Application Note: ANCCSTGPHCSOIL

Petroleum Hydrocarbons (PHC) in Soil: Canadian Council of Ministers of the Environment (CCME)

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Key Words

- TraceGOLD TG-1MS
- Hydrocarbons
- PHC
- Soil
- CCME

Abstract

Petroleum hydrocarbons are used in nearly every facet of life. Used as intended, PHC provide many benefits to society. However, if PHCs get into the soil environment a number of problems can result. The Canada-Wide Standards for PHC in Soil is a tiered standard for contaminated soil and subsoil. This application note shows examples of hydrocarbon standards and contaminated soil samples analyzed using a Thermo Scientific TraceGOLD TG-1MS capillary column. The TraceGOLD™ TG-1MS capillary column provides excellent resolution in identifying petroleum fingerprints and individual hydrocarbons.

Introduction

The Canada-Wide Standards for Petroleum Hydrocarbons in Soil is a tiered standard used in four land use categories: agricultural, residential/parkland, commercial, and industrial. The first tier provides numerical levels for these different land uses. Tier two are site-specific adjustments to tier one levels and the third tier is site specific risk assessment and management. Tier one level is the most commonly used part of this method.

The petroleum hydrocarbons are reported in four different fractions and have different levels for each fraction specific to each land use. Fraction refers to the equivalent of normal straight-chain hydrocarbon boiling point ranges. Fraction #1 covers hydrocarbons from n-C6 to n-C10. Fraction #2 covers hydrocarbons greater than n-C10 up to n-C16. Fraction #3 covers hydrocarbons greater than n-C16 up to n-C34, and fraction #4 covers hydrocarbons greater than n-C34.

Because of their volatility, petroleum hydrocarbons lend themselves to analysis by gas chromatography. A GC column needs to be able to resolve specific straight-change hydrocarbons. Also, fingerprint identification of PHC contamination in soil help in identifying the source of the contamination. A high resolution capillary column that is stable at high temperatures, such as the TraceGOLD TG-1MS capillary column, is ideal for doing this analysis.

Experimental details

Sample Preparation

Samples were provided in 2 mL glass vials. All samples were extracted with toluene and standards were also dissolved in toluene.

Separation Conditions

Instrumentation:	Thermo Scientific Trace GC Ultra
Column(s):	TraceGOLD TG-1MS, 15 m x 0.32 mm x 0.10 µm (PN 26099-0360)
Septum:	BTO, 17 mm (PN 31303211)
Liner:	Split Straight liner, 5 x 8 mm (PN 45350030)
Column ferrules:	100% Graphite ferrules for Trace injector/detector (PN 29053487)
Injection syringe:	10 µl Fixed needle syringe for a TriPlus Autosampler (PN 36500525)
Carrier gas:	Helium
Split flow:	150 mL/min
Column flow:	1.5 mL/min
Split ratio:	100:1
Oven temperature:	40 °C (1 min) to 350 °C (5.2 min) at 35 °C/min
Injector type:	Split/Splitless
Injector mode:	Split
Injector temperature:	325 °C

FID Parameters

Temperature:	350 °C
Air flow:	300 mL/min
Hydrogen flow:	30 mL/min
Nitrogen makeup flow:	25 mL/min

Data Processing

Software:	ChromQuest

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Results

The TraceGOLD TG-1MS capillary column provides great resolution and high temperature stability for performing the Tier 1 Method of the CCME Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil. The first requirement of the method is to be able to resolve and identify straight-chain hydrocarbons, specifically n-C6, n-C10, n-C16, and n-C34.

A hydrocarbon standard, containing hydrocarbons from n-C8 to n-C40 was analyzed on a TG-1MS, 15m x 0.32 mm x 0.10 µm capillary column. This analysis (see Figure 1) shows all peaks being highly resolved making it possible to report the various fractions required in the method.

Another benefit of using a high resolution capillary column that is stable to high temperatures is the fingerprinting of a hydrocarbon standard. Fingerprinting helps in identifying the source of contamination. Figure 2 shows a fingerprint of an oil extract and figure 3 shows that of diesel fuel.

A soil extract is shown in figure 4. By comparing the fingerprint of this extract with the oil and diesel fuel fingerprints, the source of contamination can be determined. Identification of the key marker straight-chain hydrocarbons in the soil extract is used to report the four different fractions for tier one.

Conclusions

The use of the TraceGOLD TG-1MS in this method demonstrates the superior resolution for fingerprinting of hydrocarbon in soil. The TraceGOLD TG-1MS provides baseline resolution for all required key marker straight-chain hydrocarbons as well as high temperature stability for analysis of long chain hydrocarbons. The method detailed in this application notes demonstrates an analysis time of less than 15 minutes for classifying petroleum hydrocarbons in soil.

References

Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil, CCME Reference Method for the Canada-Wide Standard for Petroleum Hydrocarbons in Soil – Tier 1 Method

Principles of toxicology: environmental and industrial applications By Phillip L. Williams, Robert C. James, Stephen M. Roberts, p483-486.

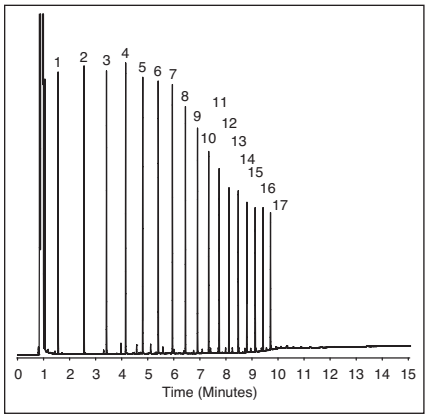

Figure 1: n-Alkane standards, even numbered carbons, from C8 to C40.

Peak identification for Figure 1:

1. n-Octane (C8)
2. n-Decane (C10)
3. n-Dodecane)C12)
4. n-Tetradecane (C14)
5. n-Hexadecane (C16)
6. n-Octadecane (C18)
7. n-Eicosane (C20)
8. n-Docosane (C22)
9. n-Tetracosane (C24)
10. n-Hexacosane (C26)
11. n-Octacosane (C28)
12. n-Triacontane (C30)
13. n-Dotriacontane (C32)
14. n-Tetratriacontane (C34)
15. n-Hexatriacontane (C36)
16. n-Octatriacontane (C38)
17. n-Tetracontane (C40)

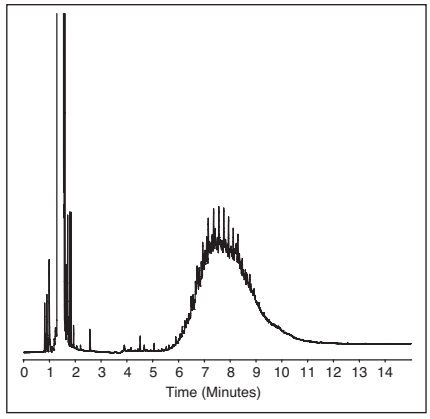

Figure 2: Fingerprint of oil standard.

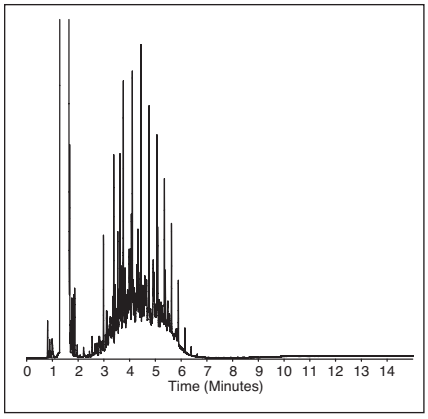

Figure 3: Fingerprint of diesel fuel standard

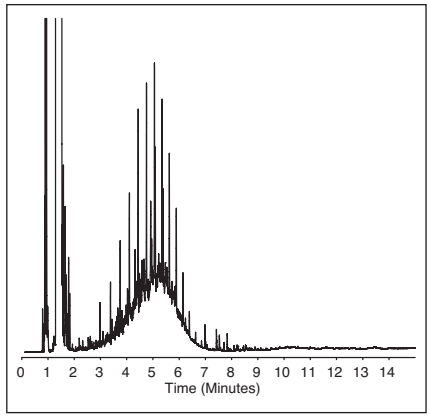

Figure 4: Analysis of soil extract.

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