

RAPID DETECTION OF OIL IN SOIL



EXPLORATION BIOREMEDIATION SITE ASSESSMENT QUICK RELIABLE
LEAK DETECTION EMERGENCY SPILL RESPONSE MONITORING PORTABLE
REGULATORY COMPLIANCE COST-EFFECTIVE ACCURATE INDEPENDENTLY
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DEPENDENTLY VALIDATED EXPLORATION BIOREMEDIATION SITE ASSESSMENT



Go to www.ziltek.com
to see online demonstration!

RemScan is the world's first handheld instrument for the rapid measurement of Total Petroleum Hydrocarbons (TPH) in soil.

The user simply pulls the trigger for a measurement – no soil extraction or consumables are required. The instrument has a full day of battery life and the data is recorded automatically for easy download.

RemScan is available for purchase or hire. Ziltek can provide an experienced operator to analyse samples in the field and can also value-add with site mapping information and regulatory reports where required.

“I used RemScan because I wanted to reduce the uncertainty of estimating contamination by visual staining and smell alone site remediation can cost thousands of dollars”

Sam Tymons, Project Manager, Enviropacific Services

Benefits

- Make real-time decisions
- Reduce laboratory analysis costs
- Minimise losses in productivity
- Accelerate project closure

Features

- 15-second measurement time
- No sample extraction required
- Calibrated against accredited standards
- Developed in collaboration with the CSIRO
- First environmental technology in the world verified in accordance with ISO 14034:2016

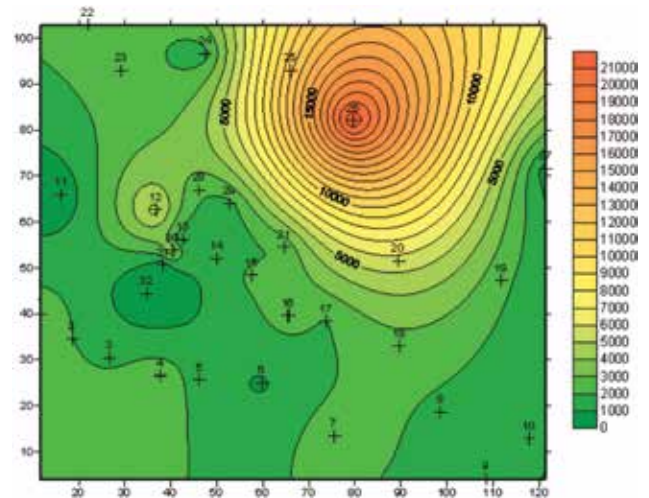


Applications

The main applications for RemScan are:

Site Assessment/Delineation

RemScan is used to measure the concentration of oil on the surface of the soil and this enables the user to quickly delineate the contaminated area. Depth profiles can be measured by taking a drill core, laying the core out and using RemScan to directly measure the hydrocarbon concentration at various points (depths) along core.



Some examples:

1. Site Clean-up. RemScan is used to determine the edge of the contaminated zone which can be marked out prior to excavation of the contaminated soil.
2. Emergency Spill response. RemScan is used firstly to delineate the spill and then, during excavation, to chase the spill and then validate that all of the contaminated soil has been removed.
3. Wash bay fines. RemScan can measure the fines which wash off vehicles in a wash bay. Hydrocarbon contaminated fines can be sent for remediation while clean fines can be dumped.

Chasing/Validation

While excavation work is being performed, RemScan can measure the remaining soil to check whether all of the contaminated soil has been removed and whether the remaining soil is clean. Once all contaminated soil has been removed, samples can be sent to the laboratory for final auditing and statutory signoff.

Sorting

RemScan is used to sort clean soil from contaminated, thereby minimising the amount of soil to remediate.

When soil is being sent to different remediation processes depending on the level of contamination, RemScan can be used to sort the soil to ensure the most efficient processing. For example, highly contaminated soil may be sent to a Thermal Desorption Unit (TDU) while lower concentrations may be sent to bioremediation. Each process works most efficiently when fed with a relatively consistent concentration and RemScan can be used to achieve this objective.

Monitoring

RemScan is used to monitor the soil after remediation to ensure that it complies with site requirements. For bioremediation processes, RemScan can monitor the decrease in the concentration of the contamination over time to determine the end point. Once the soil is "clean", it can be removed from the bioremediation pad, thereby increasing the utilisation and throughput of the bioremediation facility.

For thermal desorption or soil washing processes, RemScan can measure the product to ensure that the process has been working efficiently and correctly.

RemScan: a handheld instrument for the rapid measurement of Total Petroleum Hydrocarbons (TPH) in soil

Key Specifications

- RemScan is a unique instrument that measures TPH in Soil. No other instrument provides the same level of accuracy, repeatability and ease of use for this application. RemScan is a leading technology which is patented worldwide.
- The instrument measures TPH (C_{10} - C_{36} or other ranges if required) in soils and gives a single output in mg/kg.
- Easy to calibrate in the field – 1 minute background cap, 1 minute reference cap (both are inert materials so no need to carry calibration gases or hazardous chemicals).
- Soil readings in less than 20 seconds.
- Throughput - high rate of up to 120 samples/hour can be achieved but typically about 60 samples/hour.
- It makes a direct soil measurement – no solvent extraction of the soil is required.
- Minimal soil preparation required – requires a flat compacted soil face of around 10mm diameter (trowel and tamp normally sufficient) with an air dried surface.
- Measures the soil surface only – anywhere you can collect a soil sample, you can take a scan (including along soil cores).
- Truly portable and rugged – it is not a laboratory instrument.
- Intrinsic Safety - Not Intrinsically Safe (non-explosion proof).
- Operated through a purpose-designed user interface on a wireless PDA that can be clamped to the back of the instrument.
- Battery life – 8 hours for PDA and 4 hours per battery for instrument (comes with 2 batteries).
- Data accessible as a .csv file on a standard SD card.
- Typical accuracy:

TPH (C_{10} - C_{36}) Concentration (mg/kg)	RSD* (%)
10,000	6
2,500	7
1,000	16

*RSD is the relative error at one standard deviation

- Detection limit typically 68 mg/kg TPH (at one standard deviation).
- Operating temperature: 0 to 50°C (32 to 120°F)
- Storage temperature: -25 to 75°C (-13 to 167°F)
- Humidity: 95% non-condensing
- Power Supply: 100-240V AC 47-63Hz

Soil Calibration Models

To ensure that RemScan provides the best possible accuracy for each application, it is currently supplied with a calibration built specifically for your site (i.e. 'site specific calibration'). To make this calibration requires measurement of a suite of the customer's soil samples that covers the appropriate range of soil variation as well as the range of TPH concentrations. Ziltek liaises with the customer to determine the simplest method of obtaining the soil samples and making the calibration – contact Ziltek for more details.

Ziltek is currently developing a universal soil calibration which will enable the RemScan to automatically measure a wide range of soils without the need for specific calibrations for the site. It is expected that this will be released by first quarter 2018. We will be able to easily retrofit this method to RemScan units that are currently in operation globally.

Moisture Considerations

RemScan is sensitive to high soil moisture. Accuracy of the instrument declines above 5% free moisture content so soils should be air-dried for best results. The RemScan software will inform the user of the soil moisture content upon scanning.

In warmer conditions, the required drying can be achieved by simply letting the soil surface air dry for 15 to 30 minutes before scanning. In colder conditions, the soil can be dried sufficiently by placing a thin layer in a shallow sampling cup and leaving for a few hours or overnight, still saving significant laboratory analysis turnaround time and costs.

For high moisture applications, Ziltek can provide a Portable Drying Unit as an optional extra.



RemScan used in Rapid Response to Diesel Spill

A significant amount of diesel leaked from a storage facility in Western Australia and was captured in an emergency bund area.

RemScan was used to rapidly quantify the amount of diesel in the bund area, and later to validate the site remediation works.

During the emergency response, Ziltek collected soil samples and built a site-specific calibration model in the instrument to allow a rapid and accurate determination of Total Petroleum Hydrocarbons (TPH) C_{10} to C_{36} .

During subsequent remediation works, RemScan was used to measure more than 200 samples per day - this allowed the validation work to be completed in less than 4 days, without the constraints of standard laboratory analysis turnaround times.

During wet weather, samples were taken to the site hut for continuous high throughput processing.

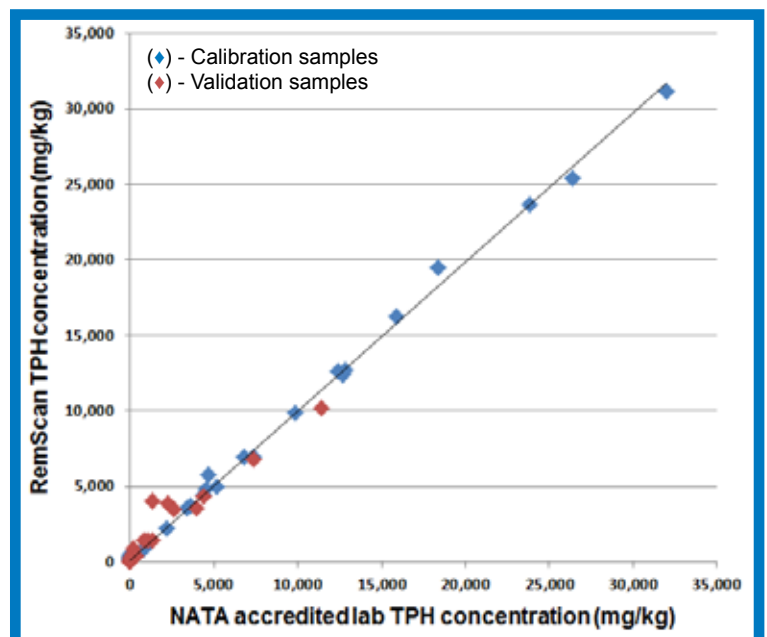
To independently verify the instrument's performance, 19 'blind' soil samples were sent to a NATA-accredited laboratory for analysis. A very close correlation was observed between the TPH values predicted by RemScan and the laboratory data with an R^2 value of 0.997.

Without RemScan, the validation works would have been extended by several weeks.

The cost savings due to accelerated project closure and reduced laboratory analysis were estimated at more than \$30,000.



Comparison of RemScan data to lab data for TPH (C_{10} - C_{36})



Independent Validation of RemScan by Battelle (USA)

Background

Battelle was engaged by Ziltek to test the performance of the handheld 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.

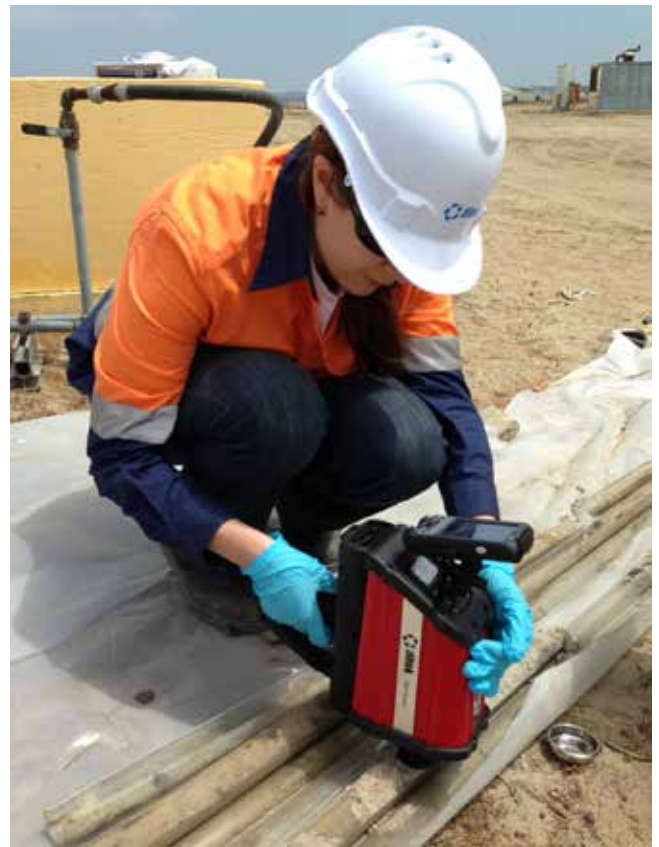


Figure 1: Using RemScan as a screening tool at the North Island test site

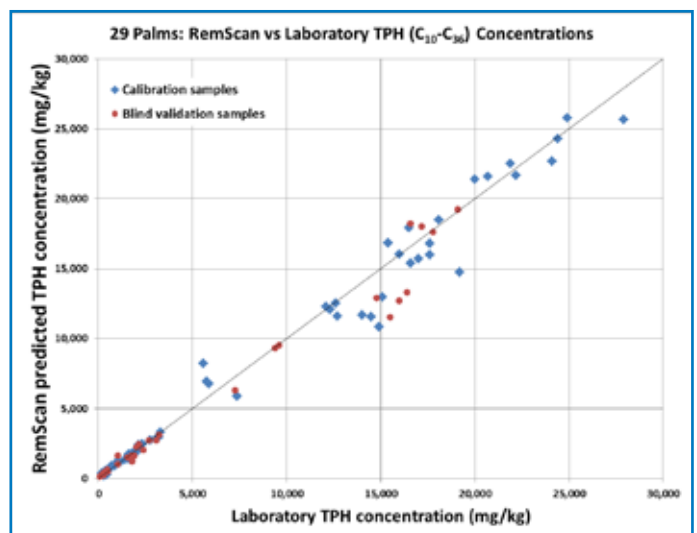


Figure 2: RemScan predictions versus laboratory assay values for calibration samples (blue) and blind validation samples (red) for the 29 Palms test site

Battelle

The Business of Innovation

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 volatilization effects). The detection limit of the method for both sites was around 65 mg/kg (at one standard deviation) 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).

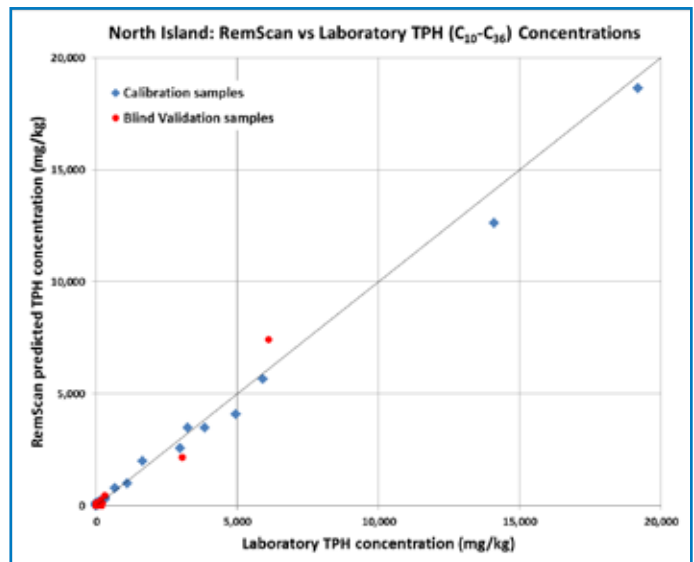


Figure 3: RemScan predictions versus laboratory values for calibration samples (blue) and blind validation samples (red) for the North Island test site

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 volatilisation effects

Rapid Validation of an Excavation Pit using RemScan

In 2012, an ageing ground mounted power transformer located in South Australia was scheduled to be removed from service and replaced. After the above-ground infrastructure was removed, transformer oil contamination was evident in the soil surrounding the footings.

Enviropacific Services was engaged to manage the excavation of the contaminated soil and to validate the pit as 'decontaminated' before it was backfilled with clean soil.

The handheld RemScan instrument was used to measure Total Petroleum Hydrocarbon (TPH) levels in the soil during the site remediation and excavation process in real-time.

The levels of TPH in the worst affected areas were up to 100,000 mg/kg. The Enviropacific Services Project Manager directed the extent of excavation until the contamination levels in the walls and floor of the pit were below the target criteria of 1,000 mg/kg TPH as measured by RemScan.

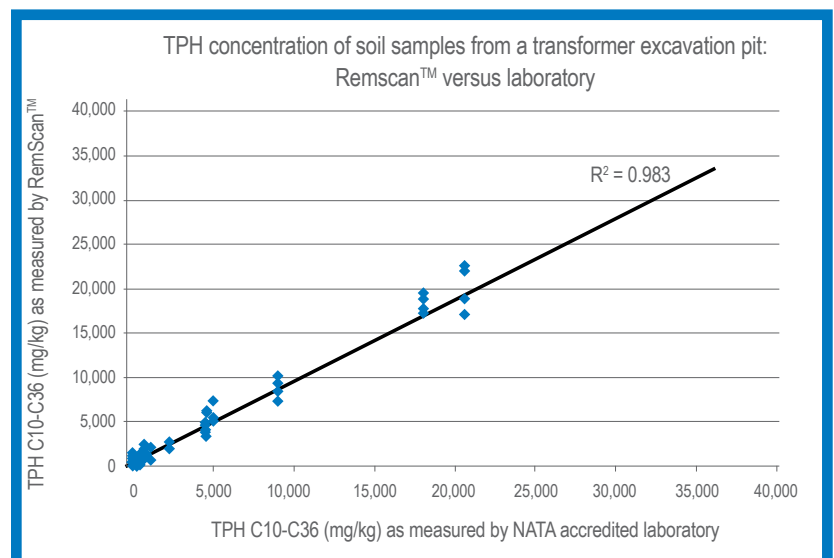
The pit was then backfilled, and soil samples that had been collected from each of the pit walls and floor were sent to a NATA-accredited laboratory for independent validation.

A week later, the laboratory results confirmed the accuracy of the RemScan instrument measurements – all samples returned TPH values well below the target criteria.

Utilisation of the RemScan technology ensured that over-excavation and extra disposal fees were avoided, and provided the project team with the confidence that they could backfill the pit on the same day without having to return to site again.

“I used RemScan because I wanted to reduce the uncertainty of trying to estimate contamination by visual staining and smell alone. Using RemScan will allow us to confidently backfill these types of excavations on the day without the risk of having to revisit the site to chase residual contamination when lab results come in - site remobilisation can cost thousands of dollars even for small sites”.

Sam Tymons, Enviropacific Services Project Manager





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