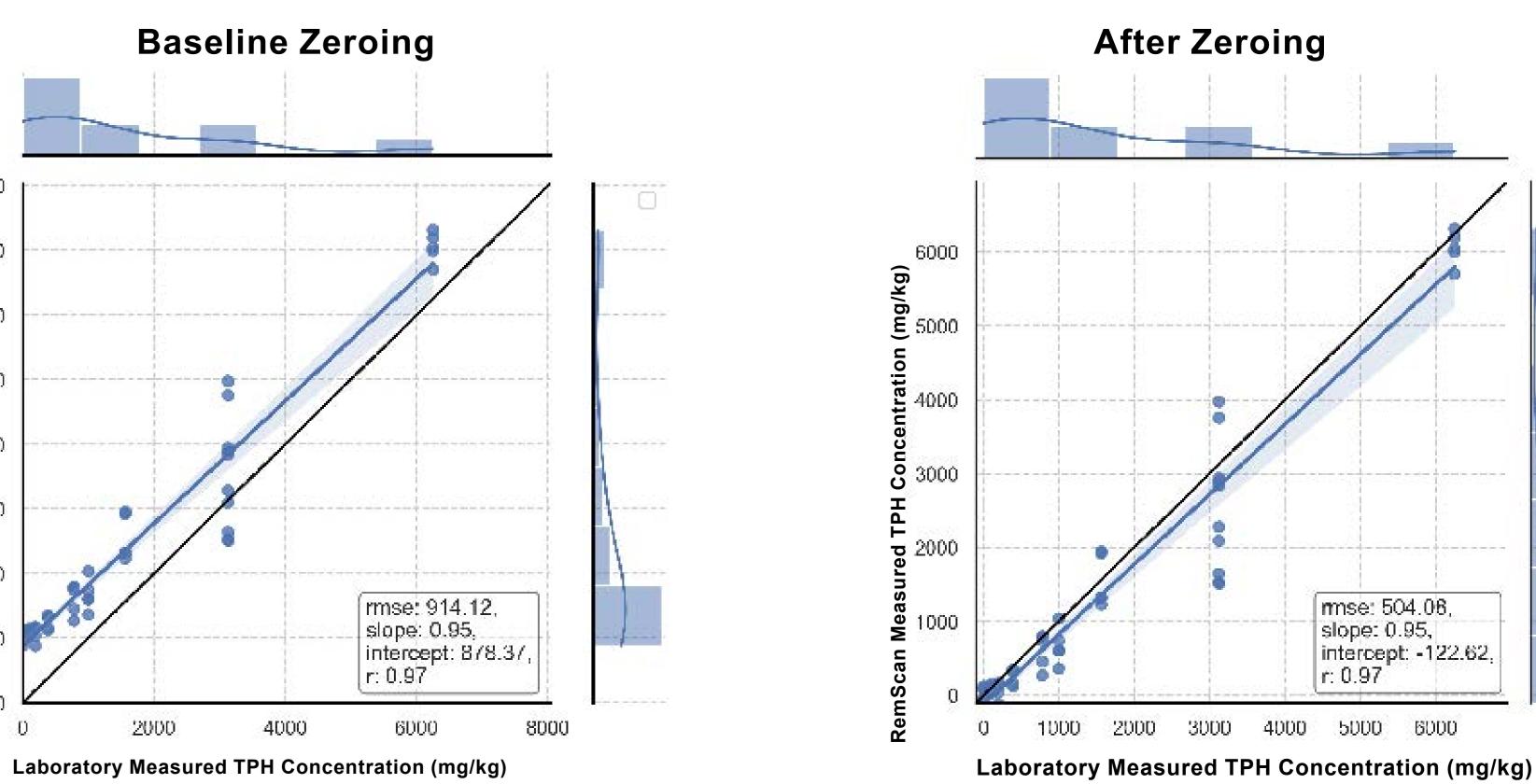


Figure 5: Baseline Zeroing effect on TPH Predictions

Spill Response Mode Field Trials

- Results from RemScan's Spill Response mode are in general agreement with laboratory GC analysis outcomes that are used to guide remediation.
- RemScan results were obtained in a matter of hours, compared against laboratory results that typically take days to obtain.
- Spill Response mode works for a variety of TPH contaminants and soil
- Ziltek continues to improve the accuracy of, and expand the variety of soil types present in Spill Response mode.

Spill Response mode extends on the capabilities of RemScan, a hand-held instrument that measures TPH contamination levels in soil. RemScan can evaluate the extent and magnitude of spills rapidly and with confidence to assist in spill response remediation activities.



Figure 6: RemScan scanning soils ex-situ



