「Application Note」

Analysis of TPH (Total Petroleum Hydrocarbon) in Soil by YL6500GC

- GC Application

Abstract

Total Petroleum Hydrocarbons (TPH) are produced in the refining process of crude oil and their main components are hydrocarbons but the composition get different depending on the type of oils. They are used to determine which oils such as kerosene, diesel or lubricating oil caused the contamination.

To reduce soil contamination, TPH analysis has been added to the risk assessment substances to evaluate the level of hazardous materials and it's getting important for both humans and the environment. Although there are some kind of specific additives used to identify which oils have caused the contamination, it's hard to identify the oil types from soils due to decomposition by multiple factors in the soil.

However, the TPH, which mainly composes petroleum products, remains in the soil such a long time, it is easy to analyze the TPH pattern of petroleum products to determine which types of oil contaminated the soil.

In this study, the analysis of TPH pattern in petroleum products and TPH analysis in soil samples with YL6500 GC were conducted according to the Soil Contamination Process Test Standard ES 07552.1b method specified by the National Institute of Environmental Research.

Method

Petroleum products were diluted by methylene chloride (CH_2Cl_2) to analyze TPH pattern. In order to measure TPH in the soil, 10 g-25 g of dried soil samples were weighed into a beaker and mixed with 100mL of methylene chloride. It's extracted after ultra-sonication and then the filtered solution was concentrated. The experimental conditions are as follows (Table 1).

A calibration curve was prepared from C7-C40 Saturated Alkanes Standard diluted at 10 to 100 ppm concentrations by methylene chloride. (Tzable 2, Fig 1,2)

Table 1. Experimental Condition

YL6500GC/FID	
Column	DB-1 (30 m x 0.2mm x 0.33 µm)
Oven	50℃ for 2 min, then 10℃/min to 320℃ for 20 min
Injector	300℃, Splilt 1:10, 2ul Injection
Carrier gas	Nitrogen at 1 mL/min

Table 2. 34 Saturated Alkane Standards

C7-C40 Saturated Alkanes Standard					
Heptane	7	Octadecane	18	Nonacosane	29
Octane	8	Nonadecane	19	Triacontane	30
Nonane	9	Eicosane	20	Hentriacontane	31
Decane	10	Heneicosane	21	Dotriacontane	32
Undecane	11	Docosane	22	Tritriacontane	33
Dodecane	12	Tricosane	23	Tetratriacontane	34
Tridecane	13	Tetracosane	24	Pentatriacontane	35
Tetradecane	14	Pentacosane	25	Hexatriacontane	36
Pentadecane	15	Hexacosane	26	Heptatriacontane	37
Hexadecane	16	Heptacosane	27	Octatriacontane	38
Heptadecane	17	Octacosane	28	Nonatriacontane	39
				Tetracontane	40

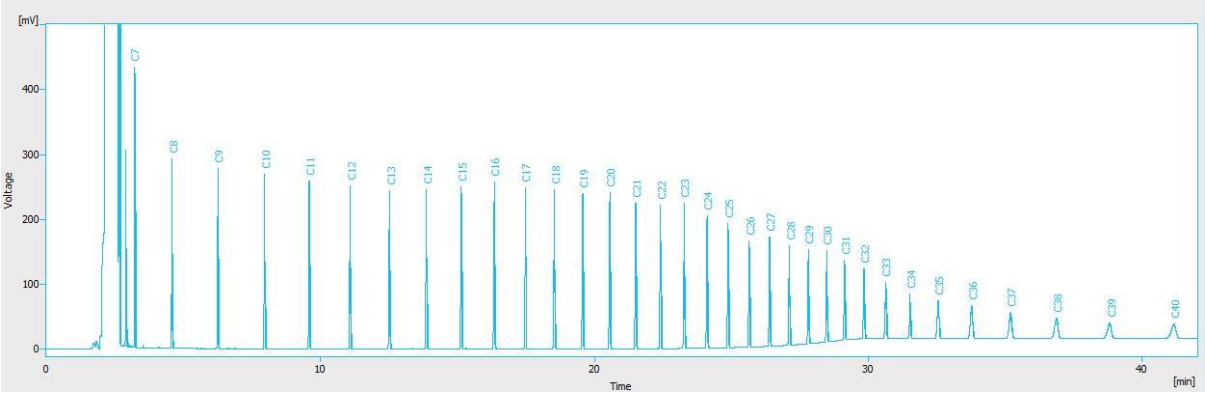


Fig 1. 34 Saturated Alkanes Chromatogram

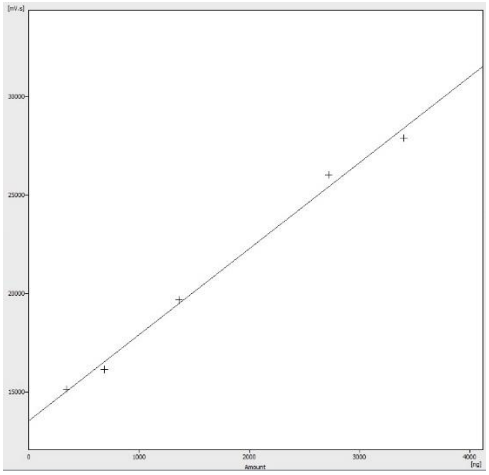
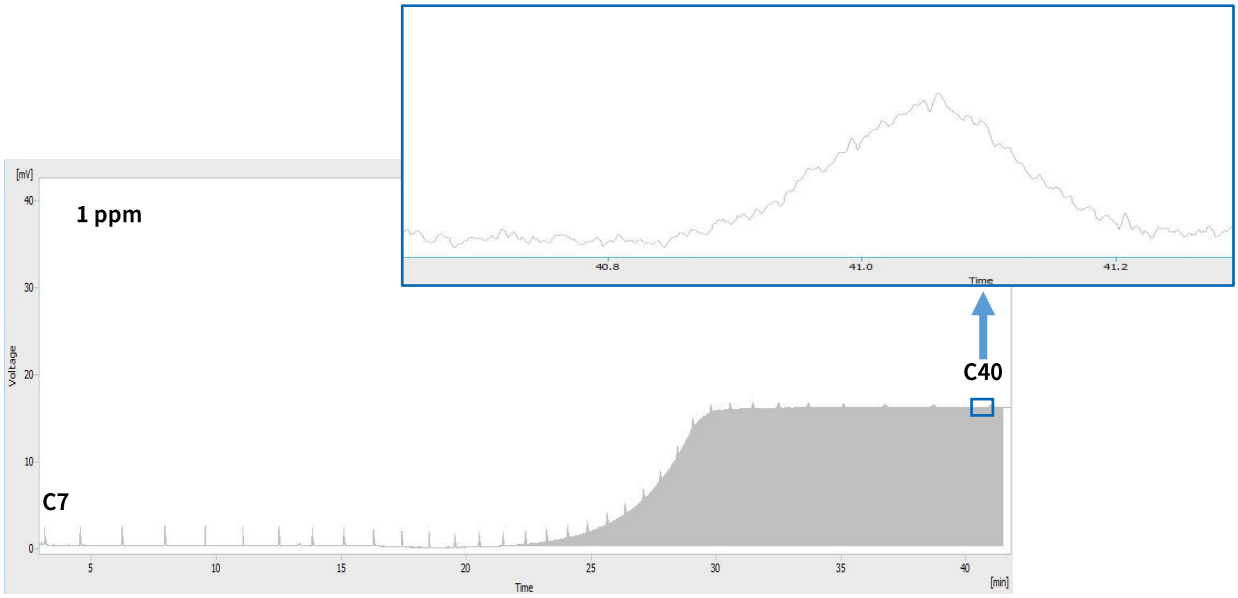


Fig 2. Verification of Calibration Curve

STD	Standard Concentration (mg/kg)	TPH Amount (ng)	Area (mV.s)
1	10	340	15139.663
2	20	680	16142.337
3	40	1360	19678.477
4	80	2720	26038.963
5	100	3400	27905.606
Linearity		R^2 = 0.997	

Table 3. Validity of Test Method

	Linearity (R^2)	MDL(mg/kg)	LOQ (mg/kg)	RSD (%)	Accuracy (%)
Soil Contamination Process Test Standard (**ES 07552.1b**)	>= 0.98	=< 50 ppm	=< 50 ppm	< 30%	70% ~ 130%
Results	0.997	8.63	27.48	3.13	100.39
	Pass	**Pass**	**Pass**	**Pass**	**Pass**



Result

To determine the validity of test results, linearity, accuracy, precision (RSD %), method detection limit (MDL) and limit of quantitation (LOQ) were generated and the results have satisfied the required limit indicated in the Soil Contamination Measurement Analysis Method standard. (Table 3)

Also, the analysis of TPH pattern enables to verify the composition ratio of hydrocarbons in petroleum products (Fig 4). Gasoline and diesel were spiked into the soil sample and sample preparation were carried out in accordance with standard method (ES 07552.1b) to identify TPH pattern (Fig 5). As a result, 2.27 mg/kg of TPH was measured (Table 4).

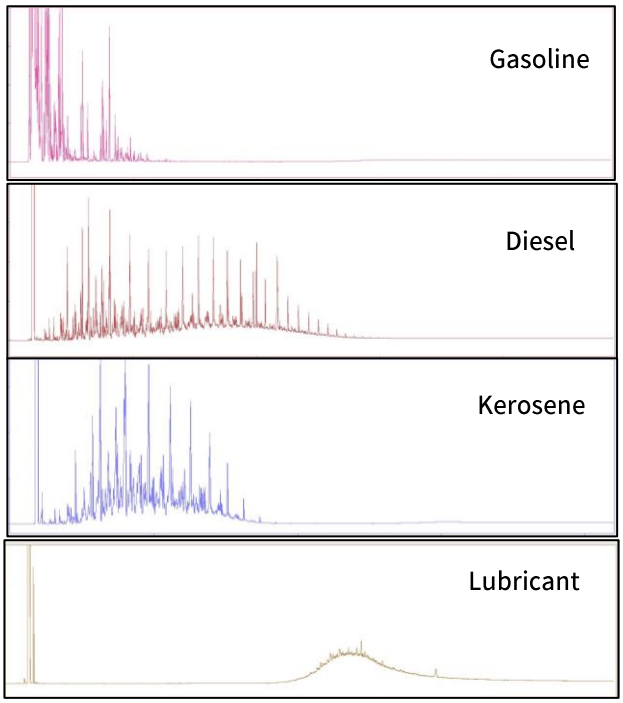


Fig 4. Total Petroleum Hydrocarbon Chromatogram in Petroleum Products.

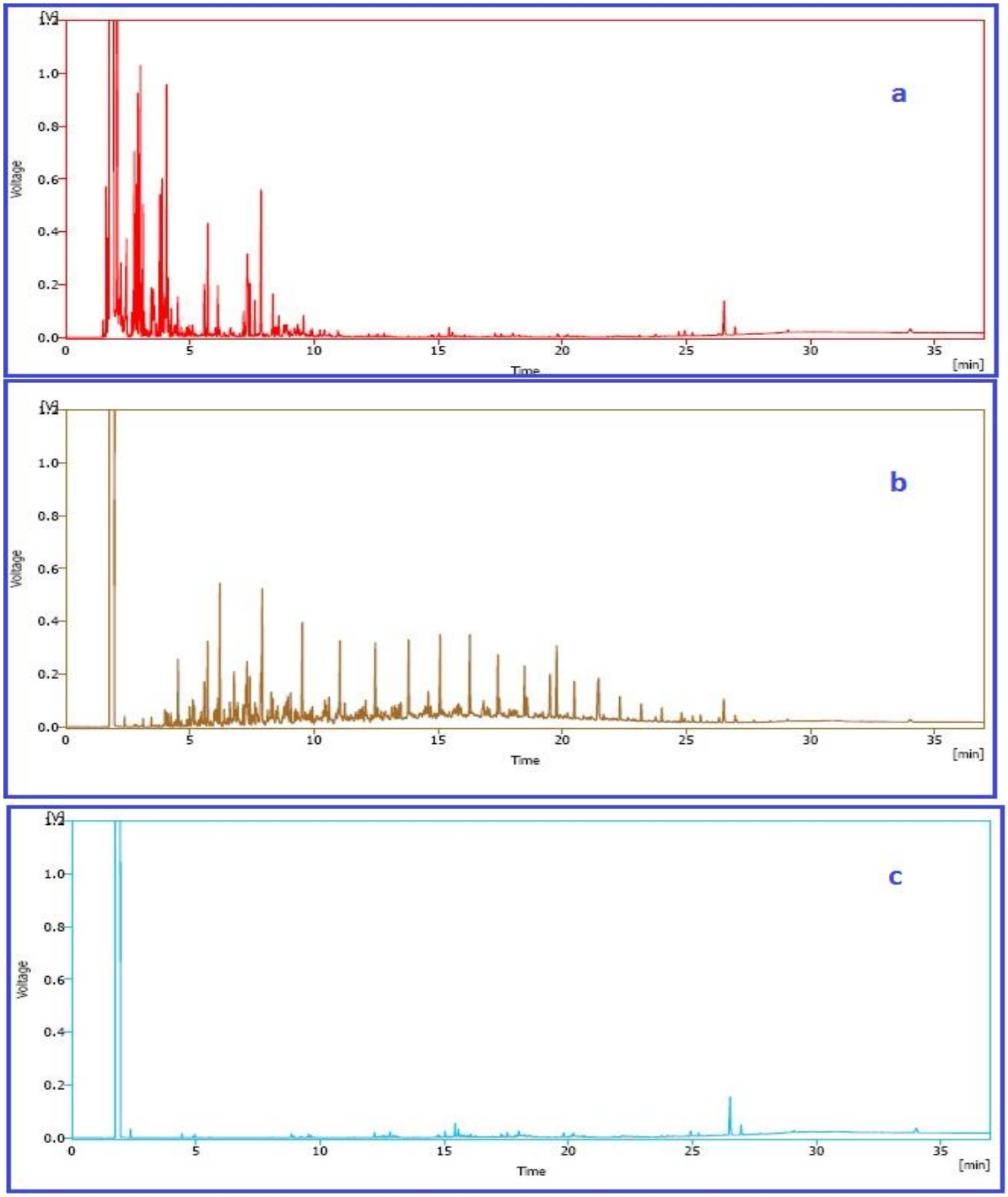


Fig 5 . Total Petroleum Hydrocarbon in Soil Samples (a : Spiked sample by Gasoline, b : Spiked sample by Diesel, c : Soil sample)

Table 4. Total Petroleum Hydrocarbon in Soil Samples

Sample	TPH(mg/kg)
C: Soil sample	2.27

Conclusion

In this study, 34 kinds of total petroleum hydrocarbons (TPH) standard, TPH in soil and TPH pattern of soil sample were analyzed to verify whether YL6500 GC can provide reliable data in accordance with Soil Contamination Process Test Standard ES 07552.1b method, which turns out it truly does.

Reference

-Soil Contamination Process Test Standard ES 07552.1b method specified by the National Institute of Environmental Research

-Lim YK, *et al*., Combined TPH and BTEX analytic method to identify domestic petroleum products in contaminated soil. J.Korean SOC. Tribol. Lubr. Eng., 33: 263-268(2017)

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