CASE STUDY

Independent Validation of RemScan by Battelle (USA)

Background

Battelle was engaged by Ziltek to test the performance of the hand-held RemScan technology for the rapid measurement of total petroleum hydrocarbons (TPH) in soil. The study was conducted in line with the former Environmental Technology Verification (ETV) program that was designed "to provide objective and quality-assured performance data on environmental technologies, so that users, developers, regulators, and consultants can make informed decisions about purchasing and applying these technologies". Ziltek made a number of claims relating to accuracy (<12% RSD), repeatability (<7% RSD) and detection limit (<250 mg/kg) which were also assessed as part of this study.

Methods

Soil samples (100) were collected at each of two US Department of Defense sites; Site 1 was located at the Marine Corp Air Ground Combat Center, 29 Palms, CA and the location of Site 2 remains confidential.

For each site, 60 samples were used to build a site-specific calibration model in the RemScan instrument which was then used to scan the other 40 'blind' samples and predict their TPH concentrations; scanning was undertaken by Ziltek and then repeated by Battelle.

The RemScan predictions were compared to laboratory assay data (US EPA Method 8100 TPH) for each of the samples to determine the accuracy of the technology. Repeatability measurements were also carried out on selected samples. After two hours of formal training, Battelle staff were asked to comment on a number of usability claims and to fill out a usability questionnaire.
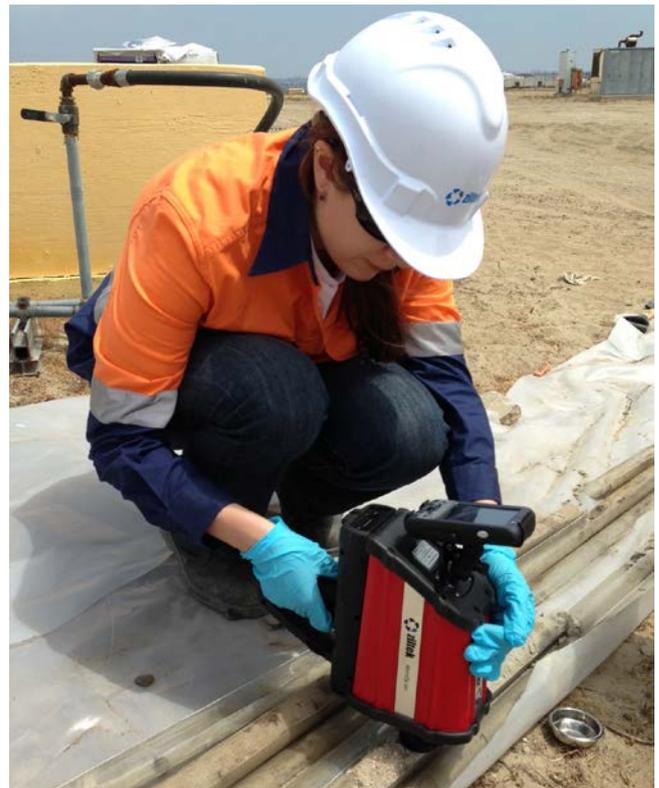

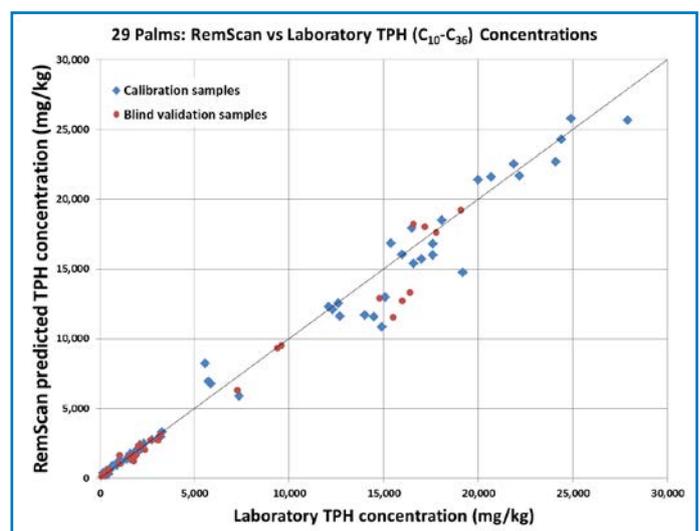Figure 1: Using RemScan as a screening tool at the North Island test site

Figure 2: RemScan predictions versus laboratory assay values for calibration samples (blue) and blind validation samples (red) for the 29 Palms test site

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Results and Discussion

For Site 1, the accuracy of RemScan was 9.4% RSD compared to accredited laboratory data, and the repeatability was 1.8% RSD. For Site 2, the accuracy could not be calculated due to lack of data points between 5,000 and 10,000 mg/kg and the repeatability was 3.3% (when adjusted for volatilisation effects). The detection limit of the method for both sites was around 65 mg/kg (at 1 st. dev.) which compares very favourably with commercial laboratories.

Using a regulatory criteria of 1,000 mg/kg, there were no false negatives or positives for either test site, which means that the RemScan technology could have been used confidently at these sites with no requirements for laboratory analysis.

The main limitation of the RemScan technology is the requirement for soil moisture to be less than 8% for accurate readings. The latest release of RemScan notifies the user when moisture in the sample is too high to obtain accurate results. High carbonate caused an under-prediction of TPH for three samples from Site 1, however in a normal commercial setting this would be overcome by including a wider range of carbonate samples in the calibration model.

Conclusions

All Vendor Claims relating to accuracy (<12% RSD), repeatability (<7% RSD), and detection limit (<250 mg/kg) were independently verified by Battelle during the blind study. Two Battelle staff rated RemScan extremely easy to use with minimal training (10/10).

North Island: RemScan vs Laboratory TPH (C_{10}-C_{36}) Concentrations
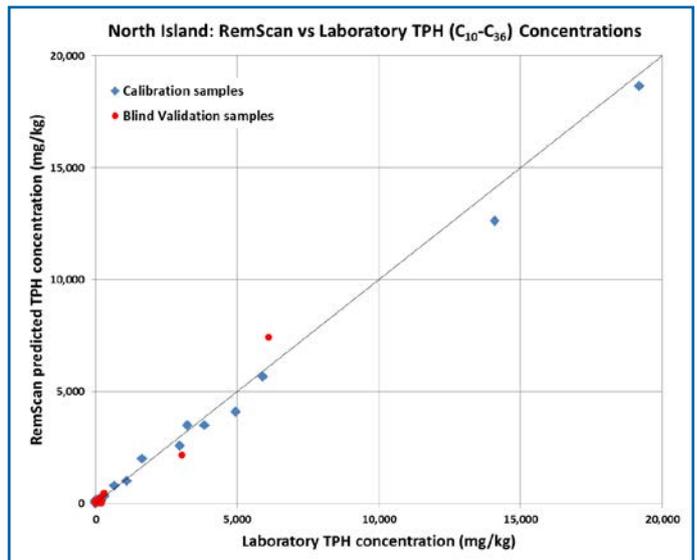
Figure 3: RemScan predictions versus laboratory values for calibration samples (blue) and blind validation samples (red) for the North Island test site

Table 1: Summary of RemScan Performance

	Site 1	Site 2	Vendor Claims Met
Accuracy	9.4%	N/A*	√
Repeatability	1.8%	3.3%#	√
Detection limit	66 mg/kg	64 mg/kg	√
False positives/ negatives (1,000 mg/kg)	Nil	Nil	N/A
Battery life	Full day of continuous use with one battery swap		
Throughput rate	10-20 samples per hour		
Operational cost	No incremental cost		
Breakeven cost threshold	7 days (1,400 samples)		
Formal training required	<2 hours		
Infield calibration time	3 minutes every hour		

*Insufficient data to calculate
#Adjusted to compensate for volatisation effects