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Method Article

RemScan: A tool for monitoring the bioremediation of Total Petroleum Hydrocarbons in contaminated soil



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A B S T R A C T

Total Petroleum Hydrocarbons (TPH) represent major environmental contaminants which pose a significant risk to ecosystems and humans health if left untreated. Bioremediation represents a simple, cheap and environmentally-safe approach to clean up TPH-contaminated sites. Traditional TPH analysis is expensive and time-consuming. Here we assess, for the first time, the potential of RemScan as a fast, accurate and cost-effective portable device to be used as a tool to monitor the bioremediation process. A variety of TPH-contaminated soils were subject to TPH quantitative analysis using RemScan. The TPH values obtained were validated and compared against the results obtained from an accredited external laboratory, which uses Gas Chromatography / Mass Spectrometry (GC/MS) for TPH analysis.

- RemScan showed a correlation coefficient (R^2) of 0.998 in comparison with the traditional methods, but importantly with a significant reduction in both time and cost.
- RemScan was successfully used to measure TPH concentrations in bioremediated, weathered-contaminated and highly contaminated soil samples with TPH concentrations varying from 100 to 100,000 mg kg⁻¹.
- The RemScan Laboratory Station was used to minimize the source of errors associated with human manual handling.

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A R T I C L E I N F O

Method name: RemScan for monitoring bioremediation

Keywords: Soil contamination, Accurate TPH assessment, Cost-effective technique

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Specifications Table

Subject area	<i>Environmental Science</i>
More specific subject area	<i>Bioremediation of hydrocarbon-contaminated soil</i>
Method name	<i>RemScan for monitoring bioremediation</i>
Name and reference of the original method	<i>WEBSTER, G. T., SORIANO-DISLA, J. M., KIRK, J., JANIK, L. J., FORRESTER, S. T., MCLAUGHLIN, M. J. & STEWART, R. J. 2016. Rapid prediction of total petroleum hydrocarbons in soil using a hand-held mid-infrared field instrument. Talanta, 160, 410-416.</i>

Method background

This study aimed to validate the RemScan to be used as an accurate, cost-effective and prompt tool for monitoring the bioremediation of TPH-contaminated soil. To the best of the authors' knowledge, the performance of RemScan in determining TPH concentration during a bioremediation process compared with traditional laboratory analysis has never been reported. The significance of this study is therefore that it represents the first to validate the use of the RemScan to evaluate the efficacy of the bioremediation of a TPH contaminated soil. In this study, a variety of bioremediation treatments were set up and soil samples were collected at different times over 150 days for quantitative analysis of TPH concentrations by an accredited laboratory using conventional GC/MS. In addition, we used the RemScan device to determine the concentration of TPH over a broad concentration range (100 - 100,000 mg kg⁻¹).

Method details

1 Sample preparation

2 Test soil samples were prepared as shown below:

3 Soil samples (n = 84) were collected from different bioremediation treatments.

4 Contaminated soil samples (n = 16) were collected from hydrocarbon-contaminated sites in Australia.

5 Soil samples (n = 5) were spiked in the lab with a relatively high concentration of diesel ($\approx 100,000$ mg kg⁻¹)

6 Soil samples were collected from all treatments using a Simple Random Sampling technique [7], so the sample represents the entire treatment.

7 About 60 g of each soil sample was air-dried for 24 h at room temperature.

8 Large clumps of the dried soil were ground using a pestle and mortar, sieved using a 2 mm sieve and then mixed thoroughly until fully homogenized.

9 *RemScan set up*

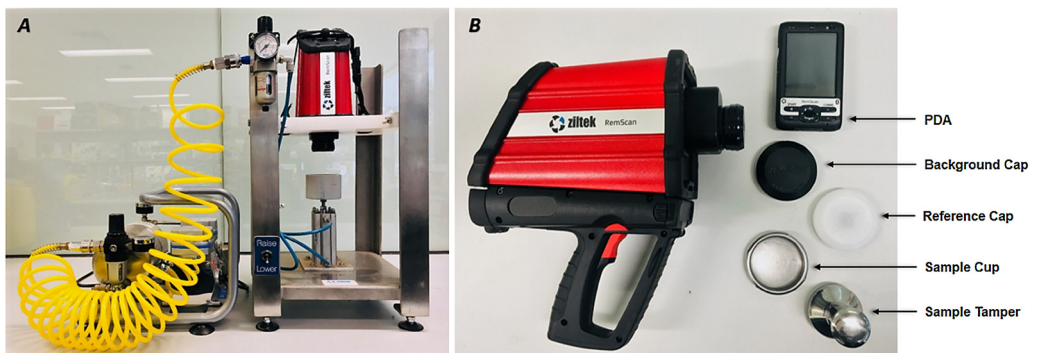


Fig. 1. (A) RemScan device installed on the Lab Station. (B) RemScan device and the related components.

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