STEPPING UP IN THE NEW NORM
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Reducing Site Liabilities – Rapid Measurement of Hydrocarbons in Soil

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ALS

THE DEMAND FOR RAPID ANALYSIS OF HYDROCARBONS IN SOIL

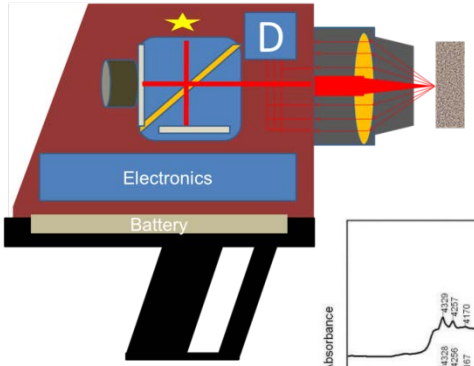
- Standard industry practice for measuring total petroleum hydrocarbons (TPH) in soil is to send samples for laboratory analysis. This is time-consuming and costly.

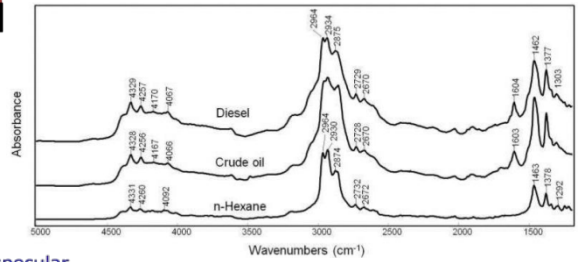
- There is a need for the rapid measurement of TPH in soil to:
    - Accelerate project closure through quicker onsite decisions
    - Collect more data for increased confidence
    - Allow smarter sample selection for laboratory analysis
    - Reduce site liabilities.

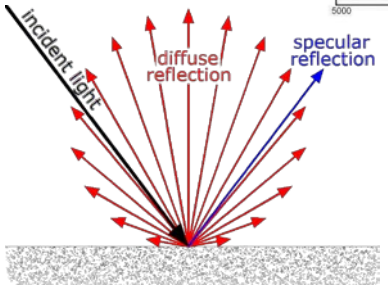
AN INFRARED-BASED TECHNOLOGY SOLUTION

- A handheld infrared device for the rapid measurement of TPH in soil has been developed (marketed globally by Ziltek as RemScan).

- A mid-infrared light beam reflects off the soil surface being measured and creates a unique soil signature. A readout of TPH C_{10} to C_{36} in mg/kg is displayed within 20 seconds.







OBJECTIVES

- The main objective of this study was to validate the accuracy and repeatability of a handheld infrared device to measure TPH in a wide range of soil types.

- The validation protocol used was adapted from the former US EPA Environmental Technology Verification (ETV) Program.

METHODS

- 50-100 TPH contaminated soils were collected from 10 global project sites including tropical areas. For each soil, a site-specific calibration model was built and loaded into the handheld infrared device.

- Blind validation samples were measured with the infrared device and the results were compared to laboratory assays for TPH C_{10} to C_{36} (US EPA Method 3570:8015C).

METHODS

Table 1: The range of soils used for the validation of a handheld infrared device

Current User Regions	Petroleum Contaminants	Applications	Soil Types
• North America • Europe • Middle East • South East Asia (tropical) • Africa (tropical) • Australia	• Crude oil (light, heavy) • Diesel • Transformer oil • Mineral oil • Jet fuel (non-volatiles) • Gasoline (non-volatiles)	• Spill delineation • Remediation validation • Site characterization • Bioremediation monitoring	• Sandy (coarse, fine) • Loam • Clay • Heavy clay • Swampy peat

RESULTS

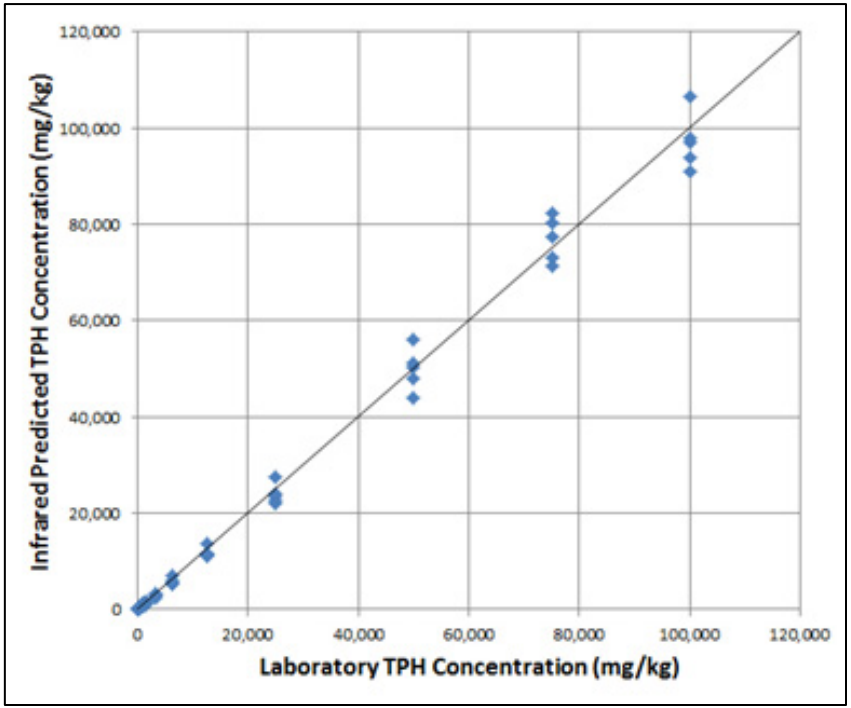


Figure 1: Infrared device measurements versus TPH laboratory data for a tropical soil from Africa

RESULTS

Table 2: A statistical comparison of infrared device measurements and laboratory assay data

Site	0-3,000 mg/kg TPH Range				0-100,000 mg/kg TPH Range		Blind Validation? (Yes/No)
	RMSECV[b] (mg/kg TPH)	Correlation Coefficient (R^2)	Detection Limit[c] (mg/kg TPH)	Repeatability (%)	RMSD[d] (mg/kg TPH)	No of Calibration Samples	
1[a]	124	0.97	66	1.8	822*	60	Yes
2[a]	88	0.96	64	3.3	n.m.	60	Yes
3	123	0.99	65	2.6	1,225	50	Yes
4	137	0.98	77	2.3	1,293	48	Yes
5	190	0.98	n.m.	<3	1,091	43	Yes
6	170	0.92	n.m.	<3	2,984	111	Yes
7	376	0.99	n.m.	<3	2,888	183	Yes
8	78	0.99	<78	<3	1,271	36	Yes
9	197	0.96	133	<3	1,345	71	Yes
10	242	0.94	196	<3	4,632	70	No

Footnotes:
[a] Data validated by Battelle using the methodology of the former USEPA Environmental Technology Verification (ETV) Program.
[b] RMSECV = Root Mean Square Error of Cross Validation
[c] Detection limit calculated at 1 standard deviation
[d] RMSD = Root Mean Square Deviation
* RMSD calculated between 5,000 – 10,000 mg/kg TPH
n.m. Not Measured

CONCLUSIONS

- The handheld infrared instrument tested here is a useful infield screening tool for assessing TPH contamination in a range of soils to complement laboratory assay methods.

- This paves the way for significant time and cost savings for companies that are assessing and remediating crude oil contaminated soils.

- The concept of taking the “lab to the field” for measuring crude oil contamination in soil, without compromising data quality, is now a possibility using this novel handheld infrared instrument.

Acknowledgements

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Questions?