

Introduction

Industry standard practice for measuring Total Petroleum Hydrocarbons (TPH) in soil involves sending soil samples to an off-site laboratory for analysis by GC-FID (US EPA Method 3510/8015). This process is time consuming (5-10 days) and costly (~100 USD/sample) and is not suitable for remote sites.

RemScan is a handheld infrared instrument that measures TPH in soil in 20 seconds, with a similar accuracy to laboratory analysis. This ISO14034 verified technology is ideal for remediation and excavation activities at remote sites where real-time decisions can lead to significant cost savings.

While RemScan is a proven technology (Webster et al., 2016; Forrester et al., 2013) and is operating at many sites worldwide (Stewart et al., 2017), a site-specific calibration needs to be built for optimal accuracy. This calibration requirement can restrict the application of the technology at remote sites.

This paper presents a new method that allows the site-specific calibration process to be completed on-site within 1-2 days with no requirement for GC analysis.



Figure 1: Scanning calibration samples using RemScan.

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Quick Calibration Method for Accurate TPH Analysis in Soil at Remote Sites without the need for Laboratory Analysis

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Methods

The general on-site calibration method for RemScan is shown schematically in Figure 2.

For this study, tropical sand from Malaysia was spiked with diesel, light crude and heavy crude oil. For each sample, a dilution series was created consisting of 14 calibration samples ranging from 0 to 100,000 mg/kg TPH. Samples were scanned with the RemScan instrument and the resulting spectra and theoretical TPH concentrations (mg/kg) were used to build calibration models using Ziltek's proprietary software. The calibration models were then loaded into a RemScan instrument for immediate on-site deployment. No GC-analysis was required.

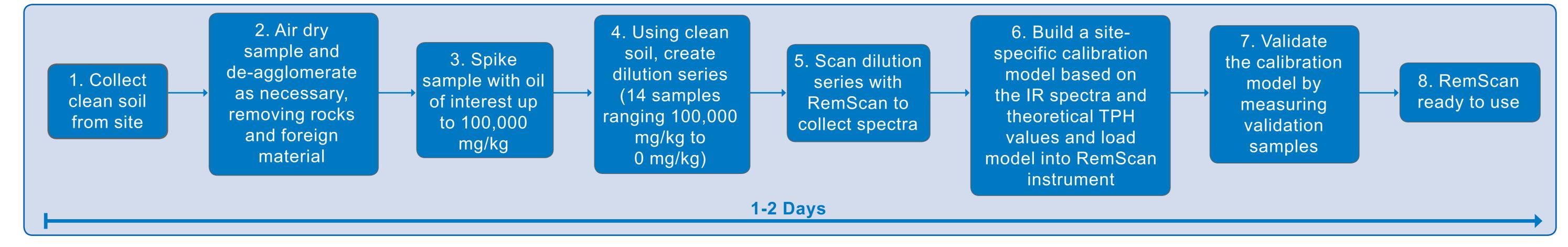


Figure 2: The on-site procedure used to calibrate RemScan without the need for laboratory analysis.

Results and Discussion

The statistics of the RemScan calibration models for tropical sand from Malaysia spiked with diesel, light crude and heavy crude oil are shown in Table 1 and Figure 3.

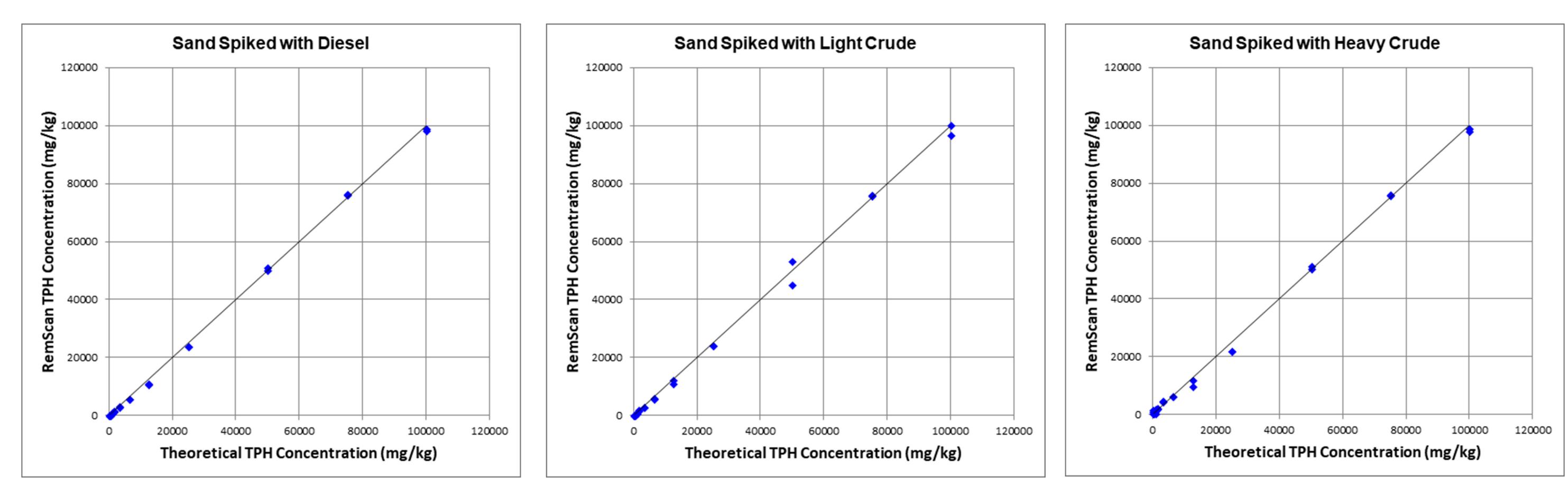


Figure 3: RemScan calibration models for tropical sand from Malaysia spiked with diesel, light crude oil and heavy crude. Each chart shows RemScan versus theoretical TPH concentrations from 0 to 100,000 mg/kg.

Table 1: RemScan calibration model statistics for tropical sand from Malaysia spiked with diesel, light crude and heavy crude oil. RMSECV = Root Mean Square Error of Cross Validation.

Calibration M

Conclusions



Figure 4: Map showing sites where RemScan has been successfully used in the field.

References G.T. Webster, J.M. Soriano-Disla, J. Kirk, L.J. Janik, S.T. Forrester, M.J. McLaughlin, R.J. Stewart, Rapid prediction of total petroleum hydrocarbons in soil using a handheld mid-infrared field instrument. Talanta. 160 (2016) 410-416. S.T. Forrester, L.J. Janik, M.J. McLaughlin, J.M. Soriano-Disla, R. Stewart, B. Dearman, Total petroleum hydrocarbon concentration prediction in soils using diffuse reflectance infrared spectroscopy, Soil Sci. Soc. Am. J. 77 (2013) 450–460. R. Stewart, A. Toop, G. Webster, T.T. Chin, G. Paulus, Reducing Site Liabilities – Rapid Measurement of Hydrocarbons in Soil, Paper No. 185255, SPE Asia Pacific Health, Safety, Security, Environment and Social Responsibility Conference, 4-6 April 2017, Kuala Lumpur, Malaysia.



	RMSECV (mg/kg TPH)		
lel Range (TPH Concentration)	Diesel	Light Crude	Heavy Crude
to 100,000 mg/kg	1,220	1,414	1,242
to 3,000 mg/kg	100	113	159

• This study demonstrates that the handheld RemScan unit for rapid measurement of TPH in soil can now be calibrated onsite in 1-2 days with no requirements for laboratory analysis.

• Using tropical sand from Malaysia, this study shows that accurate on-site calibration models can be built for RemScan regardless of the petroleum source (diesel, light and heavy crude oil).

• This new calibration method opens up market opportunities for quick closure of remediation projects at remote sites worldwide.

•RemScan has been used at many remote locations globally including in the Arctic, SE Asia, Europe and the Middle East as shown below in Figure 4.