# Application News

GC Brevis<sup>™</sup> GC-2050

# High-Speed Analysis of Total Petroleum Hydrocarbons (TPH) using Brevis GC-2050

Hitomi Tsujihata

#### **User Benefits**

- ◆ The compact model, Brevis GC-2050 (universal power supply: 230 V) enables a high-speed temperature rise. It is possible to reduce analysis time by using Brevis GC-2050 and hydrogen gas.
- ◆ Brevis GC-2050 and dual injectors save space and provides high productivity.

# **■** Introduction

Total petroleum hydrocarbons (TPH) refers to mixtures of various types of hydrocarbons. In the production of petroleum hydrocarbon products, there are concerns about environmental pollution caused by TPH remaining in water and soil. There are also health risks, so it is very important to control the concentration of TPHs.

ISO 9377-2-2000 describes a method of analysis using solvent extraction and gas chromatography. In this method, the separation of C10 from extraction solvent and elution of C40, while keeping the relative response(peak area) of n-tetracontane (C40) to n-eicosane (C20) at least 0.8, are required. For that reason, it is necessary to lower the initial temperature and increase the thickness of the column, but the analysis time takes about 20 to 30 minutes.

In the tests described here, the initial temperature was not lowered, and a column with a thick film and a hydrogen carrier were used. Brevis GC-2050 supports universal power supply, and the device is prepared with a wiring configuration for a 230 V power supply voltage to achieve high-speed temperature increase, realizing high-speed analysis within 6 minutes.

This article introduces an example of the high-speed analysis of TPH using hydrogen as the carrier gas. A system performance test and the linearity of the calibration curve was checked, based on ISO 9377-2-2000.

\* Detailed information regarding analysis of TPH is described in Application News 01-00355-JP, "High-Speed Analysis of Total Petroleum Hydrocarbons (TPH)." Please also refer to this.



Fig. 1 Brevis<sup>™</sup> GC-2050 (Left) and Dual Injectors (Right)

## **■** Sample Preparation

The samples (1) to (3) were prepared as follows.

- (1) Extraction Solvent/Background Correction Sample Heptane was prepared.
- (2) System Performance test Sample
  - 50 μg/mL alkane standard mixture (Sigma-Aldrich, P/N: 94234-2ML) was prepared.
- (3) Calibration Curve Samples (Mineral Oil)

A diluting solvent was prepared by dissolving 2.0 mg of n-tetracontane and 2.0  $\mu$ L n-decane in 100 mL of heptane. Using the prepared diluting solvent, a 5,000  $\mu$ g/mL QC standard solution (Sigma-Aldrich, P/N: 51706-1ML) was diluted to prepare 50, 100, 250, 500, and 1000  $\mu$ g/mL calibration curve samples.

# **■** Analytical Conditions

The Brevis GC-2050 (Universal power supply: 230 V) was used, with two analysis lines and dual  $AOC^{TM}$ -30i. A standard insert was used for the injection port.

Table 1 shows the analytical conditions.

	•				
Table 1 Analytical Conditions					
Model:	Brevis GC-2030 (230 V)/ AOC-30i $\times$ 2				
Syringe:	Xtra Life Microsyringe (P/N 227-35400-01)				
Injection Mode:	Sampler Navigator – Standard mode				
Injection Volume:	1 μL				
Injection Temp.:	280 °C				
Injection Mode:	Split				
Split Ratio:	1:5				
Carrier Gas:	H <sub>2</sub>				
Carrier Gas Control:	Column flow (7.00 mL/min)				
Column:	SH-I-1-1MS (P/N: 227-36004-03) (12 m × 0.2 mm l.D. × 0.33 μm)				
Column Temp.:	100 °C (0.3 min) - 65 °C/min - 175 °C -45 °C/min - 300 °C - 35 °C/min - 340 °C (0.5 min)* <sup>1</sup>				
Detector:	Hydrogen flame ionization detector (FID)				
Detector Temp.:	350 °C				
Detector Gas:	H <sub>2</sub> 32 mL/min, Air 200 mL/min				
Makeup Gas:	N <sub>2</sub> 24 mL/min				

### ■ System Performance Test

A system performance test was conducted using the 50  $\mu$ g/mL alkane standard mixture.

The chromatogram is shown in Fig. 2, and the area repeatability and average area ratio (C40/C20) are shown in Table 2.

The area ratio (C40/C20) was over 0.94, satisfying the standard requirement.

C10 eluted in 0.4 min and separation from the extraction solvent was good.

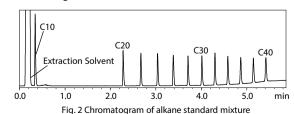


Table 2 C20 and C40 Area Repeatability and Average Area Ratio (n = 3)

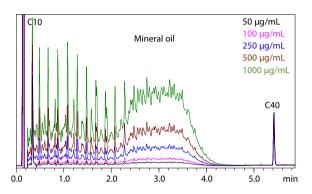
Line	C20 Area Repeatability (%RSD)	C40 Area Repeatability (%RSD)	C40/C20 Average Area Ratio
1	0.16	0.49	0.91
2	0.26	0.23	0.95

#### ■ Calibration Curve

Fig. 3 shows the chromatograms of QC standard solutions. The area for mineral oil was calculated by totaling the peak areas for all the components detected between C10 and C40.

For details on data processing parameters, please refer to Application News 01-00355.

The average area and area repeatability for mineral oil are shown in Table 3. The calibration curves are shown in Fig. 4. The calibration curve linearity R<sup>2</sup> was over 0.9998, so good results were obtained.



### **■** Conclusion

In this article, high-speed analysis of TPH was achieved using the Brevis GC-2050 (230 V) with an oven insert to enable a highspeed temperature rise, and hydrogen as the carrier gas.

The analysis time was within 6.0 min. In the system performance test, the area ratio (C40/C20) was over 0.91, satisfying the standard requirement. The calibration curve linearity R<sup>2</sup> was over 0.9998, so good results were obtained.

TPH analysis by the flagship model Nexis<sup>™</sup> GC-2030 reported in 01-00355-EN is even faster than compact model Brevis GC-2050.

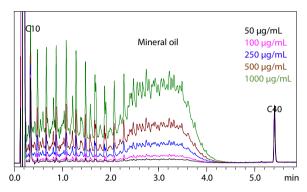
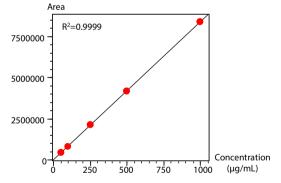


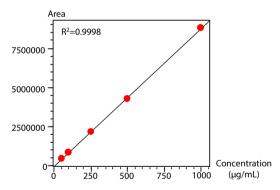
Fig. 3 Chromatograms of QC Standard Solutions (Left: Line 1, Right: Line 2)

Table 3 Average Area and Area Repeatability of Mineral Oil (n = 3, Left: Line 1, Right: Line 2)

No.	Concentration (μg/mL)	Average Area for Mineral Oil	Area Repeatability (RSD%)
1	50	411,037	1.02
2	100	793,609	0.45
3	250	2,098,153	0.45
4	500	4,163,042	0.13
5	1000	8,375,165	0.12

No.	Concentration (μg/mL)	Average Area for Mineral Oil	Area Repeatability (RSD%)
1	50	433,517	1.09
2	100	832,573	0.19
3	250	2,183,440	0.15
4	500	4,266,727	0.16
5	1000	8,783,025	0.40





01-00562-EN

Fig. 4 Calibration Curve of Mineral Oil (Left: Line 1, Right: Line 2)

Brevis and Nexis are trademarks of Shimadzu Corporation or its affiliated companies in Japan and/or other countries.



Shimadzu Corporation

www.shimadzu.com/an/

For Research Use Only, Not for use in diagnostic procedures.

This publication may contain references to products that are not available in your country. Please contact us to check the availability of these

products in your country.

The content of this publication shall not be reproduced, altered or sold for any commercial purpose without the written approval of Shimadzu. See <a href="http://www.shimadzu.com/about/trademarks/index.html">http://www.shimadzu.com/about/trademarks/index.html</a> for details. See <a href="http://www.shimadzu.com/about/trademarks/index.html">http://www.shimadzu.com/about/trademarks/index.html</a> for details.

Third party trademarks and trade names may be used in this publication to refer to either the entities or their products/services, whether or not

they are used with trademark symbol "TM" or "@". Shimadzu disclaims any proprietary interest in trademarks and trade names other than its own

The information contained herein is provided to you "as is" without warranty of any kind including without limitation warranties as to its accuracy or completeness. Shimadzu does not assume any responsibility or liability for any damage, whether direct or indirect, relating to the use of this publication. This publication is based upon the information available to Shimadzu on or before the date of publication, and subject to change without notice.

First Edition: Sep. 2023